University of London

The London School of Economics and Political Science

The Determinants of Firm Entry and Exit into Greek Manufacturing Industries: Sectoral, Temporal and Spatial Variation

Georgios Fotopoulos

Thesis submitted in fulfilment of the requirements of the degree of Doctor of Philosophy in the Faculty of Economics

Dedicated to my mother

Στη μητέρα μου

Abstract

This research investigates the determinants of firm entry and exit into Greek manufacturing industries during the eighties and early nineties. The first perspective concerns the determinants of sectoral variation of both net entry rates, and gross entry and exit rates. The role of overall macro-economic conditions, in conjunction with the effect of industry-specific structural variables, is the main focus. Net entry rates are difficult to explain using conventional measures of profitability and entry barriers. Some evidence is provided for counter-cyclical patterns in net entry rates post-1985. The determinants of net entry rates for specific industry groups are shown to be significantly different, but strongly correlated across sectors within the same group. Different industry-level factors also underpin entry by varying establishment size, rates of the largest firms exhibiting, in contrast to all other size classes considered, pro-cyclical patterns. Actual entry and exit statistics permit the testing of the symmetry hypothesis – barriers to entry are also barriers to exit — and the issue of a possible simultaneous link between firm entry and exit. The symmetry hypothesis was sustained, but whether or not entry and exit are simultaneous remains unclear. The second perspective is a spatial one. Shift-share descriptions of the variations in net entry rates of manufacturing firms across Greek regions are extended via analysis of variance to allow formal hypotheses testing. The main source of variation stems from variation in net entry in the same industry across regions. Finally, the analysis considers the determinants of variations in new manufacturing plant openings spatially across ten Greek regions. Key findings suggest that new plant opening rates tend to be higher in more specialised regions, in regions with extensive production links and where the local conditions favouring new manufacturing activity are characterised by higher small firm presence, adequate supply of skilled labour and public infrastructure investment.

Acknowledgements

I remember my first days in Reading, the first place of a foreign land I had ever seen. I was a bit frightened at the beginning, as everything around me was so different; the weather, the people, signs on the roads reminding me I was not home anymore. This initial shock was soon followed by a better mood, as I was able to discern some challenge and opportunity in the long road laid ahead of me. The challenge to adapt to a completely different way of work, to digest and accumulate new knowledge, to fulfil my mission academically. The opportunity to meet people from all corners of the world, to open my mind to different cultures and ideas, to open my heart to new friends, to try not to be an 'alien' in this country, but instead to comply with the saying "in Rome do like the Romans." Despite this, my life in England was often turbulent. My mood was frequently diverting from pessimism to optimism and back. Sometimes I felt so miserable like a 'puppet on a string' and I needed support. I am grateful to God for this support, for keeping my loved ones and myself in good health and for giving me the strength to continue when everything around looked so bleak.

I would like to thank my supervisor Professor Nigel Spence for all his support during my Ph.D. studies. He has played a lot of roles during this time, a wise and patient academic advisor, an 'agony uncle', and a good friend. I am grateful to him and I shall continue to admire, respect and learn from him, both in my academic and personal life.

I would to like to express my gratitude to Lily and Harold Prior for their kind support, friendship, and for praying for me every single day. I will always remember Irene Riga, who passed away recently, for her love and encouragement. She is and will always be greatly missed. I want to thank from the bottom of my heart my good friends Spyros and George Tryfon for their support and for sharing their wisdom with me. These retired sailors have taken me around the world through their narration of adventurous stories, but also have helped to catch up with Greek politics through our long discussions about recent political affairs.

George Anastassopoulos has always been my closest friend for all those years. I thank him for the time we have spent together discussing personal problems and studying related problems and economics. George Valiotis and Yannis Papanikou have remained true and faithful friends to me from Greece, despite that in the last five years we did not really have the chance to see each other much. I thank them both. I would like also to thank my LSE friends and colleagues Dan Graham and Antonis Rovolis for their friendship and endless and mutually beneficial discussions about economics, occasionally accompanied with a pint of lager at the Beaver's Retreat Bar.

Living in England I was surrounded by a small, warm Greek 'microcosm' somewhere close to Reading University campus. For the last four years I had the pleasure to share roof with some very nice people who I would like to thank. Nassos Magginas, being an experienced Ph.D. student, taught me the first steps in carrying out research. Tina Kalithraka had been an excellent flatmate. Doing a Ph.D. on wines, Tina had organised wonderful evenings full of taste accompanied by her warm presence. George Matzaras, the ultimate computer guru, has not only been the 'heavy artillery' in computing and programming but also a very good friend of mine.

My Greek 'microcosm' in Reading also consisted of other distinguished members. Theodore Varzakas has always been a good friend and very supportive. Like myself he is one of the few of our cohort still remaining around, one of 'the last of the Mohicans'. Nikos Korres, a good neighbour and an old friend from Athens being at the moment at an earlier stage in his doctoral studies than me, has been very encouraging. His passion for research and discovery has provided me with a lot of energy and strength. Vangelis Savvas, the new 'blood' in the Greek economics community at Reading, has always been a generous neighbour and a good friend. Panos Kanellopoulos, a musician and a good friend, has always reminded me that there are other nice things in life other than economics. I would like to thank all of my friends and each of them separately.

I am also indebted to Professor Helen Louri for her guidance. I would like also to acknowledge the encouragement provided by Professors Vasilis Droucopoulos, Yannis Stournaras, Spyros Vliamos, my supervisor from National State Scholarships Foundation of Greece (NSSF) Professor Napoleon Maravegias and George Antoniades from the National Research Foundation of Greece. Thanks are also due to NSSF for their sponsorship and to National Statistical Service of Greece for providing me with some unpublished data. I am also grateful to Professors Paul Cheshire and Ian Gordon who offered me useful supervision during my M.Sc. days at Reading.

I feel the need to thank Spyridoula who has been my partner for the most of the time needed to write this thesis. Her leave made me think that "ain't no sunshine when she is gone." However, life goes on, and I would like to thank Dominique whose warm smile and manners have brought "the sunshine after the rain" back to my life.

Last, but not least I would like to express my gratitude and love to my family and especially my parents Mella and Nikos for all their love, sacrifices made in their lives for my sake, and for their financial support.

Contents

List of Tables

List of Figures

Abbreviations

2SLS	Two stages least squares
3SLS	Three stages least squares
FGI	Federation of Greek Industries
GNP	Gross National Product
GLS	Generalised Least Squares
GDP	Gross Domestic Product
HP	Horse Power
NSSG	National Statistical Service of Greece
NUTS	*Nomenclature des Unites Territorial Statistiques* Nomenclature of Territorial Units Statistics
OLS	Ordinary Least Squares
RHS	Right Hand Side (of an equation)
S-C-P	Structure-Conduct-Performance paradigm
SIC	Standard Industrial Classification
SME	Small and Medium Enterprises
SUR	Seemingly Unrelated Regressions

Chapter 1. Introduction

1.1. Introduction

The aim of the thesis is to examine empirically patterns of entry and exit of firms into Greek manufacturing industries, and their determinants. In doing so, the phenomenon of interest has been analysed along three dimensions. Namely, the sectoral, temporal and spatial variation of entry and exit patterns. More accurately, these three dimensions are visited analytically in bundles of two. That is, cross-sectional industry data are combined with time series observations on each industry, and some combinations of regional and industry data over a single period, and regional and time series data for total manufacturing aggregates are used in the spatial analyses.

The research undertaken in this thesis builds upon research in this field that has emerged in the early 1990s, although the roots of systematic research on primarily firm entry, but less so on exit, goes back to the 1950s and 1960s. Indeed, the research in this field has intensified since the early 1990s when a considerable, amount of research has come forward at least compared with the volume of earlier work. Often these research efforts have formed volumes of collected contributions coming from different country contexts at both the industry (Geroski and Schwalbach, 1991) and spatial levels of analysis (Reynolds *et al.* 1994a), offering a basis for cross-national comparisons of the determinants of entry and exit.

The intensification of research effort in 1980s and early 1990s has been associated with considerable theoretical advancements in industrial economics, such as those relating to contestability theory (Baumol *et al.* 1983) that has fed researchers in this field with some interesting empirical but also theoretical questions to tackle. Not coincidentally, much research on firm entry and exit has been stimulated and also developed in parallel with research advancing the economics of the small firm sector. There has been an association between the small firm and the new firm that has offered a great deal of scope for researching the determinants of the emergence of the latter. Small firms have become a fashionable theme in industrial and regional economics research. Small firms have been seen as significant employment creators (Birch, 1981), as offering a viable alternative to rigid mass production structures, incorporating flexible specialisation and re-organising production patterns and inter-firm relationships (Piore and Sabel, 1984). Most important, there has been a growing interest in entry and exit, beyond the limits drawn by the small-new firm nexus, an interest driven by an increasing realisation that markets and economies are not static but evolve over time (Geroski, 1991a; Audretsch, 1995b). A full evolutionary approach to industries and economies would require, apart from an understanding of forces behind the 'mutation' of already existing firms in responding to, but also provoking changes in markets, an understanding of the effect on markets brought about by new participants, and potential entrants. The effects of entry and exit interacting with the most permanent occupants of markets, the incumbent firms, require a better understanding of the determinants of entry and exit processes *per se*. This would be helpful in raising justifiable expectations for the role of new firms in bidding down excess profits as the textbook economics assumes, in their role in introducing new innovations, in assisting a more efficient allocation of resources, in helping to reduce unemployment disparities and in restructuring economic activity across space.

Research on the determinants of variation in entry and exit across industries and across regions is an ongoing process that has not reached a unequivocal understanding of the underlying forces and mechanisms at play, although statistical and econometric results point to some regularities starting to shape up (Geroski, 1995). This manifests itself in the rather low explanatory power of econometric exercises undertaken in various countries, implying that there are many factors remaining unaccounted for within a country-independent research context. Most of all, quite 'puzzling' empirical results that are difficult to reconcile with theoretical expectations have often turned up in applied research, and *"very few have emerged from their work feeling that they have answered half as many questions as they have raised, much less that they have answered the most interesting ones"* (Geroski, 1991b, p. 282). It is clear that the determinants of entry do not seem to be unrelated to the country where the research is undertaken as *"studies bring to light substantial inter-country variation"* (Cable and Schwalbach, 1991, p. 257). This presents an 'open research invitation' for more studies coming from other countries to join forces in augmenting the research experience on the determinants of entry and exit patterns. The present research effort takes on this 'invitation' to provide evidence for the case of a small open economy — Greece.

However, this research does not constitute the sole contribution ever made by research in this field and in this country context. There have been a limited number of studies already in the Greek context examining issues relating to the determinants and other aspects of entry and exit in manufacturing industries. These concentrate on the determinants of entry and exit of somewhat larger firms (Anagnostaki and Louri, 1995a), and the effect of sectoral policy on firm entry (Anagnostaki and Louri, 1995b). Louri and Anagnostaki (1995) analyse the determinants of firm entry in two broadly defined areas, that of Greater Athens and rest of Greece. Nevertheless, the research undertaken in the thesis only rarely overlaps with above-mentioned research as the data sources utilised for the most part differ, along with the empirical questions imposed. When, however, there is some overlap between the research contained in the thesis and earlier research (Anagnostaki and Louri, 1995a), these studies remain adequately differentiated. This owes much to the fact that the present research takes a different viewpoint in specifying empirical equations to be estimated and coming later pursues the analysis further than previous researchers. Taken together with earlier Greek studies, this thesis aims to build up some first hand research experience on firm entry and exit in Greece. This is hoped to augment the empirical evidence and offer stimulation for further research efforts, as extensions of the present lines of enquiry, but also in complementary and new research avenues. This seems to comply with Geroski's (1991b, p. 283) research spirit that it is worthwhile to provoke the collection of more evidence about entry (exit), but then to pause for a while and speculate on what it might mean.

1.2. Main research themes and methodological issues

This section presents the major research themes that have been the concern of the thesis. These are not further justified as valid empirical questions at this introductory stage since this would involve a considerable repetition of material to be presented later. In any case the space usually allowed in an introductory section would not be sufficient to analyse why these are indeed interesting and fundamental questions to be asked of data available. Thus, only a brief statement of the research questions follows here and further justification is implicitly offered when reviewing the existing literature, and also explicitly argued in the corresponding chapters dealing with these research themes themselves. The main research questions are:

I. What determines net entry rate, i.e. the rate of change in the number of operating establishments, patterns across sectors and over time into Greek manufacturing industries?

II. What is the effect of wider economic conditions on net entry rates?

III. Are the determinants of net entry rates distinctively different across different industry groups, namely those of consumer, intermediate and capital goods industries?

IV. Are the determinants of net entry rates across sectors and over time independent of firm size?

V. Is the effect of wider economic conditions dependent on firm size?

VI. Are the determinants of entry and exit of firms across sectors and over time symmetrical?

VII. Are firm-entry and exit two simultaneously determined market processes?

VIII. What accounts for spatial variations of net entry rates into Greek manufacturing industries?

IX. Are the determinants of spatial variations of net entry rates into Greek manufacturing industries independent of the establishment's size?

X. What determines the variation of new manufacturing plant opening rates across Greek regions and over time?

From this list of tasks for which the present research aims to deliver some empirical evidence and hopefully some useful insights, previous empirical work in the Greek manufacturing industries has tackled only the one pertaining to symmetry of the determinants of entry and exit (Anagnostaki and Louri, 1995a). However, this research seeks to offer some evidence and also some grounds for versatile speculation and further questioning in a broader context. This is, to some extent, facilitated by the rather limited evidence that has been so far accumulated regarding some of the issues on the research task list above. In particular, each of the research questions relating to the effect of wider economic conditions, the simultaneity issue in the interaction between entry and exit, the hypothesis that the determinants of firm entry (net entry) are not independent of firm size at both industrial and spatial analytical levels, are treated in only a handful of studies. Additionally it would appear that there is no other study that compares the determinants of entry (net entry) across broadly defined industry groups. For these reasons alone another study on entry and exit could probably be justified, along with the arguments that the existing limited evidence rarely concerns a less developed, open economy such as Greece.

The empirical questions listed above only represent the major research themes that concern the research undertaken here. Additional research features concern the effect of industry trade conditions in determining net entry rates, and the statistical exploration of derivative definitions of market processes such as industry volatility and turbulence. Some rather novel elements have been the introduction of vertical integration as a potential determinant of spatial variation in new plant opening rates along with the, so far rare, use of public infrastructure expenditures. There have also been some methodological suggestions made which emerge from the need to deal with some idiosyncratic features of the data and to provide useful alternatives to proper modelling approaches where these prove difficult.

It can already be seen that the research approach adopted in this thesis is essentially 'empirical'. Indeed, the research undertaken relies heavily on statistical and econometric analysis of secondary data. In some parts of the thesis a methodological alternative that suggests itself would have been to conduct a survey. In such an approach the reliance would be placed on questioning decision-makers instead of relying secondary data sources that undoubtedly often obscure many of the underlying relationships. Nevertheless, such an approach would have been expensive in terms of time and other resources that would have been difficult to justify within the limits of the present research. Surveys, useful though they are, do present a number of difficulties. It would be difficult to decide the level and the extent of such a survey. It would probably be not too difficult to survey new firms, but quite difficult and almost impossible to survey exiting firms. It would be difficult to decide whether the survey should focus on new firms in a particular sector, or location, or to use a wider cross-section of industries and locations. Analysis of secondary data, not yet explored fully in the Greek case, can help to identify some of these difficulties and to indicate where to look and who to ask. As a result, it can be argued, surveys will be better informed and hence more successful if secondary analysis is undertaken first. But this most certainly does not disregard or discount the difficulties of working with secondary data alone.

The empirical approach adopted in this thesis is essentially data driven. This has been the norm in the research field, especially for the analysis of entry and exit at the industry level. Geroski (1991b), arguing extensively about the data-driven character of this research approach, maintains that in the course of research using secondary data unexpected results are often encountered. This occurrence leads, sometimes, to a reorientation of questions asked of the data as these unexpected outcomes are often more interesting than those the analysis was set to explore originally. Indeed, empirical projects are described by Geroski (ibid. p. 282) as *"voyages to discovery [where] one often finds that one has been more data led than one would admit (at least to the profession's methodological purists), but none worse for the experience."* In effect, there should be a continuous interaction between empirical data-driven exercises and theoretical developments, a continuous feedback mechanism running from one to another. This is aptly put by Geroski (1991a, p3) *"such empirical work throws up puzzles which stimulate the development of the theory in new directions, opening a broad range of new hypotheses for further testing."*

The research-aims of the thesis accord with these arguments. It has been mainly an effort to understand what takes place in the data available pertaining to movements of firms in and out of industries; to speculate; to identify patterns in the data that together with the findings of earlier studies help to establish some 'empirical' regularities in the Greek context. But, even when this is not entirely feasible or successful, the aim is to suggest alternative avenues of research that could extend what it is known about entry and exit of firms into Greek manufacturing industries. Furthermore, the research aims to demonstrate how this differs from, or confirms, what other empirically oriented researchers know about entry and exit of firms in other countries.

In doing so, the research follows Schmalensee's (1989, p. 1000) suggestion that research in this area of industrial economics has often been and probably should be seen as *"a search for empirical regularities, and not as a set of exercises in structural estimation."* Whether such an approach would be equally justified in the regional economics is a good question and of particular importance for this thesis as it essentially draws on both fields of academic research. It might not come as a surprise that recently Reynolds *et al.* (1994a), in their editorial address for a collected volume of work providing the basis for some cross-national comparisons on the determinants of spatial variation in new firm formation rates, seem to offer a similar research rationale. They argue that *"Progress in science usually starts with a single study indicating empirical regularities in a specific time and place. This is generally followed by additional studies that may, if all goes well, confirm the same patterns in other settings and times. Confidence in the generality of a pattern grows with increases in the diversity of settings and times in which the pattern is observed...If the same patterns are found among a number of countries, then confidence in the universal nature of these processes is substantially enhanced"* (Reynolds *et al.* 1994a, p. 344).

In searching for patterns and regularities in entry and exit patterns in Greek manufacturing industries and regions the utilisation of panel data has made it possible to carry out some empirical exercises throughout the thesis. Panel data allow the analysis to draw on two dimensions, usually those of cross-sectional time series data, that is data on industries or regions followed up in time, but also, in the case of spatial data, cross sections of cross sections data, that is regions and industrial sectors. The two dimensional analysis brings about information that otherwise could have not been observed and allows an account of the effect of unobservable factors. These are usually attributed to underlying differences of data on one or other dimension, namely, differences between the average performance of industrial sectors or regions over time, differences between regions over total manufacturing aggregates, or differences between different points in time over industries or regions. This feature of panel data undoubtedly allows for the more dynamic characteristics of the data to come into light, but also provides the opportunity for parsimonious econometric formulations to be estimated, when otherwise this would have been extremely difficult. In the present research context dealing with twenty industrial sectors would not allow flexibility in developing models to account for inter-industry variation in entry and exit flows in a cross-sectional context as this would not provide a sufficient number of degrees of freedom to carry out hypothesis testing. Additionally, having ten years of observations on each industrial sector and region would not allow reliable independent time series analysis to be carried out as far as the number of observations would be less than half that usually required for reliable estimation in this context. Most important, however, is the feature that panel data allows observation in a two dimensional space. However, this has not been without problems as *" the dilemma here is that once one brings a time series dimension to data, one necessarily introduces 'events' that are interesting but not explicable by the theory at hand"* (Geroski, 1991a, p. 2).

1.3. Thesis structure

The thesis contains ten chapters grouped into two parts. Following this introductory chapter, the first five chapters relate to an exploration of the determinants of entry and exit at the industry level. Thus, Chapter 2 offers a critical review of the theoretical and empirical literature on firm entry and exit at the industry level. The material contained in this chapter aims to serve a multiple task. First, it provides the broad theoretical framework that the research in this field has traditionally relied upon. Second, instead of a commonplace *ad hoc* brief statement regarding the importance of entry and exit for market performance and structure, it provides a review of the empirical evidence that surrounds the effects of entry and exit. This could be seen as a natural extension of the brief discussion at the start of this introductory chapter. Third, it provides the empirical formulation of the typical entry model, discussing its limitations and providing a critical and often detailed review of the empirical evidence that has been so far accumulated as to the determinants of entry and exit. This provides a full justification for the methodological approach adopted in the present research, and sets the framework for viewing the empirical results derived in the chapters to follow. Finally, it discusses some alternative approaches or possible extensions beyond the core of the traditional entry (exit) model specification and reviews the results of corresponding empirical studies.

Some of the suggestions discussed in the last section of Chapter 2 are quickly incorporated along with more mainstream determinants of entry in the econometric examination of net entry patterns across Greek manufacturing sectors over time in Chapter 3. In this chapter some approximations of notions traditionally viewed as possible determinants of entry are for the first time deployed in the thesis along with variables aimed to capture the effect of wider economic conditions. The aim of this chapter is to attempt to provide an answer to the first two of the research questions presented earlier. The research undertaken in Chapter 4 represents an effort to tackle the third of the empirical questions concerning the thesis, that is between industry group differences in the determinants of net entry rates. In particular, this research is a typical example of data-driven empirical analysis in as far as a prime motive for such an approach derives directly from some idiosyncratic patters of net entry rates revealed for the first time in the analysis performed in Chapter 3. The analysis proceeds then further in Chapter 5 to test the combined hypotheses that the determinants of net entry rates in general, but also the effect of wider economic conditions in particular, are not independent of establishment size (questions 4 and 5). Chapter 6 concludes the first part of the thesis providing a test of two hypotheses of specific interest. The first relates to whether or not the determinants of entry and exit are symmetrical (question 6), and the second to whether or not there is a clear-cut mechanism running from entry to exit and vice versa (question 7). In other words are entry and exit simultaneously related? Along with econometric hypothesis testing, an extensive statistical analysis deals not only with entry and exit patterns in Greek manufacturing industries but also with notions of industry turbulence and volatility.

The second part of the thesis initiates in Chapter 7 a critical review of the literature that relates to the analysis of entry and exit at the spatial level. There is a direct link here between some alternative approaches discussed in the last section of Chapter 2 and part of the empirical evidence reviewed in Chapter 7. This chapter sets the background necessary to place the research contained in the chapters to follow into an appropriate context. Thus, Chapter 8 deals with the research questions 8 and 9. These involve attempts to account for spatial variations in net entry rates of manufacturing establishments, and to form some empirical procedures for testing the hypothesis that the determinants of net entry rates also in a spatial context are not independent of firm size. The last research question is concerned with the identification of some important determinants of variation in new plant opening rates across Greek regions, and this is considered in Chapter 9.

The thesis concludes in Chapter 10 first providing a summary of the research findings. Some stylised results, emerging from a synthesis of related results throughout the thesis, are formulated and compared with those representing the 'state of the art' understanding of the determinants and the statistical occurrence of entry and exit patterns at both the industrial and spatial analytical levels. Limitations of the analysis undertaken are discussed next, along with some policy implication that relate to some of the results produced. This leads to the final section of the thesis that suggests possible extensions within the same research framework along with suggestions for further research. It is believed that these would help to derive more secure results, shed more light on some of the issues which have emerged, and provide complementary evidence on processes that could be viewed as natural extensions to the entry and exit research theme.

Chapter 2.

Previous theoretical and empirical research on firm entry and exit

2.1. Introduction

The aim of this chapter is to contribute a critical and discriminating account of what research on firms' entry and exit has added to general understanding about these processes. It is not the first time such an objective has been attempted and it is fair to say that critical reviews of the relative evidence have kept pace with the growing literature. An early account of the empirical literature is due to Geroski (1983) and deals with findings of the first wave of studies that followed the work of Bain (1956), Mansfield (1962) and the seminal contribution in respect of an explicit empirical-modelling approach made by Orr (1974a). Thereafter, Geroski (1991a) not only provides a comprehensive review but also many useful insights on the effects, determinants and different modelling approaches to firm entry. This relates to the second phase of entry literature, that of the late eighties and early nineties, and accounts for the main volume of work on entry and exit to date. Geroski *et al.* (1990), on the other hand, contribute to understanding about the interaction between structural market conditions and incumbent firm behaviour that populate the array of options and give way to market behaviours that have come to be called 'strategic competition'. The most recent and detailed review of empirical evidence on entry and exit is by Evans and Siegfried (1994) where more than seventy empirical studies are claimed to have been analysed. Finally, it is now certain that the research experience of the empirically oriented scholar of entry and exit has been stylised into emerging facts and empirical regularities by Geroski (1995).

Within this context of previous work the present review attempts to bring together and combine elements of other earlier accounts of the existing literature. In doing so, entry and exit is given a bi-directional consideration. Having set the analytical framework within which the empirical research has traditionally taken place, the first extended section of this chapter deals with various aspects of the effects of entry and exit on markets. This helps to justify the interest in studying the determinants of entry and exit *per se,* and avoid making *ad hoc* statements about the beneficial role of these processes, by drawing briefly on some relevant neo-classical economics textbook reasoning. Important issues relating to the effects of entry and exit on market concentration and profitability or beneficial effects of implied restructuring on productivity growth are raised. Innovation that relates to products and processes might also be one of the underlying forces behind industrial restructuring. More important, the interaction of entry and exit within industries as opposed to traditionally favoured across-industries entry and exit movements is given some extra consideration. As opposed to the review by Evans and Siegfried (1994), much more emphasis is placed here on the evidence supporting the notion that entry and exit coexist within industries as both directly respond to higher industry profits. This challenges traditional views that relate firm exit to low or negative industry profits. In doing so, the present review extends evidence forwarded by Cable and Schwalbach (1991) in their international review of contrasting determinants of entry and exit.

Next comes an account of the empirical evidence on the determinants of entry and exit. This follows a rationale that the more that is known about the effects the more that is required to be known about the determinants, and the more certainty about the latter means more light in understanding the realisation of the former. Above all, it also helps in forming more realistic expectations about structural change in manufacturing industries. The empirical formulation of the entry model (Orr, 1974a) together with its critics and limitations are discussed first, and this gives way to an often detailed analysis of the empirical outcomes relating to the most established core of the determinants of entry and exit. Some limited account is given next of empirical evidence relating to the theorisation of strategic entry deterrence. Going beyond the basic core of entry and exit determinants, some time is also spent discussing extensions of the basic empirical formulations. This leads to the last section that incorporates some alternative, but hopefully not mutually exclusive, approaches that often stem out from areas of economic thinking outside that of industrial economics. This, indeed, helps a lot to cross-fertilise versatile alternatives which can be used in the search of what lies behind entry and exit of firms in manufacturing industries.

As a considerable amount of time is spent discussing the empirical outcomes of various determinants of entry and exit, some effort has been made to bring to the surface counterintuitive results. Such features have often been conveniently overlooked in previous reviews of the empirical evidence. This serves as a strong reminder of the tough research reality in trying to match imperfect models with even more imperfect data. Moreover, this constitutes an effort to offer, instead of stylised empirical facts and regularities, some insights into the exceptions that verify the rule.

2.2. Entry, exit and market structure, conduct and performance

The broad theoretical framework of what has become the economics of industrial organisation is mostly viewed as essentially neo-classical[1] and that at the very core has been the structure conduct performance paradigm (S-C-P). Industrial organisation has been defined as *"the study of the organisation of industry rather than the firms therein"* (Davies and Lyons, 1991, p. 1). These authors justify the use of neo-classical label in several ways. First, firms are usually assumed to be profit maximising entities. Second, both the theory and empirical analysis emphasise equilibrium solutions. Third, uncertainty is overlooked, as cost and demand parameters are assumed known. Fourth, the neo-classical characterisation may be justified from a welfare point of view since perfect competition is recognised as the benchmark market structure in the provision of efficient allocation of resources.

The S-C-P framework suggests that there are links between market structure and the conduct of business in determining market performance. However, although this order of causality was 'state of the art' once (Mason, 1949; Clark, 1940; Bain, 1956, 1968), recent research has pointed to the possibility that conduct and performance may in turn affect structure. Hence, all the elements of the S-C-P trilogy *"may be jointly determined in a given market situation"* (Clarke, 1986, p. 2).

A limited account of the elements making up the S-C-P trilogy suggests that performance relates to factors such as profitability, efficiency and market growth.

1 See Davies and Lyons (1991) and Clarke (1986) for a review of alternative schools of thought.

Conduct would reflect upon factors such as pricing, advertising, innovation and new product development, and structure would summarise factors such as market concentration and factors that deter new competition.

The S-C-P paradigm owes much to Bain (1956) who emphasised three fundamental elements of structure, namely those of sellers concentration, the degree of product differentiation and, most important here, the *condition of entry*. The condition of entry relates to factors inhibiting firms from outside an industry to settle in and compete with incumbent firms. The manifestation of such condition of entry arises as the main consequence the persistence of positive profits in the long run. Thus, a conventional definition of entry barriers is *"...the advantages of established sellers in an industry over potential entrants, these advantages being reflected in the extent to which established sellers persistently raise their prices above a competitive level without attracting new firms to enter the industry"* (ibid. p. 3)[2]. This definition crucially implies a comparison between pre-entry levels of profits enjoyed by incumbent firms and expected post entry levels of profits for entrants. The former is what makes entry an attractive option, at least as an intention. However, what converts an intention to enter into actual entry is the expected post-entry level of profits and its relation to the pre-entry level. The existence of

---

2 Stigler (1968, p.67) defines an entry barrier as *"...a cost of producing which must be born by a firm which seeks to enter an industry, but is not born by firms in the industry."* This definition differs from that of Bain in that it entails in a comparison of post-entry profits for both entrants and incumbents. It emphasises more the condition of post-entry competition than the condition of entry itself. For Stigler a barrier to entry exists if post entry, when the costs of entry have already been encountered, there is difference in production efficiency between new and incumbent firms (Geroski *et al.* 1990). From a welfare perspective, von Weizsacker (1980, p. 400) defines entry barriers as *"socially undesirable limitations of entry, which are attributed to the protection of resource owners already in the industry"* and more specifically as a *"cost of producing (at some of every output) which must be born by firms which seek to enter an industry but is not borne by firms already in the industry, and which implies a distortion in the use of economic resources from a social point of view."* In this sense, a barrier to entry exists if the equilibrium relates to less entry than the social optimum (Geroski *et al.* 1990) because incumbents are overly protected. However, socially sub-optimal entry could also occur if an activity is not efficiently protected, providing less incentive for firms to devote resources to an activity. Such a case would be less engagement in research and development activities in the absence of adequate patent protection (Geroski *et al.* 1990, Lyons, 1991). Desmetz (1982) places attention on exogenous restriction imposed on markets, such as government interventions, maintaining that such restrictions can impose entry barriers making it possible for firms to earn supernormal profits. In the absence of these restrictions the competitive economy, left unconstrained, will erode monopoly profits in the long run. However, according to Clarke (1986, p.72), such an argument *"only represents an expression of faith in the competitive economy and ignores the possibility that market power can exist in the absence of government restrictions."*

entry barriers becomes self-evident if expected actual entry does not materialise given the presence of positive returns. This is an important consideration, recognising that small entry flows alone should not be suggestive of high entry barriers. Small entry flows can be encountered both in industries with high entry barriers and unattractive industries exhibiting low profitability (Geroski and Schwalbach, 1989). This property of barriers to entry places them to be at the heart of industrial organisation economics in that, in their absence, no monopoly power would be sustained, since actual entry or the threat of entry would result in perfectly competitive markets (Davies and Lyons, 1991). Considerations like these have placed entry barriers in a prominent position when it comes to competition policy concerns (Geroski and Schwalbach, 1989). Entry barriers inhibit the mobility of firms between markets. The higher are entry costs, the less likely is market entry and so the lower the intensity of competition will be. Consequently, a causal relationship — competition intensity dependent on entry barriers — can be posited.

Since barriers to entry seem to matter regarding the amount of competition, the need arises to identify their sources. Bain used the theoretical notion of *easy entry,* employed in price-theory, to describe situations where there is no impediment to entry, and incumbent firms do not have any advantage whatsoever over potential entrants. This implies that they cannot elevate prices above competitive levels without attracting entry, which in turn will introduce output that would bid down prices to their pre-entry levels. Identifying the necessary but also efficient conditions for *easy entry* would, in their absence, also identify sources of entry barriers. According to Bain three conditions should be simultaneously fulfilled to ensure no impediment to free entry. First, established firms should not have any *absolute cost advantage* over potential entrants. Second, incumbent firms should have no *product differentiation* advantage over potential entrant firms. Third, *economies of scale* are negligible suggesting that the optimal level of production for a firm should be unrelated to total industry output. It follows by deduction that when not absent or negligible these structural elements constitute sources of entry barriers.

The first condition can arise under various circumstances. Incumbent firms could enjoy absolute cost advantages if they have access to superior production techniques learned through experience, or through research and development, or have generally accumulated capital that reduces their cost of production.

Product differentiation advantages relate to selling-cost advantages enjoyed by established firms because of consumer preference for their products. *"Different buyers have different product allegiances or preference patterns, so that the preferences in question do not result in some universally agreed upon system of grading or rating of the competitive products"* (Bain, 1956, p. 114). The extent to which consumer preference for incumbent's products permits price rises above a competitive level, managing at the same time to deter entry, has been recognised by Bain to depend on the importance of economies of scale, not only in production but, more important, in selling.

Economies of scale, according to Bain, should restrict entry in two ways. First, if the minimum efficient size of plant in an industry is an insignificant fraction of industry output, then entry even at the optimal production scale would not have any noticeable effect on industry output, and hence in market prices. Conversely, an entry at optimal scale would increase industry output and, if the incumbent firms maintain their pre-entry levels of output, this will reduce industry-selling prices[3]. An alternative would be that incumbents would threaten or engage in retaliatory pricing, making it difficult for entrants to operate at an optimal level. If an entrant chooses to enter at some sub-optimal level then they would have to bear the costs of this choice. The second way economies of scale operate in restricting entry is when they are substantial. Thus building an appropriately sized plant would require investing large amounts of capital, which may be difficult to raise in the presence of capital market imperfections.

However, both absolute cost advantages and product differentiation could potentially necessitate higher capital requirements for entering firms. Of the former, exclusive or lower cost deals with suppliers of bulk production inputs could impose the need for entering firms to raise capital to achieve similar deals. Credit references and high interest rates might make this all rather difficult. Of the latter, consumer loyalty may, for example, provide incumbents with a first mover advantage to exploit a new market niche, when compared with later entrants. Certain expenditures relating to product differentiation, such as advertising, are irrecoverable (sunk) and potential entrants may suffer from having to invest large amounts of capital in uses with highly uncertain outcomes.

[3] This has often been termed the percentage effect of economies of scale (Bain, 1956 p.55)

All these entry barriers have been codified by Bain (1971) according to the following argument[4] *"[If the condition of entry] is primarily a structural condition, determining in any industry the intra-industry adjustments which will and will not induce entry [then] consistently, the ultimate determinants of the condition of entry either reflect or refer directly to long-run structural characteristics of markets, and it is these which determine the condition of entry"* (ibid. pp. 159 & 171)

This definition helps with the need to rule out the effect of transitory and varying short-term conditions. It makes explicit that the condition of entry implies situations where the gap between the prices for the average incumbent and the competitive level prices can be sustained without attracting entry over a number of years rather than months. It also makes a *"sharp distinction between fundamental conditions which create asymmetries between firms, and the conduct of strategic behaviour of incumbents which aims to exploit such conditions in order to profitably inhibit entry"* (Geroski, 1983 p. 2). It also facilitates the need to concentrate on determinants that *"change slowly over time and are not subject to deliberate alterations by potential entrants"* (Bain, 1971, p. 178). A legitimate long-run view of the determinants of an entry condition should *"represent primarily a structural framework for market behaviour rather than the result of this behaviour"* (ibid.).

This definition glosses over is the possibility that some structural factors may reflect incumbent's behaviour (Geroski *et al.* 1990), and it also limits the effect of entry on market structure should the barriers to entry serve their purpose. Bain has, it is true, recognised that, although structural and long term, the entry condition is not necessarily permanent and immutable. He asserts that *"the basic characteristics of a market can change, and the condition of entry may then change in response"* (Bain, 1971 p. 177). In addition, he maintains that viewing the entry condition as a long run structural determinant of market behaviour is a generalisation which *"like many others about economic affairs, is of course, true only subject to exceptions, or as a representation of a general tendency"* (ibid. p. 178).

4 This, not very widely used reference, concerns an essay entitled "Barriers to Entry, Concentration and Profit Rates" and contributed by Bain to a collection. It represents excerpts from his classical work *Barriers to New Competition* (1956).

has

Geroski (1991) casts no doubt that entry barriers are a principal determinant of excess profits and consequently of the entry of new firms. He is similarly clear that entry barriers as defined by Bain are stable enough over time, but he does offer a more refined view of the role of expected profits in conditioning entry flows. The fundamental issue becomes to recognise that *"while entry barriers are stable over time, the net costs that barriers create for entrants can be significantly modified by mediating market conditions"* (ibid. p. 57). This brings into play exogenous factors that alleviate or stretch the effect of entry barriers felt by entering firms. A typical illustration is an unexpected exogenous increase in market size that in turn decreases the negative 'percentage' effect of economies of scale barriers on entry and limits the scope for aggressive counter-action by incumbent firms. Or, alternatively, demand may be dealt with by increasing output by utilising excess capacity (Spence, 1977) previously built up by incumbents strategically for their own benefit or to 'squeeze' entrants. This example shows how elements of market conduct and exogenous factors affecting market performance interact with structural factors, such as entry barriers. It confirms the view that *"while an entry barrier like economies of scale may be time invariant, its effect need not be"* (Geroski, 1991 p. 57).

Within this setting Geroski (ibid.) suggests that the determinants of excess profits might classified into three groups. The first consists of quite time invariant structural factors, such as barriers to entry that create costs for entrants. The second involve variations in market conditions that affect perceptions of the effectiveness of entry barriers. Both of these might be seen as exogenous to the actions of entrants and incumbents. Furthermore they both in part affect the third factor in that they set the 'arena' where the interaction between entrants and incumbents around entry barriers takes place. The third factor is endogenous in determining variations of expected profits across industries and over time.

Transitory factors mediating market conditions, on the one hand, and interaction between entrants and incumbents to overcome and defend entry barriers, on the other, give way to gradual evolution of industry structure over time. These dynamic adjustments according to Geroski (ibid. p. 262) stem from changes in market conduct that bring about changes in market performance in the short-run for given configurations of entry barriers. Conduct matters because higher inflows of new firms changes the perceptions of the market environment that each firm faces and has to compete within *"not so much changing market structure as changing what structure means for the expected profits of entrants"* (ibid. p. 102). This, occurring continuously and endogenously along with exogenous effects, such as market expansion or contraction, government regulation, evolutions in technology, affects the composition of entry barriers and *"plants the seeds for longer-run changes in performance"*(ibid. p. 262).

Entry has so far been associated with increased competition and the discussion above points to implications that entry might generate feedback on industry conduct and performance, and on industry structure. Indeed, this has been a widespread impression and as Geroski (1991, p. 6) notices *"interest in entry is often dominated by interest in its consequences."* Many empirical papers on the determinants of entry initiate their introduction with statements on how important entry is. Evans and Siegfried (1992) summarise some of the benefits firm entry brings in terms of the functions that entry performs. First, entry comprises one of the ways by which resources can be allocated towards more efficient uses within an environment characterised by changing demand and cost conditions. Second, it serves as a potential threat and actual force to limit the extent to which market power can be exploited by established firms. The effect of entry could be the bidding down of prices and eliminating excess profits. Third, the threat of competition from new, lower cost sellers creates an incentive for existing firms to minimise costs. Finally, new entrants may introduce new products and innovative methods facilitating technological change.

Exit has often come into the discussion as a complementary market function that contributes to industry evolution *"by retiring old and inefficient capital"* (Rosenbaum and Lamort, 1992). Entry and exit, together, are claimed to condition the mobility of resources affecting simultaneously the levels of competition and production efficiency in markets (Evans and Siegfried, 1994).

Geroski (1995) points out that empirical evidence from various studies shows that entry and exit are highly positively correlated. This offers grounds for speculation that entry and exit are part of a process where large numbers of new firms displace large number of older firms. This implies that a more efficient allocation of resources may result from more efficient firms taking the position of those less efficient. Nevertheless, displacement as a 'push' factor is only one of the possible facets of the relationship between entry and exit. As Waterson (1984) argues, the demise of an existing firm may create 'room' for an entrant implying that 'push' and 'pull' factors co-exist in determining the interaction between entry and exit. An inquiry into the impact of entry on market functioning would not be adequate if the interaction between entry and exit remains unexplored.

The introduction of the role of exit, and its interaction with entry, integrates the analytical framework in relation to the benefits that entry might be carrying within the S-C-P paradigm. However, despite sometimes over-enthusiastic agreement on the properties of entry, there has been considerable debate on whether these effects of entry can be actually achieved in practice (Geroski *et al.*, 1990). The following subsections, reviewing the empirical literature on related issues, helps to clarify if this is so and why.

2.2.1. Entry market penetration, concentration and profitability

Empirical observations from several countries seem to indicate that the degree market penetration by new entrants has been often quite modest. McGuckin (1972) using a sample of 151 US manufacturing industries and data derived from consecutive manufacturing censuses within the 1947-1963 period investigates the relationship between net entry[5] rates, concentration change and market share stability. The results of this study point to a significant negative relationship between net entry rates and changes in the share of the market controlled by the largest firms. This provides some evidence favouring the view that entry may have a significant effect on competition and market performance. However, as it was also found that entry does not affect shifts in market share distribution patterns among the largest firms in an industry over time, the impact smaller firms entry on market structure and performance is of collective rather than individually challenging importance.

Biggadike (1976), using firm level data on 20 large US firms studied around forty entry attempts, was able to show that around 10% penetration was achieved within two years after entry and that this corresponds to less than 40% of these entrants. MacDonald

5 Net entry is defined as the change in the number of firms operating in an industry between two points in time. Thus, it reflects the net addition or net reduction in the number of operating firms as the result of both entry and exit from an industry.

(1986) uses firm-level data for 46 US food manufacturing industries and maintains that although entry and exit primarily take place at the industry fringe, the employment share of small entrants is by no means negligible, in some cases new entrants supplying half of an industry's new output.

Moving from firm level data to sectoral aggregates, the picture is little altered. In Canada, the Baldwin and Gorecki (1986) study reveals that the employment share of new entrants varied from 0.62% to 5.09% across industries and the average size of new entrants was about 60% when compared with the average incumbent firm. Dunne *et al.* (1988), using US census of manufacturing data for consecutive censuses over the 1962-1982 period, point out that the market share of all entering firms varies from 13.9 to 18.8 percent over time. On average, an entrant produces just around 35.2% of the mean output level of the incumbent firms in the industry.

Geroski (1991a) sketches the relative picture for UK manufacturing industries over the 1974-1979 period. The overall average market penetration was around 3% per industry annually. Hause and Du Rietz (1984) using employment-based proxies for market shares on new entrants in Swedish industries observe that entry accounts for only a modest share of an industry's activity, even over period spanning 15 years. This ranged between 1.7 to 5.8 percent depending on the type of entrant over all the industries considered. Evidence from Germany (Schwalbach, 1991) suggests that between the 1983-1985 period in 183 four-digit (SIC — Standard Industrial Classification) manufacturing industries on average around 11% of all firms were new. These accounted for on average 5% of industry sales, and 8% of employment having an average size of around 70% of the size of the existing firms. It was further argued that, in the absence of entry, the concentration ratios for the largest ten would have resulted in an average increase of around three percentage points above what otherwise would have been the case.

Along with the hypothesis that entry responds to industry profits, it has been also hypothesised that the entry-exit process in an industry may have in turn some impact on industry profit levels. Mueller (1991) points out that empirical evidence in support of the second part of this two-way causal relationship is rather weak. Geroski (1995, p. 430) in a paper summarising the experience gained from empirical studies on entry asserts that *"entry seems to have modest effects on average industry price-cost margins."* Empirical evidence for UK industries allows Geroski (1988) to suggest that the effect of entry on profit margins has been modest and that *"entry as a market feedback process is rather slow in operation"* (ibid. p. 23). It takes time for new entrants to place themselves firmly in market and able to challenge incumbent firms. Geroski argues that assuming that new entrants exert all the competitive pressure and ignoring the within-industry competition may overstate the already modest effect of entry on margins. Carree and Thurik (1994) take on this last critical point, and by applying a simultaneous model that relates persistence of profits to net entry, and using panel data for retailing sectors in Netherlands, distinguish between the effect of actual entry and potential entry[6]. Empirical evidence obtained in this study points to incumbent firms as being the only competitive source having a statistical effect in eroding excess profits. Jeong and Masson (1991) find some significant negative effect of entry on profits in Korean manufacturing during expansion, but not during economy-wide contraction periods.

Stonebraker (1976) studies the interaction between entry and profits using a two-equation model. The relationship between profits and entry in this model remains indirect in that profits are supposed to be a positive function of 'entry risk', the latter being measured as the percentage of loss making firms in an industry and determined by entry barriers. Within this framework, econometric analysis confirms a positive and significant association between high profits and low entry. Masson and Shaanan (1982) use a more elaborate model but this remains indirect because whereas profits are determined directly by concentration, the latter is used as a surrogate to indirectly reflect the effect of entry on industry structure. The empirical results of the study signify a significant effect of concentration on profits inferring at the same time an implied negative effect of entry on profits. Geroski and Masson (1987) directly associate entry with concentration and empirically examine how fast entry induced by excess profits in highly concentrated industries reduces concentration and eventually profits. The empirical evidence provided suggests that this process is quite slow and that most entry penetration is in fact at the expense of fringe firms rather than of larger incumbents. From a somewhat different

6 Potential entry was proxied by the amount of industry turbulence i.e. the sum of absolute values of entry and exit.

perspective, Rosenbaum (1993) investigates the simultaneity between profits, entry and changes in concentration. The empirical conjecture adopted reveals that profit rates respond positively to concentration and entry barriers, net entry rates are positively determined by profits, industry growth, and imports, but negatively and modestly related to factors hypothesised to deter entry. Market growth, import penetration and entry positively affect changes in concentration[7]. On the simultaneity issue, empirical testing of the correlation of those right hand side (RHS) variables supposed to be endogenous and the respective error terms revealed that statistically strong correlation was not evident thus offering scope for single-equation estimation.

2.2.2. Entry and productivity growth

Empirical evidence from Canada (Hazledine, 1985) suggests that in the short to medium run new firms do not make a great contribution to productivity growth. Baldwin and Gorecki (1991) have challenged this view. Using panel data on 167 four-digit Canadian manufacturing industries for the 1970-1979 period, they compare labour productivity levels of new and also exiting firms with those of continuing plants in an industry. Their results reveal as expected that plants of exiting firms have been less productive than plants of continuing firms. However, new-entry plants have been more productive than continuing plants but less so than new plants of already existing firms. Regression results reinforce these findings leading the authors to conclude that entry and exit make an important contribution to total productivity growth.

Geroski (1989), using a data set covering 79 three-digit UK industries for the 1970-1979 period, examines the effect of competition on total factor productivity growth[8]. The effect of competition is assumed to stem from domestic entry penetration measured as the market share of new firms appearing in each industry and in each of the

---

7 However, it should be emphasised that both industry growth and net entry were expressed in their squared values and the outcome of their coefficients should be interpreted accordingly. Rosenbaum points out that, despite its statistical significance, the coefficient of squared net entry rates on concentration implies that this effect is not large because net entry rates might be dominated by movement of small firms at the industry fringe. The positive effect of industry growth on concentration is interpreted as suggesting that concentration tends to adjust more quickly in industries that grow or contract rapidly, rather than in stagnating ones.

8 Total factor productivity is defined in this study as the rate of growth of output discounted by a weighted-sum of rates of growth in the inputs used.

study years, from foreign entry penetration measured as import penetration, and from the number of major innovations in each industry. The estimation results reveal that domestic entry and innovation have a significant positive effect on productivity growth, but the same is not evident for foreign entry. The latter has a negative effect, giving way to speculation that foreign entry might displace domestic production without reducing domestic capital stock. Overall this research offers empirical support to the proposition that in industries characterised by higher entry rates and innovation, often, but not exclusively, associated with new firms, incumbents find themselves under considerable competitive pressure to improve productivity.

2.2.3. Entry, exit and industry innovation

It was seen earlier that Bain (1971) believes industry structure to be a long-run determinant of market behaviour. But this, like all rules is subject to exceptions. He recognises innovative activity by new firms as just such an exception when he asserts:

> *Only one specific exception may deserve special attention ... In some industries (though not in the majority of them), the ability of potential entrants to make effective innovations has periodically broken down the product advantages of established firms ... Here the role of existing product preferences as structural determinants of action can be questioned ... It will be interesting to see if we can identify some more fundamental determinants of the condition of entry in this area, in the shape of those things which determine whether or not potential entrants are likely to be in a position to make effective product innovations.* (Ibid. p. 178)

Geroski and Pomroy (1990) offer some evidence that innovative activity has a negative although moderate effect on industry concentration in UK manufacturing industries. It would be interesting, however, to see if this can be generalised in other country contexts in favour of a proposition asserting that new firms are considerable agents of innovation.

A helpful pre-requisite for the discussion to follow is the assumption that the majority of new entrants are small.[9] Given this convention, the central stimulus for the discussion to follow is the Schumpeterian assertion that *"...what we have got to accept is that (the large scale establishment) has come to be the most powerful engine of progress..."* (1950, p. 106). The basic argument in favour of large firms is that there are

[9] Empirical evidence has suggested that there is a positive correlation between firm size and firm age (Evans, 1987).

economies of scale in the production of knowledge and that large firms have the capacity, infrastructure, as well as the financial resources to engage in research and development[10]. Geroski (1991a, p. 215) points out that this assertion *"must be answered if the case for entry as a creative force is to be accepted."*

There have been a number of important parameterisations in the literature setting the framework for answering the question put forward above. Winter (1984, p. 297) uses the term 'entrepreneurial regime' to describe conditions in an industry that are favourable to innovative activity associated with entry but not to innovation carried out by incumbent firms. For exactly the opposite situation the term 'routinised regime' has been coined. Gort and Klepper (1982) take the view that the higher the proportion of non-transferable information contained in the product, the higher the role of accumulated learning-by-doing experience and the lower the probability for rejecting the Schumpeterian hypothesis is. A broader view would examine the link between entry and innovation through a product life cycle lens. There are four stages in the evolution of a product in any typical industry — introduction, growth, maturity and decline (Vernon, 1966). Gort and Klepper (1982) associate these stages with a gradation of net entry intensity. In the introduction phase net entry is small, it intensifies in the second stage, it starts to recede in the third stage until it reaches zero levels in the fourth stage that highlights the obsolescence of the product. Studying 46 products over 73 years, the authors concluded that, indeed, the innovation pace does vary directly with entry intensity. Their evidence suggests that in the early stages innovative activity mainly stems from efforts carried out by an industry's outsiders. The situation reverses when reaching the 'maturity' phase when innovations stem basically from the industry's insiders. Mueller and Tilton (1969) provide some support for the idea that innovation in the early stages of the life cycle is more likely to be provided by new entrants. Empirical evidence suggests that R&D financing required in the early phases of the life cycle are considerably lower than those required in subsequent phases.

Acs and Audretsch (1987) test a modified version of the Schumpeterian hypothesis. The hypothesis related innovative advantages of large firms with imperfect competition,

[10] See Rothwell (1989) for a further discussion of innovative advantages and disadvantages related to firm size

and those of small firms with more competitive markets. Using data on US manufacturing industries, the research findings suggest that large firms tend to have innovative advantages in industries that are concentrated, capital intensive and adopt extensive product differentiation strategies. On the other hand, small firms were found to be more innovation prone in industries where the overall innovation activity is more intense and there is a high proportion of large firms. Acs and Audretsch (1988), using size-related definitions of innovation, offer some support to Winter's (1984) hypothesis that innovation of small and larger firms thrive under different technological and economic environments. Moreover, when using a size-independent definition of innovative activity, industry concentration exhibits a negative and significant effect, which points in an opposite direction to the traditional strict Schumpeterian hypothesis.

In a more direct Schumpeterian context, Geroski (1990) tests the proposition that the degree of innovativeness in an industry is positively determined by the degree of industrial concentration or monopoly. The empirical specification adopted relies on a rich data set containing information on some 4378 significant innovations introduced in the UK between 1945-1983 in 73 three-digit industries. Estimation results yield that highly concentrated industries and those becoming more concentrated appear to be less innovative. In contrast, those where entry is higher and exhibit a greater extent of industry fringe seem to be more innovative. However, there might well be an indirect effect of market power on innovation as a result of a chain-reaction effect running from increased industry competition to lower expected post innovation returns, hence providing less scope for innovation. Estimating an auxiliary regression on actual returns on innovation and extent of monopoly power demonstrates this negative indirect effect to exist but it is relatively small compared to the positive effect of competition on innovation. When, however, a causal bi-directional analysis between innovation and entry was undertaken in a later study (Geroski, 1991d) it was shown that, if there is any causality at all, this runs from entry to innovation but not the other way around. Nevertheless, the analysis also points to the positive correlation between entry and innovation stemming from a strong interdependence between structural and quite time invariant in the short-run factors like entry conditions and technological opportunity. When these factors are accounted for, the effect of entry on innovation is not only modest but also *negative.* Geroski (1991a) offers a potential reconciliation of these two seemingly contradictory results. This suggests that measures of concentration and entry reflect competitive conditions prevailing in two different segments of an industry. It may be possible that rivalry in industry has a different effect on innovation at the 'top' of an industry compared to its effect at the industry 'fringe'. Geroski believes overall that the positive association between entry and innovation is strong enough to offset the negative causal effect that entry has on innovation.

From a novel perspective Audretsch (1995a) studies the type of firms that exit an industry under alternative technological regimes. He hypothesises that, if the 'entrepreneurial regime' better characterises an industry, then exits should be mainly attributed to incumbent firms that innovative new entrants replace. If however the 'routinised regime' better describes the technological information conditions then the hypothesis assigns exits to young entrants of the recent past. The empirical evidence provided offers some support for both of these hypotheses.

2.2.4. The interaction between entry and exit and industry evolution

One of the most striking features emerging from statistical analysis of the size distribution of firms in an industry is that it is skewed towards smaller firms (Simon and Bonini, 1958; Acs and Audretsch 1993). This property tends to persist at least in the short-run to medium run. However, as aptly put by Audretsch and Mahmood (1993, pp. 31-32) *"...viewed through a dynamic lens, the often-observed asymmetric size distribution of firms becomes more understandable. According to this view, the frequent observation of industries dominated by small firms does not mean that is the same set of small firms being observed over time."* This very consideration brings out that behind a seemingly time-invariant size distribution structure there might be hidden a rapid and dynamic process altering the identities of firms making up the size-distribution at various points in it. This process may involve entry and exit of firms from an industry creating a turbulent environment at the industry fringe. Or it may go further and change the identities of the participants in the market way beyond the fringe through a process of selection, upward struggle and growth (Marshall, 1920). Such intra-industry dynamics may well not change greatly the number of market participants at any given time (Geroski, 1991a, 1995; Dunne and Roberts, 1991). Following this line of argument a consistent view of entry becomes that *"the market dynamics associated with entry are not, it appears, so much associated with changes is the size of the population of firms or products in a market as they are those associated with changes in the population characteristics of firms or products"* (Geroski, 1991a, p. 7).

Beesley and Hamilton (1984) associate the degree of 'seedbed' activity, being the extent to which new and small firms can challenge existing firms, with the degree of turbulence[11] in an industry. They argue that *"...the concept of a seedbed cannot be disassociated from business trial and error (birth and death)...active seedbed industries will be in continuous flux due to contemporaneous birth and death flows"* (ibid. p. 228). Turbulence has been defined as the sum of firm births and deaths as a percentage of existing firms, and some support is offered for the idea that higher turbulence is associated with higher innovation activity in UK manufacturing. Furthermore, empirical results point out that turbulence has some effect on industry concentration, but only as far as the component of turbulence relates to diversifying spin-offs of existing firms. Audretsch and Acs (1990) study the determinants of industry turbulence by relating entry and subsequent survival and growth to the extent of learning-by-doing practices of firms in an industry (Jovanovic, 1982). Evidence provided suggests that in industries where knowledge inevitably requires actual participation in that industry there is less trial and error activity, and hence turbulence, than in industries where experience obtained outside the industry can be transferred successfully into it by new entrants. Audretsch and Acs (1991) suggest that turbulence has been higher in industries where potential entrants have an innovative advantage over incumbent firms, and Audretsch (1994) demonstrates that the exit rate of new entrants has been higher in innovative industries in the short but not in the long run.

Caves and Porter (1976) propose that *"if industries vary in their rates of turnover, the occurrence of exit should be positively related to the occurrence of entry"* (ibid. p57). A number of subsequent studies have confirmed a positive relation between entry and exit across industries. Yip (1982) has observed that industries experiencing more entry in US

11 See Gudgin (1978) for a similar definition. The term 'generational turnover' as opposed to 'turbulence' has been used in Caves and Porter (1976) and the terms 'firm-turnover' and 'producer-turnover' in Dunne *et al.* (1988) and Dunne and Roberts (1991) have essentially the same meaning.

manufacturing can be associated with those exhibiting higher exit. Dunne *et al.* (1988)[12] analysing entry and exit patterns for 387 four-digit US manufacturing industries using census data for 1963-1982, confirm that entry and exit rates were highly and positively correlated. Evidence from Canada provided by Shapiro and Khemani (1987) researching the determinants of entry and exit using a cross section of 143 four-digit industries also supports the positive relation of entry and exit. In a European context, Geroski (1991a) reports high positive, though fairly unstable over time across industries, correlation between entry and exit rates for UK manufacturing. Results for both the Norwegian (von der Fehr, 1991) and Belgian (Sleuwaegen and Dehandschutter, 1991) manufacturing industries also point in the same direction. Kleijweg and Lever (1994) report correlation between entry and exit rates in Dutch manufacturing industries between 1986-1992 amounting to 52 percent and this is not dissimilar to German studies (Schwalbach, 1991) ranging between 0.32 to 0.55 for various entry and exit measures. Evidence from Greek manufacturing (Anagnostaki and Louri, 1995a) also accords with that from other country studies. Cable and Schwalbach (1991) making an international comparison of entry and exit processes provide additional evidence, summarised in Table 2.1.

Table 2.1. Correlations between firm entry and exit

	Number of firms	**Market share**	**Relative size**
Belgium	0.660	0.161	0.890
Canada	0.039	0.682	0.393
FRG	0.342	0.572	0.525
Korea			
1976-78	-0.409	—	—
1979-81	0.350	—	—
Norway	0.488	0.219	0.180
Portugal	0.030	0.170	0.010
UK	0.318	0.513	0.872
USA	0.270	0.520	0.600

Source: Cable and Schwalbach (1991)

Along with correlations between entry and exit in terms of number of firms (column 1), correlations in terms of market share and relative size of entrants and exiting

[12] Subsequent studies in US manufacturing undertaken by Austin and Rosenbaum (1991), Rosenbaum and Lamort (1992) and Evans and Siegfried (1992) also draw the same conclusion essentially using the same data source as in Dunne *et al.* (1988). As they differ only in the length of the study period employed they need not be considered in detail.

firms provide some interesting insights[13]. In column 2 Canada stands out in that market shares of entrants are highly correlated with those of exiting firms while the respective correlation in terms of number of firms is low. Portuguese manufacturing industries present a similar tendency but to lower degree, whereas Belgian manufacturing is characterised by an inverse trend. The third column of Table 2.1 suggests that in some cases the average size of entrants closely resembles that of exiting firms. The existence of positive correlation between entry and exit in the first place would be difficult to reconcile with the common view that exit is associated with negative supernormal profits (Geroski, 1995), which in turn indicates a negative rather than positive correlation between entry and exit. Reconciliation is possible if entrants displace some incumbents. Indeed, Cable and Schwalbach (1991) argue that if entry and exit processes represent flows of firms so that no individual industry would simultaneously exhibit both entry and exit then across-industry correlations between entry and exit should be negative. If, on the other hand, all exits were replaced by entry then the correlation between entry and exit would have been positive and the correlation coefficient itself should be approximately unity. Drawing on their review but considering also firm size, Cable and Schwalbach believe that there is, in some cases, a tendency of exiting firms to be replaced by entering firms of similar size.

While 'replacement' or 'displacement' would facilitate an explanation for the statistical occurrence of a positive correlation between entry and exit, another research option seeks to explore similarities or dissimilarities of the effect of structural conditions in accounting for inter-industry variations in entry and exit. Caves and Porter (1976) assert that *"each source of entry barrier identified by Bain can also erect a barrier to exit"* (ibid. p. 44). If valid, this proposition states that many determinants of entry and exit behave in a symmetrical manner, and hence, the positive correlation between entry and exit is justified. The cornerstone supporting the 'symmetry' hypothesis relates to capital durability and specificity that binds it to particular uses[14]. These traits of capital make it not easily recoverable (sunk) in case of exit and forces, on the one hand, incumbents to

[13] The negative correlation between entry and exit counts for Korea in 1976-1978 refers to conditions of wide economic contraction.

[14] See also Eaton and Lipsey (1980).

bound their markets and deters entrants who must duplicate assets having higher opportunity costs for them than for incumbent firms, on the other. Dunne and Roberts (1991) associate high levels of turbulence with few sunk costs and maintain that any research that attempts to assess inter-industry differences in the competitive effect of entry should distinguish between industries by levels of turbulence.

Support for symmetry hypothesis would vindicate the sunk-costs nature of entry barriers that translates them to exit barriers and also justifies the persistence of incumbent firms in unprofitable activities (Caves and Porter, 1976). Shapiro and Khemani (1987) tested the symmetry hypothesis under the condition of possible displacement. Econometric results suggested that when displacement effects are ignored (entry is not included amongst the determinants of exit) there is a considerable degree of symmetry between the determinants of entry and exit. Most striking, however, was not the support of symmetry *per se* but rather the positive effect of industry profitability on exit. The need for some reconciliation was immediate and the possibility of displacement was the obvious choice. When displacement effects were allowed, the extent of observed symmetry was reduced, but entry did have a positive effect on exit. Baldwin and Gorecki (1991) suggest that the effect of entrants on incumbents seems to be limited and that replacement of less efficient firms by more efficient entrants seems to take place primarily at the industry fringe. Dunne and Roberts (1991) argue that 'displacement' of exiting producers by entering firms could justify the positive effect of industry profits on exit that they obtain in some econometric specifications. Sleuwaegen and Dehandschutter (1991) find little evidence favouring symmetry but they do say that some partial 'displacement' takes place as lagged entry seems to induce exit and lagged exit to invite entry. Von der Fehr (1991) also supports the notion that past exit induces current entry.

The terms 'replacement' and 'displacement' have often been used interchangeably in the literature without always being totally clear. Carree and Thurik (1996) do make it clear that *"...Replacement occurs when exit causes entry ...[and] ...Displacement occurs when entry causes exit"* (ibid. p. 156). However, this might be too strong as it is quite difficult to separate real causality from statistical incidence. A positive effect of entry on exit, and vice versa, might not be something different from the simple notion that entry fills the market vacuum created by exiting firms without the latter being necessarily forced out by more competitive entrants. Moreover, the extent of the symmetry hypothesis complicates matters considerably to the extent that entry and exit as similarly determined by common factors may represent the effect of these factors when used as determinants.

Few studies have attempted to resolve matters concerning the interaction between entry and exit in a simultaneous equations model framework[15]. Austin and Rosenbaum (1991), using a data on entry and exit for US manufacturing industries, issue qualified support for symmetry and demonstrate some evidence that industry profitability is positively related to both entry and exit. Nevertheless, their results are inconclusive for entry and exit as parts of the same two-way feedback mechanism. Using similar data but applying a somewhat different model, Rosenbaum and Lamort (1992) reach the conclusion that industries experiencing higher entry rates also experience higher exit rates and that the two processes seem to respond to the same factors but they do not seem to be simultaneously determined. Industry profitability was found to be a significant determinant of exit in a single equation, but not in a simultaneous equation framework. Evans and Siegfried (1992) utilise the same entry and exit data as Austin and Rosenbaum (1991) and point to evidence that entry and exit are simultaneously linked. Kleijweg and Lever's (1994)[16] study on Dutch manufacturing also supports that there is a significant interaction between entry and exit, which points to displacement and replacement effects. In contrast, results for retailing sectors provided by Carree and Thurik (1996) again in the Netherlands suggest that while there is evidence that entry and exit interact, simultaneity is absent.

2.2.5. The role of potential entry and contestability theory

An account of the role of entry on market performance should take into consideration that *"entry does not necessarily have to occur in order to have an effect on market performance"* (Geroski, 1991a, p. 10). This concerns the threat that potential entry creates and, hence, the discipline that it exerts on incumbent firms concerning pricing behaviour. If this is a case, then observed entry flows alone may understate the competitive pressures entrants exert on incumbents. The role of potential entry is

15 A more detailed account on these studies is given in chapter six where the present research makes its own contribution to the limited empirical evidence providing results for Greek manufacturing industries.

16 A more accessible version of this paper can be found in Kleijweg and Level (1996).

celebrated most in contestability theory, where it is regarded to be as effective as actual competition (Gilbert, 1989). A contestable market is *"one to which entry is absolutely free, and exit is absolutely costless"* (Baumol, 1982, p. 3). This 'freedom of entry' means that the entrant is not in a disadvantageous position in terms of production techniques or production quality relative to the incumbents. Exit is costless if *"any firm can leave without impediment, and in the process of departure can recoup any costs incurred in the entry process [and] if all capital is saleable or reusable without loss other than that corresponding to normal user cost and depreciation, then any risk of entry is eliminated"* (ibid. p. 4).

In a recent theoretical piece Cairns (1994) scrutinises contestability theory for its explicit assumption of symmetry among firms in an industry and develops a multi-period theoretical model where information asymmetry is introduced. Uncertainty is twofold as it exists on the part of potential entrants regarding how incumbents are pricing and on the part of incumbents concerning how potential entrants may respond. Cairns demonstrates that the threat of entry imposes a partial price discipline rather than leading to optimal pricing (as assumed by contestable theory under conditions of certainty).

Contestability theory proponents claim a distinction between fixed costs of production and sunk costs claiming that only the second actually create barriers. A favourite example has been the airline industry, which exhibits high fixed costs that are not sunk in that an aircraft can be diverted to other uses (Geroski *et al.* 1990). Given this assertion it might be expected that in airline industries entry and exit is easy and the effect of potential competition important. Shepherd's (1984) evidence from the US airline industry suggests that, although entry and exit exerts some influence on market shares, the main effects stem from interactions among incumbents.[17] MacLeod (1987) argues that sunk costs could take on various forms and demonstrates the effects that each has on the set of theoretical equilibrium market structures. Following a distinction made earlier by Eaton and Lipsey (1980), he refers to two forms of sunk costs. The first form depends on the malleability of capital, which is the extent to which it can be recovered in the case of cessation of the firm's operations. The second form concerns sunk costs whose sunkness

[17] See also arguments in Weitzman (1983) for the denial of 'pure' fixed costs and in support of sunk costs and their role in decreasing average costs.

relates to the difficulties of getting capital instantaneously removed from the market. While the first category does not seem to deter entry, according to the author the second certainly does. Entry deterrence is the product of costs that are sunk due to the time it would take to leave the market[18].

A number of empirical studies have tested the direct effect of sunk-cost proxies on entry and exit. Kessides (1991) developed a formal model for the evaluation of the degree of contestability in US manufacturing industries. Sunk-cost proxies used in this study include estimates of the amounts of investment in buildings, machinery and advertising that might become irrecoverable in the event of exit. The results provided suggest that sunk costs are an important impediment to contestability as they were found to lower entry rates in response to industry profitability, increasing at the same time the probability of an aggressive reaction by incumbent firms. Rosenbaum (1993) also finds sunk cost proxies to have a significant negative effect on net entry, and Rosenbaum and Lamort (1992) using some inverse notion of sunk costs indicate that sunk costs may also significantly deter exit. Mata's (1991) results on Portuguese manufacturing indicate that sunk costs present a significant entry deterrence factor but only for large-firm entry. In contrast, sunk-cost proxies were not found to be significant barriers to entry in the Norwegian manufacturing industries (von der Fehr, 1991). However, the same is not evident for Belgian manufacturing where sunk costs involved in high cost machinery and equipment were found to present a significant entry, but not exit barrier (Sleuwaegen and Dehandschutter, 1991). Shaanan (1994), using a more elaborate definition of sunk costs based on engineering-statistical cost estimates of industry specific capital, argues that sunk costs present a significant barrier to entry in sample of 40 US manufacturing industries.

In Schwalbach's (1991) study for German manufacturing the specifications of interest relate to Baumol's (1982) argument that a market can be contestable despite the presence of high concentration levels and an absence of entry when entry barriers are low[19]. The industries identified by Schwalbach to present these features were cigarettes

[18] See also Schwartz and Reynolds (1993) for a similar argument.

[19] Gilbert (1989) points out that even a natural monopoly would be consistent with contestability theory if the price charged by the monopolist suffices to cover only average costs.

and asbestos manufactures which exhibiting low entry barriers, while at the same time experiencing zero entry and high concentration ratios.

2.3. Empirical specification of the entry model

The definition of entry as outlined by Bain (1956) (section 2.1) poses problems for an apt measurement of the height of entry barriers. This is because barriers to entry as defined are likely to be entrant specific. A barrier to entry from the point of view of one potential entrant may not be so from the point of view of another (Geroski *et al.* 1990). What would be needed would be an evaluation of the individual's perceptions of the degree of protection barriers that provide for incumbents and obstacles for those who aspire entry. This implies that there is a considerable degree of heterogeneity amongst incumbent firms and amongst potential entrants. In order to account for this heterogeneity Bain (1956) established two concepts. The first refers to the 'immediate condition of entry' which is evaluated the by the long-run price-minimal cost gap attained by the most favoured incumbent and is marginally sufficient to induce entry by the most 'advantaged entrant'. If such a hypothetical most favoured entrant cannot perform post-entry as well as the incumbent firms then barriers to entry are said to exist and this provides an estimate of the minimum height of entry barriers faced by all potential entrants in an industry (Geroski, 1983, Geroski *et al.* 1990). The second concept refers to the 'general condition of entry' concerns the succession of values of the intermediate condition starting from the most favoured entrant in response to the distribution of price-minimal cost values, and moving towards less efficient entrants.

Using these concepts Bain (1956) examined 20 US manufacturing industries and classified them in 'high entry barrier' industries if incumbent firms could elevate prices by 10% above minimal costs, forestalling entry at the same time. Industries experiencing 'substantial' entry barriers were those where the percentage of price elevation was around 7% percent. Industries facing 'moderate to low' barriers were those where the percentage of price elevation above minimal costs ranges between 1% and 4%. This classification was achieved by first ranking industries according to each individual source of entry barrier and then aggregating their scores on a continuous scale. Bain made the self-critical point in respect to these estimations that these are quite speculative *"because both the* *'guess-estimated' character of much of the basic data and of theoretical uncertainty concerning the effect on entry of certain estimated situations"*(ibid. p. 71). Nonetheless, Bain identified as most significant barriers to entry those related to product differentiation advantages and economies of scale.

The study of entry barriers was revolutionised by Orr who first considered entry barriers in direct relation to firm entry firms *per se* (ibid. 1974a) and devised a less subjective direct method for calculating the height of barriers to entry (ibid. 1974b). Previous studies considering the role of entry barriers were confined to examine the determinants of inter-industry variations in profitability[20] and as such could not draw conclusions on the direct influence of industry structure in determining entry. The notable exception to this was the work of Mansfield (1962) who first regressed entry and exit rates on industry profitability and capital required to build a plant of minimum efficient size. His results suggested that the entry rate would increase by at least 60% if industry profitability doubled, and would decrease at least 7% if capital requirements doubled. As far as exit rates are concerned, Mansfield concludes that these would decrease by at least 15% if an industry profitability doubled or if the ratio of the average size to minimum efficient size of firm doubled.

Orr (1974a) develops a more elaborate model given in the following estimable equation for a cross section of 71 Canadian industries:

$$E = f\ (\pi^{p} - \pi^{*}, \dot{Q}) \tag{2.1}$$

This equation asserts that entry into an industry is a function of the difference of past industry profitability π^{p}, as a proxy of expected post-entry profits attainable by entrants, and the long run profit rate π^{*}, predicted for this industry on the of level of entry barriers, plus the effect of past industry growth rate of output ($\dot{Q}$). Orr justifies the inclusion of past industry growth on the grounds that in fast growing industries the arrival of entrants has less profound effects on industry output and prices.

As far as the vector of variables that determine the long-run profit rate is concerned, Orr included a measure of minimum efficient plant size, the amount of fixed capital

20 See Lyons (1991) for a review of this type of studies.

required to build a minimum efficient plant size, advertising intensity as proxy for product differentiation advantages, and R&D intensity. In addition, a measure of risk that relates to industry profits was used along with an industry's concentration ratio.

The first two variables concern the twofold economies of scale effect analysed in section 2.1. The inclusion of advertising intensity follows Bain's (1956) result that product differentiation was one of the most significant entry-barriers, and Comanor and Wilson (1967) who suggested that advertising intensity, as a proxy of the product differentiation barrier, is an important determinant of profits in US manufacturing. The introduction of R&D as barrier to entry has been influenced by the discussion in Mueller and Tilton (1969). This indicates that R&D might be a barrier if there are economies of scale in conducting R&D, and also that if it can be associated with protected know-how indicated by patents possessed by incumbents and generating absolute cost advantages[21]. Risk was measured as deviation of profit rates over a period and hypothesised to exert a negative influence on entry capturing the off-putting effect of profit fluctuation on risk averse potential firm proprietors. Concentration enters the barrier to entry vector on the premise that it reflects the possibility of collusive reaction by incumbent firms at the expense of entrants. The results obtained by estimation show that capital requirements, advertising intensity and high concentration are significant entry barriers, whereas past industry profitability and industry growth have only a weak positive effect on entry[22].

Orr (1974b) used the estimators of the barriers to entry vector to construct an index of the height of entry barriers for each industry, weighting the value of each barrier to entry for each industry by the corresponding barrier to entry estimator. The mechanics of the Orr-type of model and the construction of the barriers to entry height index have been usefully recapitulated in Cable and Schwalbach (1991). Adopting their notation, the entry process is described by:

$$E_{jt} = \gamma \left(\Pi^{e}_{jt} - \Pi^{*}_{j}\right) + u_{jt} \qquad (2.2)$$

[21] Mueller and Tilton suggest that this would be the case at the 'technological competition stage' where learning-by-doing offers incumbents a great advantage and patents have not yet expired. This would not be the same as at the 'imitation-stage', which is more conductive to entry.

[22] The minimum efficient plant size proxy was dropped for multicollinearity reasons. As an additional determinant of entry, the logarithm of industry sales was added and a positive significant effect was detected.

where E_{jt} is entry in industry j at time t which responds to the difference between the expected post-entry profits (Π^e_{jt}) and the long run 'limit profit' after *all entry has ceased* (Π^*_j). The latter is determined by an array of m barriers to entry contained in vector X. This relationship is given by:

$$\Pi^*_j = \beta_0 + \sum_{m=1}^{M} \beta_m X_{mj} \tag{2.3}$$

Substituting Π^*_j in (2.2) by its equivalent from (2.3) yields

$$E_{jt} = \alpha_0 + \alpha_1 \Pi^e_{jt} + \sum_{m=1}^{M} \alpha_m X_{mj} + u_{jt} \tag{2.4}$$

Establishing correspondence between the parameter γ in (2.2) and the estimated coefficients in (2.4) entails in that $\alpha_0 = -\gamma\beta_0$, $\alpha_1 = \gamma$ and $\alpha_m = -\gamma\beta_m$. Inserting the long-run equilibrium conditions that $\Pi^e_{jt} = \Pi^*_j$ and $E_{jt} = u_{jt} = 0$, produces an estimate of the level of 'limit profits' and hence of the height of entry barriers in an industry j which is depicted by:

$$\hat{\Pi}^*_j = \hat{\beta}_0 \sum_{m=1}^{M} \hat{\beta}_m X_{mj} = \frac{-\left(\hat{\alpha}_0 + \sum_{m=1}^{M} \hat{\alpha}_m X_{mj}\right)}{\hat{\alpha}_1} \tag{2.5}$$

As it stands, the Orr-type of entry model allows, along with an estimator of the height of entry barriers, the derivation of an estimator of the responsiveness of entry to profitable opportunities (γ). It also makes possible inference as to the importance of individual barriers to entry included in the X vector. However, in applied research the last two properties of the model have attracted most attention as *"most scholars have been concerned more with the determinants of entry barriers than with its height overall"* (Geroski and Schwalbach, 1989, p. 23).

This model is not without its critics. Geroski and Schwalbach (1989) and Geroski (1991c) discuss the limitations of the Orr-type of model and focus their doubts on four issues. The first concern is about the usual practice imposing one-year lagged price cost margins in attempt to proxy the expected post-entry levels of profits. This is claimed to assume that potential entrants have very naïve perceptions of the post-entry market conditions and ignore the effect that their entry will have on profits. In addition, this practice has been held responsible (Geroski, 1995) for the frequent statistically insignificant estimates of γ found in the literature. The second problem relates to measurement of entry barriers. The critique suggests that often the practice here has been to rely on easily gathered proxies. This, in turn, suggests that there are important omitted factors that relate to entry barrier notions. This coupled with the possibility that proxies may suffer from measurement error could bias the estimates of the height of entry barriers derived. However, Orr (1974b) when first proposing a measure of the height of barriers to entry was aware of this, arguing that *"...this index should be interpreted as merely a useful approximation to the relative overall height of entry barriers"*(ibid. p. 42). The estimates used by Orr to derive his index accounted for slightly less than half of the variation of entry rates and this made his cautioned interpretations conditioned on a conscious recognition of a possibly important role for omitted factors. The third problem should be seen in conjunction with the first and asserts that it is too risky to assume that the parameter γ as a speed of adjustment of entry to an excess profits index is the same across industries. This may be so if the factors determining γ are correlated with the height of entry barriers across industries. The fourth critical issue relates to the somewhat arbitrary aggregation of different types of entrants into the same 'pool'. Different types of entrants may have different potential in being successful when entering. This, in turn, may imply that they do not all have the same perceptions of entry barriers or that barriers are not equally decisive in conditioning entry decisions across a spectrum of heterogeneous queue of entrants. This consideration has brought about entry definitions going beyond classical ones restricting attention to firms building new plants and installing new equipment (Bain, 1956), those emphasising the independence of new firms (Johnson, 1986) and those having no obvious parent in existing organisations (Allen, 1970). Geroski (1991a) argues that, in terms of the effect on competitive processes, entry by foreign producers, entry by acquisition, or even changes in management of exiting firms might not differ much from entry more narrowly defined. In this sense entry may be viewed *"in terms of new sources of supply, regardless of whether this involves new sources of production"* (ibid. p. 10). A number of scholars have offered interesting and versatile typologies of entrant-types varying in the degree of openness adopted. Thus Mueller (1991) differentiates between *de novo* entry[23], entry by an existing firm building a new plant, entry by altering the product mix of an existing plant, entry by acquisition and entry by foreign firms. Evans and Siegfried (1992) restrict attention to all but the last of these and maintain that transfer of ownership of an existing firm through merger does not represent entry if merged firms do not diversify into new products or areas. Storey (1991) distinguishes in greater detail by defining *diversifiers* as firms entering a specific industry while operating at the same time in another and *switchers* as firms that move from one sector to another but no longer operate in the industry which they left[24].

The applied research has, to some extent, taken into consideration these points of criticism. The availability of panel data in many counties has allowed repeated in time observations for individual industries, making it possible to account for the effect of omitted time-invariant, but across industries highly differentiated factors, that might relate to persistent features of industry structure. Some experimentation with alternative expected post-entry-profit approximations has been witnessed in applied research and some account for entry-type heterogeneity has also been provided. Research has paid much less attention to the possibility that the speed of adjustment may be industry-specific and the limited evidence that exists in this direction does not so far seem to be clear[25]. In contrast, there is some evidence from studies that have distinguished between different entry types providing some support for Hines' (1957) suggestion that the effect of entry barriers is felt more by *de novo* entrants, who represent the most common form of entry rather than by diversifying firms[26]. Moreover, there is also some evidence that the small firm might respond differently to entry inducements and impediments compared to its larger counterpart.

---

23 This type of entry is close to the classical definition, but narrower, as it refers to the introduction of new production capacity in industry by a firm not existing before and which is not affiliated to an existing one operating in another sector.

24 Von der Fehr (1991) refers to switchers as moving firms.

25 See discussion and empirical results related to this issue in Geroski and Schwalbach (1989) and Geroski (1991c).

26 Mata (1993a) examines the interaction between type of entrants and provides evidence that the less favoured type of entry is de novo entry as it is deterred by all other types of entrants. Only expanding firms deter diversifying firm entry.

The Orr-type of model has been for more than twenty years the 'workhorse' of the industrial economics empirical literature on entry[27]. But it is true to say that subsequent research has taken a somewhat looser form in respect to variables included in the entry equation. The 'state of the art' is probably best described in Cable and Schwalbach's (1991) view that

> *"...with the theoretical debate as yet unsettled, there is a strong case for inclining toward the most general empirical specifications that data considerations will allow, if for no other reason than that the ensuing results all add grist to the theorists' mill."* (ibid. p. 263)

There follows an account of the accumulated empirical evidence that surrounds the very core of barrier to entry notions in the context of the original Orr research specification. Where applicable, efforts to deal with some of the aforementioned criticisms are notified. Empirical evidence about the more general specifications of entry models is discussed in separate sections.

2.3.1. The effect of industry profits on entry and exit

Duetsch (1975) uses a somewhat different approach to Orr (1974a) in allowing for non-positive values of net entry. He retains the assumption that net entry is a function of industry profitability, which in turn is determined by conditions of entry in an industry. However, he points out that if price cost margins reflect industry profitability that is attributed to high entry barriers, net entry rates might be lower in industries exhibiting higher margins as the latter *"may not offer an unusually attractive incentive for entry"* (ibid. p. 453). Regressing net entry on the residuals of a regression of price cost margins on capital and advertising intensity proxies provides low explanatory power and insignificant results for industry profitability for a large cross-section of US manufacturing industries. When, however, margins directly enter the net entry equation, a positive and significant effect was found but only when industry concentration was excluded from the regressors. In a later study Duetsch (1984) confines his analysis to positive net entry values and provides evidence supporting a positive, and overall quite significant, effect on net entry. Chappell *et al.* (1990) analyse net entry for a cross-section of US manufacturing industries between 1972-1977. The analysis uses only positive

[27] Some other typologies of entry models are discussed in Geroski (1991a) chapter 3.

values of net entry and proposes a Poisson model to account for the non-negativity of the dependent variable. The empirical evidence as to the effect of industry profitability on net entry indicates that this is positive and significant. The same is the case in research by Rosenbaum (1993) and Kessides (1991). Kessides, however, suggested that in industries with high sunk costs, net entry and the margin could move in opposite directions if higher margins prompt incumbent retaliation and this threat, in turn, outweighs the initial corresponding incentive.

Yamawaki (1991), using panel data in a fixed-effects model finds that the price cost margin has a positive but insignificant effect on net entry rates in the case of Japanese manufacturing industries. Nevertheless, when, prior to pooling, separate period by period regressions were performed on a cross section of around 135 Japanese manufacturing sectors, the effect of profit margins was found to be negative in three out of five cases. In one of them (1982-1983) it was established with almost 95% confidence that this negative effect is statistically significant. Unfortunately, he does not make any further comment on these results beyond emphasising the temporal instability of his cross sectional results.

Jeong and Masson (1991) using rational expectations formulations to approximate post-entry expected profits found them to exert a positive and significant effect on net entry rates[28]. Geroski (1991c) also uses a rational-expectations formulation[29] to derive predicted values for expected post entry profits in a study examining the determinants of net entry market penetration, distinguishing at the same time between domestic and foreign entrants. Domestic entry seems to respond much more rapidly to profits than does foreign entry. The coefficient for domestic entry is four times larger than the insignificant coefficient for foreign entry and rational-expectations derived proxies for expected profits perform better than more naïve ones based on one-year lagged profitability.

The effect of industry profitability on gross entry[30] has been more consistent with theoretical expectation when compared with the aforementioned studies using net entry.

[28] The net entry rates used in this study are dominated by an excess of entry over exit and thus are primarily positive.

[29] To derive the rational expectation based predicted values the author regresses price cost margins on themselves, lagged up to three periods in the past, and also lagged industry growth and lagged industry exports.

[30] Gross entry refers to counts of firms entering an industry.

Khemani and Shapiro (1986) find that price-cost margins, averaged over four years before entry, have a significant positive effect in explaining variation of gross entry. Shapiro and Khemani (1987) show that the same holds when entry was estimated along with exit in a recursive system. Other empirical evidence from the US manufacturing industries accords with theoretical expectation in both a panel data analysis with industry-fixed effects (Dunne and Roberts, 1991) and in cross-sectional estimation contexts (Highfield and Smiley, 1987; Mayer and Chappell, 1992)[31]. The Austin and Rosenbaum (1991) and Rosenbaum and Lamort (1992) studies also yield significant results on industry profitability when single gross entry equations were estimated, with and without exit amongst the independent variables. However, the same finding was not so clear[32] when entry was estimated along with exit in a simultaneous equation framework. In the same simultaneous estimation context, Evans and Siegfried's (1992) results verify this insignificance and above all their analysis yields a negative insignificant sign when entry by diversifying firms producing in existing plants was concerned. This inconsistency in the direction of the effect, accompanied with statistical insignificance, has also been evidenced in Hilke (1984) analysis of the determinants of entry market shares in a sample of US manufacturing industries.

In contrast Schwalbach, (1987) concludes that profit margins have a significant effect in increasing the production share of diversifying firms in Germany. Mata (1993a) distinguishes between *de novo* entry and entry by existing firms in Portuguese manufacturing. The latter category is further disaggregated according to whether the parent firm operates in same industry (expansion), in related industries (extension) or in different industries (pure diversification). The results show that industry profitability is positive and significant only for expanding firms, and positive but not particularly significant for all other types of entrants apart from diversifiers where its effect is insignificant but, surprisingly, negative. When, however, no distinction for different types

[31] Highfield and Smiley (1987) have used autoregressive models of profits to derive predictions of expected post-entry industry profits. Mayer and Chappell (1992) use non-linear quasi-maximum likelihood estimation based on compound bivariate Poisson distribution to separate the effect of the determinants of entry and exit using net entry rates.

[32] In Austin and Rosenbaum (1991) margins were significant in one of the study periods considered, whereas in the Rosenbaum and Lamort (1992) single period study it is insignificant.

of entry is made, past industry profitability has a positive and significant effect on firm entry (Mata, 1993b). Anagnostaki and Louri (1995a) produce results in the same vein but for Greece.

There are other results which to point in the opposite direction. Von der Fehr (1991) distinguishes among different types of entrants and finds that industry profitability seems to be more important in determining entry rates of de novo and of 'moving' firms[33]. Kleijweg and Lever (1994), retaining the term existing firm entry to refer to diversification and also expansion firm entry, approximate expected profits by taking returns on investment data and suggest that this has a significant effect for new but not for existing firm entry in Dutch manufacturing industries.

A limited number of studies have distinguished between small and large firms entering and have evaluated the effect of profitability prospects on entry. MacDonald (1986) finds that the effect of profitability on entry has been insignificant but, surprisingly, negative. Acs and Audretsch (1989a) compile evidence for a significant positive effect of industry profitability on small-firm net entry rates. When, however, a gross entry (birth rate) definition was used (Acs and Audretsch, 1989b) the coefficient of lagged price cost margins proved insignificant for all firm-size classes concerned and negative for entry of firms employing less than 500 employees.[34] These results contrast with those of Mata (1991), where profitable opportunities seem to be positive and significant in determining gross entry rates of small firms, but negative and insignificant for larger firms. Mata argues that past industry profits might not be a good proxy for expected post-entry profits for more sophisticated entrants, such as larger Portuguese manufacturing firms. Empirical evidence for German[35] manufacturing industries provided by Wagner (1994) makes inference about the effect of industry profitability on entry of firms of various sizes even more puzzling. This study distinguishes between small firm

[33] Von der Fehr (1991) defines as 'moving' those plants previously employed in other industries. The other entrant-types pertain to diversifying and expanding firms using new plants or existing production facilities.

[34] Acs and Audretsch (1989a,b) broadly define small firms in US manufacturing industries as those employing less than 500 employees and they use a sliding cut-off point to allow for narrower definitions of small firms within the 1 to 499 employees range.

[35] This research refers to manufacturing industries in the German region of Lower Saxony.

entry, small single-plants entry, and the two taken together. The results offered on profit rates heavily depend on the econometric technique applied. They range from positive and significant when small firm and small single-plant entry equations were estimated by ordinary least squares (OLS), to negative and significant when the equation single-plant entry was estimated with some robust estimation techniques.

From a rather novel perspective, Sleuwaegen and Dehandschutter (1991) taking into account the open character of the Belgian economy include among other determinants of entry rates not only domestic price cost margins but also the corresponding German ones. Both profit margins were found be positively and significantly related with higher entry rates in Belgian manufacturing industries.

A number of studies have offered support for the conjecture that exit occurs because of industry unprofitability (Siegfried and Evans, 1994). Marcus (1967) finds a strong positive association between firm exit and the proportion of loss making firms in an industry. Hudson (1986) shows that profitability has a negative and significant effect on voluntary, and also compulsory, company liquidations in England and Wales. The same is evident for US manufacturing as well as business firms failures (Hudson, 1989) utilising an extensive Dun and Bradstreet data set. On the other hand, Baden-Fuller (1989) studying the determinants of exit decisions in the case of a declining industry – the UK steel casting industry – favours the view that unprofitability does influence exit decisions, but not in sense that the least profitable firms first exit from an industry. Exit seems to be a strategic decision and firms having a larger market share and diversifying firms exit first. Schary (1991) distinguishes between three types of firm exit. These are through merger, voluntary liquidation or bankruptcy. Using firm level data for the US cotton industry, she suggests that the form of exit is not related to profitability and the same applies for other firm characteristics such as financial, which alone are not able to predict the form of exit.

More recent empirical evidence from studies concerned with the determinants of inter-industry differences in firm exit has offered ambiguous results for the effect of industry profitability. Apart from research finding a positive effect for industry profitability, discussed in section 2.2.4, a number of studies have produced inconclusive evidence for the direction of the effect or have produced negative estimates. Negative effects of industry profitability have been inferred in Mayer and Chappell (1992), Sleuwaegen and Dehandschutter (1991) and Anagnostaki and Louri (1995a). Inconclusive results have been reported in Evans and Siegfried (1992) and Kleijweg and Lever (1994) who do not find any significant influence, although the direction of the effect varies across different types of exiting firms and under alternative econometric model specification in the latter case.

2.3.2. Industry growth

In the research that followed Orr's (1974a) seminal paper a number of studies using net entry as the dependent variable found evidence that past industry growth, measured in various ways, has a positive and significant effect. Most work has been undertaken for the US manufacturing industries. Using cross sectional data, Duetsch (1975) found that growth in industry demand has a positive and significant effect on net entry, and the same holds when net entry is restricted to only positive values (Duetsch, 1984; Chappell *et al.* 1990). More recent comparative cross-sectional analysis, allowing for non-positive values produces reassuring results (Kessides, 1991) and this has been substantiated in a panel-data context without industry fixed-effects (Rosenbaum, 1993). Acs and Audretsch (1989a) usefully conclude that industry growth is a strong positive determinant of small firm net entry.

Yamawaki (1991) and Jeong and Masson (1991) have compiled reassuring evidence for the positive effect of this variable on net entry rates for Japanese and Korean manufacturing industries respectively. Gorecki (1975) suggests that there is a strong positive link to net entry of both new and diversifying firms in the UK manufacturing sectors. Nevertheless, it is surprising that the same is not the case when the determinants of net market share penetration of domestic and foreign firms are concerned (Geroski, 1991c). In this research the effect of lagged domestic production growth has a negative effect on both types of entrants and is significant for domestic firms[36].

Using a gross entry definition Khemani and Shapiro (1986) find that industry growth, discounted for the effect minimum efficient plant size, has a positive and

[36] Geroski (1991c, p.81) notices that this result holds also when gross entry penetration is used as a dependent variable.

significant effect on entry in Canada. Furthermore, this holds even when entry and exit are estimated in a recursive system (Shapiro and Khemani, 1987).

Early results from US manufacturing industries point out a positive but statistically insignificant effect of past industry growth of sales on entry (Masson and Shaanan, 1982). On the other hand, Hilke (1984) finds some moderate effects and MacDonald (1986) presents more supportive results, at least concerning smaller firms. Highfield and Smiley (1987) maintain that one of the most important microeconomic factors explaining inter-industry variations in new firm formation in US manufacturing industries is higher growth in industry sales[37]. Dunne and Roberts (1991), Austin and Rosenbaum (1991) and Mayer and Chappell (1992), all offer additional reassuring evidence. Rosenbaum and Lamort (1992) also find that there is strong positive statistical association between industry growth and entry in a single equation estimation, but this reverses direction and becomes insignificant in a simultaneous estimation context. This insignificance and instability in the direction of the effect across different types of entrants was the main characteristic of simultaneous estimation results in the Evans and Siegfried (1992) study. Acs and Audretsch (1989b) conclude that past industry growth is conducive to firm births across a wide spectrum of firm size classes, but it appears that it induces more large-firm than small-firm births.

Distinguishing for different types of entrants, Mata (1993a) finds a positive and of moderate significance effect only for *de novo* entry. The direction of the effect was quite unstable for alternative methods of estimation for the same entrant type but also across different types in all other cases considered. Aggregating by type of entrants[38], Mata (1993b) generates a negative and fairly significant estimator for past industry growth. It is argued that this may be due to measurement of entry in terms of number of firms, which gives greater weight to small units. If this a valid assumption, then this result may be seen in conjunction with those of an earlier study (Mata, 1991) which signified that industry growth is more conducive to large firm entry, corroborating the results of Acs and

[37] Hilke (1984, p. 237) supports the proposition that growth might be perceived by entrants to be a better predictor of future profits and high past profits.

[38] The operational definition used encompasses those firms that existed in 1986 but not in 1982, and also those existing before 1982 but who changed their main activity between 1982 and 1986.

Audretsch (1989b). However, this result is somewhat puzzling in that the definition used encompasses also diversifying firms, and because the same negative effect was found to be significant for the number of firms increasing employment and also, although insignificant, for entry measured in terms of employment.

The distinction between small and more generally defined firm entry in Germany (Wagner, 1994) yields quite unstable results for the effect of industry growth. But some positive and significant results can be seen in some econometric specifications for small and small single-plant entry. There is strong evidence pointing to a significant effect of industry growth on the production share of diversifying entrants in the same country (Schwalbach, 1987). Kleijweg and Lever (1994) produce results which also suggest that industry growth is more conducive to existing firm (includes diversification) entry rather to new firm entry. There is a significant direct effect for the former and an insignificant negative relationship with the latter in Dutch manufacturing. Von der Fehr (1991) distinguishes also between different entry types, but his results for Norwegian industries have been predominantly negative and insignificant. Insignificance has also become evident in the case of type-independent entry rates in Greek manufacturing (Anagnostaki and Louri, 1995a), in all but one case the direction of the effect being positive. In sharp contrast not only domestic industry but also European-wide industry growth rates turn out be significant motivators of firm entry in Belgian manufacturing industries (Sleuwaegen and Dehandschutter, 1991).

As far as the relation between firm exit and industry growth is concerned Caves and Porter (1976), utilising firm-level data, suggest a negative and statistically significant relationship. MacDonald (1986) and Shapiro and Khemani (1987) also find a negative but not a statistically profound relationship. More recent studies on exit in various countries have been more conclusive in outlining the same message both for cross sectional studies (Austin and Rosenbaum, 1991; Mayer and Chappell, 1992; Jeong and Masson; 1991) and using panel data (Dunne and Roberts, 1991; Rosenbaum and Lamort, 1992). As an exception, Anagnostaki and Louri (1995a) find a positive and significant effect on exit. Kleijweg and Lever (1994) also find a weak negative effect of industry growth on exit, but somewhat more significant on exit by bankruptcy. Sleuwaegen and Dehandschutter (1991) present an interesting case suggesting that whereas domestic industry growth exerts a negative and significant influence on exit of Belgian firms, the same is not evident for European-Union wide industry growth. In the wider context the positive, though insignificant effect, is thought to reflect some traces of intra-EU competition.

In a simultaneous estimation context, there is some evidence suggesting a negative effect of industry growth in the exit equation (Austin and Rosenbaum, 1991; Rosenbaum and Lamort, 1992), but not when allowance for different exiting firm types is given (Evans and Siegfried, 1992)[39]. From a somewhat different perspective, Audretsch (1994) examining the incidence of exit for a cohort of firms, finds that industry growth decreases the probability of exit in the short but not in the long run. This might be consistent with the Bradburd and Caves (1982) suggestion that growth affects industry profitability in the short-run. Audretsch (1995a) distinguishes between exiting firms that were recent entrants and incumbents, and concludes that industry growth is a stronger exit deterrence force for new entrants than for incumbent firms.

2.3.3. Economies of scale

The empirical examination of the effect of economies of scale as an entry barrier on net entry rates has not produced unanimous results. Gorecki (1975) finds a negative effect on net entry rates, significant only for new entrants but not for diversifying firms. Kessides (1991) and Rosenbaum (1993) obtain empirical results also suggesting a negative effect of economies of scale proxies on net entry, but with varying degrees of significance. Negative effects continue in the Jeong and Masson (1991) study. They prove to be of moderate statistical significance only when periods of economic contraction and expansion are combined in a full business cycle.

In contrast, both Duetsch (1984) and Chappell *et al.* (1990) restrict net entry to non-negative values and they derive insignificant but direction varying estimates and significant and positive coefficients respectively. The authors attribute this non-traditional result to the economies of scale proxy used in their study that was defined as labour productivity in the four largest firms in the industry over labour productivity in all smaller firms. It is argued that a high productivity differential has an off-putting effect on entry only in cases where entering firms have to directly compete with larger more efficient

[39] In Evans and Siegfried (1992) there some traces for positive effect of industry growth on exit of diversifying firms.

firms. If however, as the authors prefer it, there is an extensive fringe consisting of inefficient firms, entrants might have a cost advantage over fringe firms and this might stimulate entry. Acs and Audretsch (1989a) use the changes of small firm productivity over the average productivity change in an industry and they also discover a positive and significant effect on small-firm net entry rates.

Dealing with gross entry, the empirical results obtained have too been ambiguous. In accordance with theoretical expectations, Masson and Shaanan (1982) find a negative effect of scale on entrants' market share, and Hause and du Rietz (1984) find that doubling the optimum plant size has a substantial effect on entry as it entails in a reduction of annual entry rates by 1.3%. MacDonald (1986), Khemani and Shapiro (1986), Shapiro and Khemani (1987) and Mata (1993b) all find empirical support vindicating that economies of scale present a significant entry barrier. Mayer and Chappell (1992), using quasi-maximum likelihood estimates based on net entry, attribute a negative and significant effect of scale on probabilistically derived entry rates. In contrast, Highfield and Smiley (1987) do not find any statistical support for a strong effect of economies of scale proxies. Jeong and Masson (1991) differentiate that whereas economies of scale are not a significant entry barrier when entry is concerned, they are more powerful in inversely affecting entrants' market shares.

A series of studies from various country contexts have offered quite mixed and sometimes surprising results. Thus, Austin and Rosenbaum (1991), using a two-study-period cross sectional analysis, produce a positive and significant result for the effect of minimum efficient size on firm entry for one of them. Dunne and Roberts (1991) using panel data estimation on quite similar data reach the conclusion that economies of scale present a significant entry barrier. When, however, industry-fixed effects were included in the econometric model specification this result was neither negative nor significant. Rosenbaum and Lamort (1992) panel data, estimations without fixed effects add further to the puzzle, producing statistically insignificant and direction varying results when different models are calibrated. The same has been also evident in Sleuwaegen and Dehandschutter (1991) who produce positive albeit insignificant estimates.

As far as the effect of economies of scale on different entry types is concerned, Acs and Audretsch (1989b) derive a negative effect for small firm entry (firms employing less than 100 employees). This, however, switches to be positive and insignificant for other definitions encompassing larger firms, but still smaller than a cut-off point of 500 employees. Mata (1991) finds also a positive and almost significant effect on large firm entry, but a strong negative effect on small firm entrants. Von der Fehr (1991) produces a strong positive effect of minimum efficient plant size on de novo and 'moving' firm entry, claiming that the economies of scale proxy has been correlated with both industry size and capital requirements. He blames these correlations for this surprising result. Schwalbach (1987) points in an opposite direction demonstrating that economies of scale have a significant negative impact on the production share of diversifying entrants. The contrast is intensified as Mata (1993a) shows that economies of scale are an impediment to *de novo*, expansion and extension entry, while the corresponding coefficient for diversification entry is positive and significant.

Evidence on the effect of economies to scale proxies on firm exit has been limited but equally ambiguous. Shapiro and Khemani (1987) find that economies of scale are a significant entry deterrence factor. Dunne and Roberts (1991) suggest the same but not when the effect of time-invariant industry-specific omitted factors are allowed in econometric panel data specification, yielding a positive but insignificant effect. Austin and Rosenbaum (1991) have also traced a positive, but insignificant effect, and Jeong and Masson (1991) the same but only during economy-wide expansion. Audretsch (1994) finds evidence that economies of scale are conducive to exit of recent entrants, but significantly deter exit of firms operating in an industry for ten or more years.

2.3.4. Capital intensity

Evidence on the effect of capital requirements on net entry has been quite limited. Empirical findings suggest, however, that this has been negative (Duetsch, 1984; Chappell *et al.* 1990; Rosenbaum, 1993; Jeong and Masson, 1991) and of some statistical significance in only a few cases (Duetsch, 1984; Chappell *et al.* 1990). As far as the effect on small firm net entry is concerned, Acs and Audretsch (1989a) find that this is negative and significant only when small firms are defined as employing less than 100 employees. Yamawaki (1991) provides somewhat ambiguous results explaining that capital intensity in a period by period comparative cross sectional analysis was found to be positive in two out of five cases and very significant in one of them (1982-1983). The same, however, was not true when the multiperiod cross sectional data were combined in a panel data set estimated with industry-fixed effects. This rendered capital intensity a negative and statistically significant determinant of net entry rates.

Using gross entry, a number of studies have come to the conclusion that a strong negative effect of capital intensity on entry exists and that this accords with theoretical expectations (MacDonald, 1986; Austin and Rosenbaum; 1991, Dunne and Roberts, 1991; Khemani and Shapiro, 1986; Shapiro and Khemani, 1987; Mata, 1993b; Sleuwaegen and Dehandschutter, 1991; Jeong and Masson, 1991). In Masson and Shaanan's (1982) research although the effect is still negative its statistical significance is weak.

Almost inevitably, some research reveals a positive effect of capital intensity on gross entry (Highfield and Smiley, 1987; Mayer and Chappell, 1992) but this is rarely significant. Rosenbaum and Lamort's (1992) estimates generate a negative but weak effect in a single-equation estimation and a positive but insignificant one in simultaneous equation context. However, in sharp contrast with all other studies, Audretsch and Acs (1994) find capital intensity to have a positive and statistically significant effect on new firm start-ups. It was suspected that the capital intensity proxy was positively correlated with the industry correlation variable. When the latter was dropped, the former remained positive but more important, doubled its magnitude. Acs and Audretsch rely on the previous Audretsch (1991) finding that capital intensity is a significant barrier to the survival of new firms, to infer that capital intensity might not deter entry but considerably reduces the post-entry probability of staying in business.

Acs and Audretsch (1989b) using a sliding, employment-based definition of small firms produce insignificant estimates which, however, are varying in their sign depending on the employment range selected. Mata (1991) offers evidence that capital intensity effectively deters small firm entry but its effect is weak when larger firm entry is modelled. In a similar fashion, Wagner (1994) provides robust negative estimates of capital intensity for small-firm entry. In Mata (1993a) capital intensity has been found negative for all different types of entrants and quite significant for *de novo* and diversifying firms. Von der Fehr (1991) reports negative and significant estimates for all types of entrants considered, whereas Kleijweg and Lever's (1994) results depend heavily on the type of entry studied. They are positive and quite significant for existing firm entry whereas the opposite is the case for *de novo entry.*

As far as the effect of capital intensity on firm exit is concerned a number of studies have indicated that this is negative and significant in a single equation framework (MacDonald, 1986; Shapiro and Khemani, 1987; Mayer and Chappell, 1992; Kleijweg and Lever, 1994), or negative but insignificant (Marcus, 1967; Jeong and Masson, 1991). Caves and Porter (1976) find a positive and significant effect in explaining the persistence of low profit businesses. Audretsch (1994) suggests that capital intensity, as an exit barrier, seems to have a longer run impact on exit that starts from 6 to 10 years after entry. In other research, results have been dependent on alternative econometric formulations used. Dunne and Roberts (1991) find a significant negative effect with panel estimation but positive and significant when industry-fixed effects are allowed. Austin and Rosenbaum (1991) find a negative and significant effect in all exit equations with the only exception being the corresponding equation in a simultaneous equation framework for the first of the two study-periods considered. This has been also the case when exit was estimated in a recursive estimation system in Shapiro and Khemani (1987). Kleijweg and Lever (1994) obtain insignificant estimates for capital intensity in determining general but not bankruptcy exit when allowing for some interdependency between entry and exit. Other research has produced positive, but insignificant, results (Caves and Porter, 1976; Sleuwaegen and Dehandschutter, 1991)[40].

2.3.5. Product differentiation

In a similar fashion to Orr (1974a), Duetsch (1975) hypotheses that industries characterised by intense product promotion may show higher profits and lower net entry rates. The regression estimates concerning advertising intensity were consistently negative. Gorecki (1975) assumes that there should be a differentiated impact of the product differentiation barrier when net entry of diversifying and non-diversified entrants (specialists) are concerned. If a diversifying firm might already have been successful in establishing its products elsewhere then this would enable it to take advantage of its name when entering a new industry. Contrary to Gorecki's expectations the advertising

[40] This result of Caves and Porter (1976) refers to analysis of the occurrence of exit of a major competitor.

intensity had a positive and significant effect on specialist-firm net entry, but was insignificant and negative for diversifying entrants. He proposes that the attraction of higher profits might have been stronger than the barrier presented by product differentiation. However, such an interpretation, as the author admits, is tentative to the extent that the product differentiation proxy has the opposite sign for the diversification type of net entry.

Kessides (1991) usefully clarifies that advertising could be a barrier to entry to the extent that there are both sunk costs and economies of scale involved in advertising expenditures. Nevertheless, it is also emphasised that advertising is also a means to inform consumers about the attributes and prices of products. In this sense if advertising is considered as a substitute for experience, it offers a means to overcome consumer loyalty. Evidence provided seems to support the notion that entrants perceive a greater likelihood of success in markets where advertising plays an important role. This perception is demonstrated to be more important in inducing net entry than the entry-reduction effect arising from sunk costs. This analytical framework is helpful in justifying the positive and significant effect of advertising intensity on net entry rates found also in Yamawaki (1991), despite the fact that he does not offer any explanation for this empirical outcome.

In both the Duetsch (1984) and Acs and Audretsch (1989a) studies the effect of product differentiation proxies on net entry was essentially insignificant but varying considerably in direction, depending on study periods and definitions. In a series of more recent studies, product differentiation proxies exhibit a negative and quite significant effect on net entry (Chappell *et al.* 1990; Rosenbaum, 1993; Jeong and Masson, 1991).

As far as the effect of product differentiation on gross entry is concerned, many studies provide evidence that this is a significant entry barrier (Masson and Shaanan, 1982; Khemani and Shapiro, 1986; Shapiro and Khemani, 1987; Sleuwaegen and Dehandschutter, 1991; Schwalbach, 1991; Jeong and Masson, 1991; Austin and Rosenbaum, 1991; Rosenbaum and Lamort, 1992; Mata, 1993b; Anagnostaki and Louri, 1995a). Exceptions, as usual, can be found. Highfield and Smiley (1987) find a negative but insignificant effect. Mayer and Chappell (1992) find a positive and significant effect and following Kessides (1991) maintain that this result reflects *"the long standing* *controversy 'advertising promotes market power' versus 'advertising promotes competition'*" (p. 776) arguing that in their data this controversy is resolved in favour of the latter.

In respect to whether or not product differentiation as an entry barrier has a differential impact depending on the type of entering firm, MacDonald (1986) shows no direct effect for food industry fringe firms. Acs and Audretsch (1989b), considering a large cross section of industries, find it to be highly significant in determining small firm entry. Mata (1991) clearly indicates that, whereas product differentiation is a significant barrier to entry for small Portuguese firms, this is not the case for larger entrants. In addition, it seems to have a differentiated effect on different entry types. It is negative and significant barrier for *de novo* entry, but positive and significant for expanding firms (Mata, 1993a). Kleijweg and Lever (1994) obtained results that correspond to those of Mata (ibid.) in direction but not in significance. In contrast, Schwalbach (1987) offers empirical support to the idea that the production share of diversifying entrants is significantly reduced in industries keen to promote intensive product differentiation practices.

If advertising expenditures involve a high degree of costs that are sunk, this would suggest that advertising intensity might also be an important exit barrier. Caves and Porter (1976) are able to show that the exit of a major competitor is significantly deterred by higher advertising intensity, but also that higher advertising has a positive but not significant effect in determining the persistence of low profitability businesses. Furthermore, Audretsch (1994) concludes that firms in industries with higher advertising intensity face a higher likelihood of exit for up to ten years post-entry.

In research studying the determinants of inter-industry differences in the incidence rather than the probability of exit, empirical results on the role of product differentiation have been mixed. Thus, there is some limited support for advertising intensity being a significant exit barrier (Sleuwaegen and Dehandschutter, 1991; Austin and Rosenbaum, 1991). There is some evidence that this might be so in periods of economic expansion, but not in economy-wide contraction when exit is induced by higher advertising intensity (Jeong and Masson, 1991). Conversely, there is evidence that the exit deterrence of product differentiation might be weak (Khemani and Shapiro, 1987, Rosenbaum and

Lamort, 1992). Kleijweg and Lever (1994) suggest that this might not be uniform over different types of exiting firms finding that this is negative for general exit, but positive for the exit of diversifying firms. Insignificant and directionally unstable results have been the rule rather than the exception when allowing for some degree of interdependency between exit and entry (Khemani and Shapiro, 1987; Austin and Rosenbaum, 1991; Rosenbaum and Lamort, 1992; Evans and Siegfried, 1992).

2.3.6. R&D and innovation

An earlier section has focused attention on the effect of entry on innovation. Reversing the angle of the analysis offers a complementary view on this relationship. Given differentials in the level of technology across industries, a number of studies have examined whether higher levels of innovation, or of efforts to produce new technological advances actually hinder the entry of new firms. Or, whether sunk costs involved in R&D processes would, in turn, obstruct exit of firms heavily committed in this respect. Searching for an empirical regularity in this direction has been hindered by even more ambiguous results in respect to the direction and statistical significance of the effect.

Support for the notion that higher R&D intensity is an entry barrier can be found in the research of Khemani and Shapiro (1986), Shapiro and Khemani (1987), but their estimates are not significant. Highfield and Smiley's (1987) results, in contrast, suggest that R&D intensity might have some entry-enhancing effect. Finally, Sleuwaegen and Dehandschutter (1991) provide insignificant and also inconclusive results in respect to the direction of the effect.

Schwalbach (1987) asserts that the effect of R&D on diversification entry is twofold. It can be an entry barrier if entrants need, because of it, extra resources in order to compete. It may also be an incentive to enter if firms that have accumulated experience in R&D in other industries wish to transfer and gain from this by entering a new industry. This seems to be echoed by the positive sign of the corresponding estimated coefficient. However, the unquestioned acceptance of this result is obstructed by its statistical insignificance. Kleijweg and Lever (1994) provide supporting evidence suggesting that R&D intensity has a positive and, under some model specifications, significant effect on existing firm entry. The same, however, is not evident for *de novo* entry where the insignificance and also the varying sign of the corresponding coefficients raise interpretation uncertainties. Von der Fehr (1991) finds a negative and significant effect on diversifying firm entry, but positive and insignificant for *de novo* firms. Evans and Siegfried (1994) suggest that whereas R&D intensity has a positive and significant effect on *de novo* and diversification entry using new plant facilities, it is insignificant when aggregating on different entry types and negative for diversification entry using existing production facilities.

In respect to small firm entry, Acs and Audretsch (1989a) using net entry data find a negative and significant effect for R&D expenditures. The same is also true in Acs and Audretsch (1989b) using gross entry data and a direct measure of an industry's innovative activity (total innovations). Despite this, in industries where small firm innovation ratios have been higher, entry of small firms has been significantly facilitated, suggesting that innovation might offer a viable small firm strategy (Acs and Audretsch, 1989a, 1989b). Audretsch and Acs (1994) add further evidence revealing a more far-reaching positive effect of higher small firm innovation activity. New small firm start-ups are also facilitated by industry-related university research whereas it is not deterred by higher within an industry company R&D intensity even in industries where learning-by-doing plays an important role. Wagner's (1994) results range from indicating that R&D intensity is an insignificant entry barrier to pointing to a significant effect, depending on the alternative econometric model formulations applied.

As for R&D as an exit barrier, Shapiro and Khemani (1987) find this to be significant when displacement effects are not accounted for by the econometric model specification, but not when the opposite is the case. Kleijweg and Lever (1994) suggest that R&D is a significant exit barrier for general exit but not for exit by bankruptcy. In a simultaneous equations estimation framework, Evans and Siegfried (1992) demonstrate that the corresponding coefficient estimate is negative and significant for general exit, but positive and insignificant for other exit types concerning variants of diversifying firms.

From a different perspective, Audretsch (1994) argues that the probability of exit for establishments is apparently higher in innovative industries in the short-run (up to approximately four years post entry) but not in long run. This is consistent with the notion that highly innovative industries are associated with considerable turbulence (Beesley and Hamilton, 1984). In industries characterised by a 'routinised' technological regime, the implied greater large firm innovation advantage is conducive to exit of younger firms, but not for firms that have been established for more than ten years in an industry (Audretsch, 1995a).

2.4. Strategic entry deterrence

2.4.1. Limit pricing and excess capacity

Geroski *et al.* (1990) maintain that the extent to which structural conditions actually impede entry depends on the interaction of entry barriers with industry behaviour. This implies that incumbent firms may be able to capitalise strategically on entry barriers and enhance their entry deterrence value. One way of doing so is to manipulate entry by affecting the pre-entry level of profits to pre-empt and deter potential entrants. This has been the basic feature of the so-called 'limit-pricing' model which according to its proponents (Bain, 1956, Sylos-Labini, 1962) is based on two fundamental conditions. The first asserts that existing firms are supposed to maintain their output post-entry and, given no information gaps, potential entrants are able to foresee the effect that entry would have on industry supply. The second assumes that incumbents can manipulate the price necessary to deter entry. Thus, perfect information and calculation of post-entry profits according to pre-entry prices have been the key to the success of this strategy. Unless the height of entry barriers falls in extreme situations, where incumbents have no advantage whatsoever over potential entrants (easy entry) and where entry barriers are so high that prices maximising short-run profits are not sufficient to make entry an attractive alternative, existing firms face two choices. The first is to continue charging high prices and in the absence of sufficiently high entry barriers to invite entry (ineffectively impeded entry). The second is to choose 'limit-price' which in conjunction with the costs that entry barriers involve makes entry unprofitable (effectively impeded entry) sacrificing current profits to ensure future market power. Gaskins (1971) developed a model that is more dynamic in the sense that the choice faced by incumbent firms can be adjusted depending on the threat felt by incumbent firms each time and guided by maximisation strategies regarding the present value of future profits. In this way, entry can be 'regulated', which means that incumbents aim to keep entry under control, as an alternative to 'limit-price' which implies no entry taking place but often involves more sacrifice on behalf of incumbent firms. Masson and Shaanan (1982) and Jeong and Masson (1991) have offered some limited empirical support to 'dynamic limit pricing' using cross sectional data, whereas Smiley (1988) surveying 293 US firms found that only 2-3% of the respondents used limit pricing.

Spence (1977) developed a theoretical model where 'limit-pricing' generates a credible threat when there is considerable investment in production capacity when the latter involves sunk costs that signal the incumbents' commitment in the industry. On the other hand, investment in excess capacity *per se* might create an entry barrier in that it would tend to lower average production costs for incumbent firms post entry and/or increased production would undercut the demand faced by entrants post-entry. Highfield and Smiley (1987) used an excess capacity proxy among other entry determinants and obtained an insignificant and, contrary to expectations, positive estimate. Smiley (1988) found only 6-9 % of his survey respondents to have been engaged in excess capacity utilisation strategies. Some econometric evidence provided by Hilke (1984) on a limited sample of US manufacturing industries indicates that, although excess capacity and past non-accommodating entry response proxies found to have a negative effect on entry market shares, these were short of any conventional statistical significance. Lieberman (1987) confined his analysis to 38 chemical product industries, and derived econometric estimates unable to reveal any statistical significance of excess capacity as an entry-deterrent. Since an econometric investigation may be adequate to support the overall insignificance of excess capacity it would not be equally enabling to preclude its occurrence. Thus, case by case investigation was followed and indicated that only in three cases-products excess capacity was held not as necessary preparation to respond to cyclical demand condition but actually as an entry deterrence means. Despite this in all three cases some entry has occurred.

2.4.2. Concentration

Industry concentration has been used as a proxy for the scope of collusive reaction by incumbent firms. However, it has been suggested that retaliation by incumbents might not be a credible option in cases of high levels of concentration, and that in any case the effect of concentration on entry depends on entrants' assessments of the ease of collusion in an industry (Jeong and Masson, 1991). Duetsch (1975) argues that the effect of concentration on net entry might be difficult to predict and indeed both he and Jeong and Masson (1991) find that concentration has a positive, and statistically significant, effect on net entry rates, whereas the same positive effect was insignificant in Duetsch (1984). Duetsch (1975) argues that as concentration is often positively correlated with industry profitability entrants might have stronger perceptions for post-entry profitable opportunities in highly concentrated industries and this could offer some explanation for this positive effect. In contrast, Chappell *et al.* (1990) and Acs and Audretsch (1989a) provide results suggesting that higher concentration significantly reduces net entry and small-firm net entry respectively.

In studies using gross entry as the dependent variable, there is much support for the idea that concentration does represent a significant entry barrier (Khemani and Shapiro, 1986; Shapiro and Khemani, 1987; Mayer and Chappell, 1992; Audretsch and Acs, 1994; Anagnostaki and Louri; 1995a). Highfield and Smiley (1987) and Anagnostaki and Louri (1995a) have also detected a negative but statistically insignificant relationship, and Jeong and Masson (1991) find it to be significant when it comes to entry market shares. Hause and Rietz (1984), using a dummy variable for industries with significant cartel agreement (as a proxy for monopoly power), find that this has a significant negative effect on entry. As an exception, Rosenbaum and Lamort (1992) provide consistently positive estimates for concentration across different econometric specifications, which are sometimes significant.

Acs and Audretsch (1989b) have demonstrated that the negative relationship between concentration and gross entry is significant for small but not large firm entry, which turns out to be significantly induced by higher concentration. Wagner's (1994) results on small firm entry provide a quite mixed picture as the effect of concentration ranges from being a significant entry barrier for all types of entry taken together to being a significant inducement to entry for small single-plant firms. Schwalbach (1987) detects an insignificant, albeit positive effect, on the production share of diversified entrants and suggests that concentration might not be an entry barrier *per se* if the incumbents' perceptions suggest that their positions would be essentially unchallenged post-entry. In contrast, von der Fehr (1991) finds a negative and significant effect of concentration on both *de novo* and diversifying entrants.

Empirical evidence on the effect of industry concentration on exit is limited. Audretsch (1994) hypothesises that since this has been often used as an indication of possible retaliatory behaviour of incumbent firms it might be expected that it should be positively associated with the probability of exit. Indeed, results cited in his research indicate that the probability of exit increases with industry concentration in the period from four to ten years after entry. In a later study, Audretsch (1995a) distinguishes between exiting firm types and provides econometric evidence consistent with Baden-Fuller's (1989) suggestion that incumbents account for a greater share of exiting firms in more concentrated industries.

2.5. Extensions of the model: beyond the basics

2.5.1. Multiplant operations and diversification

Duetsch (1984) first introduced the extent of multiplant operations in an industry as an aspect of market structure that could give rise to entry barriers. He argued that there might be economies and pecuniary advantages related to multiplant firms that create clear disadvantage for single-plant firm entry. These advantages are best thought to stem from: the ability of multiplant firms to spread costs over alternative production activities, their ability to raise capital as they are already established firms, their experience in conducting R&D and sales promotion activities and their potential in achieving better deals in procuring materials due to their larger scale. On the other hand, multiplant firms as they operate in different industry segments might also be able strategically to reduce prices where they feel more threatened, aiming to manipulate entrants perceptions for post-entry market profitability prospects. Indeed, the corresponding estimated coefficient being both negative and significant justifies the author's theorisation.

A number of subsequent studies (Khemani and Shapiro, 1986; Shapiro and Khemani, 1987; Chappell *et al.* 1990; Mayer and Chappell; 1992) have also detected a significant and negative effect of multiplant production on entry. Most of all, it has also been demonstrated that extensive multiplant operations in an industry give rise to significant exit barriers (Shapiro and Khemani, 1987; Mayer and Chappell, 1992), presumably because multiplant firms are difficult to displace. In an inverse manner, McDonald (1986), using the share of industry employment accounted for by single-plant firms, finds that this has a profound positive effect on fringe firm exit. On the other hand, Audretsch (1994), being primarily concerned with the determinants of the probability of exit, addresses the role of ownership status and obtains results suggesting with considerable statistical confidence that independent establishments are less likely to exit. This supports Baden-Fuller's assertions (1989) that multiplant enterprises are more likely to close subsidiary plants than are single plant firms to exit from an industry, but contrasts with that of Dunne *et al.* (1989) who found that plants belonging to a multiplant firm tended to have a lower probability of exit.

From a somewhat different perspective Duetsch (1975) considered the role of product diversification, proxied inversely by a primary product specialisation index, on net entry rates. The rationale for using this variable is that diversification by incumbents might reduce entry as far this relates to an ability of diversified firms to engage in predatory pricing. Moreover, potential entrants might find it difficult to calculate their risks when compared with profitable entry opportunities in that the real level of profits in activities of entrants' interest might be obscured in consolidated financial reports. Duetsch anticipates that highly diversified industries may show higher profits but lower net entry, and this is confirmed in his econometric estimations. In a similar fashion, Mata (1991) proxies industry diversification as the degree of employment of an industry's firms belonging to other industrial classifications and finds a negative and significant effect in the case of small firm, but not for large firm, entry. When distinction between *de novo* and diversifying firm entry is made, Mata (1993a) is able to show that industry diversification has a negative effect on both entry types, but significant only in the case of the former. Schwalbach (1987) argues that diversification of firms classified in a four-digit sector taking place within the same 2-digit industrial classification would give way to economies of scale and facilitate entry through diversification. His positive results indicate that in this way profitable transfer of know-how takes place from already operational activities in a broader industry classification to a narrower one.

2.5.2. Trade conditions and foreign competitors

To date, empirical studies when concerned with the market where potential entrants might participate or where exiting firms were already operating have confined themselves only to domestic markets and growth in domestic production. However, von der Fehr

(1991) argues that whereas this is satisfactory in a closed economy, it would not be ideal for a small open economy. In the latter case the size of domestic industry should be adjusted for trade flows i.e. augmented by industry imports and reduced by industry exports. Alternatively, industry imports and exports should be used along with other entry determinants because the demand prospects faced by potential entrants are also determined by export possibilities and probably restrained by competitive imports. On the other hand, import penetration by lower cost foreign producers might put domestic firms at a cost disadvantage and squeeze profit margins, thus increasing the propensity for exit for the less competent firms. Von der Fehr (ibid.) identifies industries exposed to such foreign competition as those being the most risky, and this might be used to justify the otherwise quite paradoxical results that export orientation has a negative effect on entry. More important, while import penetration has usually been insignificantly negative, the only exception being for expanding firms, export orientation has been surprisingly significant for all types of entrants, apart form diversifying firms transferring existing production facilities to the new industry. In contrast, Rosenbaum (1993) finds a statistically positive effect for import penetration on net entry rates but unfortunately cannot explain his result. Kleijweg and Lever (1994) conclude that export orientation has a positive influence on existing-firm entry but not for *de novo* entrants, and a negative and significant effect on exit by bankruptcy. Finally, Anagnostaki and Louri (1995a) provide results indicating that import penetration has a negative effect on both entry and exit whereas export orientation is symmetrically positive to both entry and exit.

In an indirect fashion some other studies have been concerned with the effect of protectionism on entry and exit. In particular, Khemani and Shapiro (1986) argue that high tariff protection such as in Canadian manufacturing may, by limiting import penetration, enhance market power of incumbent firms that can in turn be used against domestic entry. The effect of protectionism on exit concerns Shapiro and Khemani (1987) who hypothesise and empirically support the idea that high tariffs often protect inefficient domestic production creating an artificial exit barrier. The presence of strong competitors such as foreign multinationals in domestic markets has also been found to present an entry barrier in Khemani and Shapiro (1986). Geroski (1991c) is not concerned with the direct effect on entry of foreign firms operating domestically, but he offers some useful insight comparing the determinants of domestic and foreign entrants. The evidence suggests that domestic entry responds faster to industry profits, but as the height of entry barriers faced by the two entry types is similar it seems that neither is a substitute for the other when evaluated as competitive forces in the UK manufacturing industries.

2.5.3. Labour market considerations, entrepreneurship and macroeconomic conditions

Creedy and Johnson (1983) criticise the S-C-P literature pointing out that while new firm formation plays an important role in this analytical framework, it does not pay much attention to the transition of a new firm founder from being an employee to being self-employed. Storey and Jones (1987) make the critical point that within the S-C-P paradigm the *"socio-economic determinants of new firm founders are invariably neglected"* (ibid. p37), and Storey (1991) maintains that future research should benefit from the interface of the standard industrial economics approach and the literature on entrepreneurship.

The theoretical background of the 'entrepreneurial approach' can be traced back to Knight (1921) who suggested that an individual moves across three states — those of unemployment, paid employment and self-employment. What determines the transition between employment and the setting up of a new firm depends on a comparison between the expected utility of the wage earned when working for someone else and the future entrepreneurial income. These ideas have been formalised by Kihlstrom and Laffont (1979) who further introduced a risk element based on the assumption that, when individuals choose between wage income and running their own business, are both uncertain about the prevailing demand and cost conditions as well as their own entrepreneurial ability. Jovanovic (1982) assumes that individuals are unsure about their abilities, but can gradually learn, and therefore change their behaviour over time. Lucas (1978) recognises that individuals differ in their entrepreneurial abilities and equilibrium in an economy is achieved through an allocation of individuals across managerial and working roles. Brock and Evans (1989) add that there is industry-specific human capital, which does not restrict individuals to switch between entrepreneurial activity and working but might be restrictive in the sense that in doing so individuals are often confined to the same industry.

A second important consideration in the literature has been that of switching between being unemployed and self-employed. Oxenfeldt (1943) proposed that individuals faced with unemployment and little alternative prospect of obtaining work as an employee would be more inclined than those in employment to set up their own business. Evans and Leighton (1989) explore some empirical aspects of entrepreneurship and suggest that people becoming self-employed tend to be those who were receiving low wages, who have changed jobs frequently and who have had long unemployment intervals in their professional life. Blau (1987) develops a model to account for rising self-employment that allows for heterogeneity of workers in terms of managerial ability. He provides time series evidence suggesting that taxes on higher income and total factor productivity for self-employed have a positive effect on rising self-employment. The first result implies that the self-employed enjoy greater opportunities for under-reporting income than employees in paid employment, and the second that technological conditions favour self-employment without specifically indicating what they really are.

Binks and Jennings (1986a) point out that 'pushed' entrepreneurs *"while not necessarily less efficient than those attracted to owner management, the industries which they naturally choose to enter, and their desire to innovate, may differ substantially"* (ibid. p. 9). This implies that 'pushed' entrepreneurs may find it easier to enter declining sectors and this limits their potential to constitute a leading source of economic recovery in a period of severe recession (Binks and Jennings, 1986b). Harrison and Hart (1983) argue that if individuals forced into self-employment are less dynamic than individuals 'pulled' in to exploit market opportunities, it might be expected that the failure rates of the former would be higher than for the latter. Hudson (1989) examining the determinants of US firm births and deaths concludes that although the unemployed are more likely to set up business, such firms are subsequently more likely to fail. Evans and Leighton (1990), using survey data on young people, demonstrate that 51.5% of unemployed men who started their own business returned to wage employment after a year, when the corresponding figure for those previously employed was only around 37%.

Storey and Jones (1987) maintain that the net effect of exogenous reductions in industry demand on entry depends on two conflicting factors. The first refers to decreasing entry barriers via an increase in the supply of second hand machinery. This might be a result of firm closures and/or reduction in capacity of larger firms as hypothesised by Binks and Jennings (1986a). The second, however, is based on a traditional view that unemployment and reduced demand signal poor profitability so discouraging entry or that unemployment depletes the assets of potential entrepreneurs. Hamilton (1989) suggested that the time series relationship between unemployment and business formation rates might be non-linear and estimated that a turning point exists when a 20% unemployment level is reached. The implication is that as local economies become more and more depressed with unemployment persistently rising, 'push' factors are not accompanied by sufficient levels of 'pull' for new business opportunities. This implies that given that the economy continues to deteriorate only the first of those who become unemployed have the chance to become self-employed having at the same time the opportunity to exploit some market niches. Consistent with this view are the time-series results provided by Binks and Jennings (1986b) suggesting that whereas in the short run higher unemployment levels have a positive effect on new firm registration, an acceleration in the level of unemployment dampens new company registration rates. Meager (1992)[41] is primarily concerned not with firm births *per se* arguing that self-employment should be accounted for as a distinct labour market state. It is further argued that 'push' and 'pull' factors may co-exist as in a recessionary period. Increases in unemployment may subsequently lead to increases in self-employment levels, which, in turn, could to be moderated by the counteracting effect of the lack of 'prosperity-pull' associated opportunities. Thus, an approach based on analysis of inflows to and outflows from self-employment is called for if the effects of wide-economic conditions on self-employment are to be properly identified.

In a time series context, Robson (1991) finds that the ratio of incorporations to self-employment depends on real average self-employment income and the ratio of unemployment to vacancies providing strong evidence for the 'push' hypothesis. Harrison and Hart (1983) and Hamilton (1986) find positive evidence that unemployment contributes significantly in explaining time-series variation in new firm registrations in Northern Ireland and Scotland respectively. Recent time series evidence on the determinants of new firm registrations in the Republic of Ireland (Burke, 1996) suggests

[41] A critical review of approaches and corresponding results of the effect of unemployment on self-employment is given in this paper.

that whereas two years lagged unemployment is conducive to the formation of larger firms, one year lags in unemployment deters small new-firm formation. On the other hand, real wages have a significant negative effect on new firm registration that accords with the hypothesis of 'income-choice'. Given that this is research is also concerned with the effect of labour and product market integration between Republic of Ireland and the UK, Burke suggests that the net effect of these processes has been negative for Ireland. This he thinks is due to a negative real wage effect when corresponding wages in the UK are incorporated over riding the positive effect of Ireland's export to the UK, consequently leading to less new firm formation in the Republic of Ireland.

In a cross-sectional estimation context for UK manufacturing industries, Creedy and Johnson (1983) show that expected earnings from employment have a negative effect on new firm formation rates whereas the effect of the expected income from self-employment moves in the opposite direction. However, as the former effect is more statistically significant than the latter it has been argued that this difference reflects measurement errors relating to self-employment income, implying that individuals have more information about earnings from employment than from self-employment. The only entry barrier proxy used refers to capital requirements and this was found to have a negative and significant effect on new firm formation. In contrast, Storey and Jones (1987) do not find any statistical association between new firm formation and industry profitability, but paying more attention to labour market considerations they do find a strong positive effect of labour shedding. Carree and Thurik (1996) test the unemployment 'push' hypothesis in the Dutch retailing sector maintaining that high levels of unemployment, or strong increases in level, may deter shopkeepers in exiting because of unfavourable conditions in the labour market. Their empirical results suggested that changes in the level of unemployment have a positive and significant effect on entry, but are negative and insignificant on exit. However, the same was not evident when the level of unemployment was used. It is argued that recently unemployed might have a greater potential for self-employment than those being in this state for longer. The level of unemployment might not be an adequate proxy of the unemployment 'push' effect in that this is more related to the degree of structural unemployment.

In a somewhat less direct context, Santarelli and Sterlacchini (1994) test some of these issues using panel data for Italian manufacturing industries. Small firm profitability was employed to proxy income from self-employment and average wages as an index of paid employment income. Furthermore, small firm presence was used as a surrogate inversely related to the level of entry barriers. New firm formation rates are defined as the number of new firms over existing ones in each sector and also over employment, since it is claimed that latter definition might be more appropriate in income-choice analytical framework. Paradoxically, small firm profitability is negative under both alternatives and significant when new firm formation is defined over employment. The effect of wages is positive and significant when the first definition is used and negative, as expected, when new firm formation is defined over employment. This indicates that new firm formation is smaller in sectors dominated by small firms[42]. Results for the same country provided by Revelli and Tenga (1989) suggest that entry of small firms is deterred by entry barriers, but enhanced in expanding markets where the expected growth rate of small firms is high and where exit at zero costs offers an insurance against failure.

Storey (1991) maintains that the S-C-P literature places the emphasis on microeconomic rather than macroeconomic conditions and points to the studies by Highfield and Smiley (1987) for US and Yamawaki (1991) for Japanese manufacturing industries as important exceptions to this norm. Indeed, the former study in a time series context provides evidence that higher unemployment and lower GNP growth rates, accompanied with lower inflation, positively affect new firm formation. In contrast, Yamawaki (1991) finds net entry rates to be positively associated with real GNP growth and negatively associated with indices of the cost of capital. Subsequent research meets Storey's request for greater consideration of the effect of wider economic factors on firm entry, but they also add a degree more ambiguity. Audretsch and Acs (1994) find a negative effect of interest rates on new firm start-ups in US manufacturing industries, but a positive effect for both the GNP growth rate and unemployment. Wagner (1994) also produces a positive but insignificant effect of unemployment on small firm entry in Germany and a negative but statistically weak coefficient for interest rates. Mata (1996) provides evidence that higher GDP growth is most conducive to small firm births in

[42] Acs and Audretsch (1989b) explicitly test if small firms prefer entering industries where small firms dominate and obtained a negative and significant coefficient for their small-firm-presence proxy suggesting the opposite. See also Carree and Thurik (1996) for similar results when small firm entry in retailing sectors is concerned.

Portugal and that, interest rates effectively deter entry only when wider definitions of small firms are employed. Hudson (1987) argues that interest rates have two conflicting effects on new firm formation. The first makes it more difficult for potential entrepreneurs to obtain credit, as higher interest rates are designed to reduce the supply of credit in the economy. The second might be in favour of new firms and is based on the conjecture that these might be less risk avert and that high interest rates are in favour of high risk enterprises (Stiglitz and Weiss, 1981). Hudson (1987) finds evidence that interest rates have a significant negative effect on firm births, and a positive effect on firm deaths (Hudson, 1989).

This last and wide ranging section of the review seems to typify much of what has gone before. The literature is beginning to consolidate a number of causal dimensions involved in determining entry and exit. But the amount of contradictory evidence that is available must mean that there is still a considerable amount of research left to do. It is the intention of this thesis to make just such a contribution.

Chapter 3.

Net entry of firms and the effects of business conditions†

3.1. Introduction

In this chapter the influence of demand fluctuations and cyclical business conditions on net entry (including net exit) of firms in Greek manufacturing is examined. The review of the relative literature in the previous chapter helps to recognise that the entry and exit of firms in industrial sectors has been assumed to have a twofold effect on industrial evolution. First, to the extent that firms are attracted into newer more 'innovative' industries, this could result in a healthier industrial structure. Second, when this kind of 'turnover' occurs in traditionally declining sectors, further industrial decay can result (Binks and Jennings, 1986a).

These aspects of entry and exit clearly call for an evaluation of policies that aim to encourage new firm generation. Furthermore, besides the type of industry which should enjoy assistance from designated policies, the policy makers should be aware of the sensitivity of entry decisions to short-run disturbances, as the latter are determined by prevailing macroeconomic conditions, which themselves can be influenced by policy. The need to account for macroeconomic influences on entry has been pointed by Storey (1991) and the considerable fluctuation of entry in time has been emphasised in Geroski (1995). More than other alternative entry measures, net entry appears to present a strong tendency to fluctuate over time (Yamawaki, 1991) and this is often accompanied by lower variation across industries (Geroski, 1991a).

---

† This chapter draws on Fotopoulos, G., and Spence, N., 1997, Net Entry of Firms into Greek Manufacturing: The Effects of Business Conditions, *Small Business Economics*, 9(3), 239-253. Thanks are due to V. Droucopoulos (Centre of Planning and Economic Research, Athens), H. Louri (Athens University of Economics and Business) and to two anonymous referees for most helpful comments of the draft.

Despite the importance of cyclical business conditions in affecting entry and exit conditions in the short-run, previous empirical work on this topic is scarce. What is available concentrates heavily on highly industrialised and developed countries (Highfield and Smiley, 1987; Audretsch and Acs, 1994; Yamawaki, 1991; Wagner, 1994). The notable exception that stands out is Mata's (1996) research on Portuguese manufacturing. These studies, however, have not offered an unequivocal understanding of the conditions favouring new firm generation. Moreover, there is rarely more than one study available for each country making it often difficult to judge the validity of results in such a context before further seeking similarities and differences through international comparisons.

The present study aims to enrich the existing empirical evidence, drawing evidence from a less industrialised country, a small open economy — Greece. It seems reasonable to hypothesise that in a country like Greece, cyclical macroeconomic and business conditions do affect entry and exit conditions. Without having strong preconceptions about the exact direction of the relationships between firm entry and exit and macro-conditions, they are expected to be significant.

To analyse the relationships mentioned above, this research is organised as follows. In the next section the measure of firm entry to be used and its limitations are described. Descriptive statistics are given for net entry rates of Greek manufacturing industries for the period 1981-1991. A series of analyses of variance measures are also calculated to reveal the degree and main sources of variation of firm entry.

In section 3.3 hypotheses concerning potential determinants of net entry rates are stated. In addition, a number of different hypotheses and their outcomes are considered to denote the cases where no clear-cut conclusion can be made for the validity of the hypotheses presented. Section 3.4 contains some econometric analysis to account for variations in net entry using both macroeconomic and industry-specific variables.

3.2. The measurement of firm entry and the temporal/sectoral variation in net entry

The measure or definition that should be used to consider entry of firms into an economy is influenced by two important factors. The first is the nature of the variable the measure has to capture. The second is the data availability permitting the use of the desired measure. Inevitably the choice of empirical measures of firm entry is the product of constrained selections.

In empirical work two categories of measurement have been used: gross entry and net entry. The former relates directly to the number of new firms in the market over a period (actual entry), whereas the latter is simply the change in the total number of firms in an industry over a period. In this sense, the net entry measure treats exits as negative entries. The use of this latter kind of measure arose mainly out of data constraints preventing researchers from using more conceptually secure gross entry figures.

The use of a net entry measure in industrial studies has been widely criticised in that it necessarily excludes detail on firm turnover that is the outcome of the number of entries and exits. Clearly a net entry figure near zero may result either from near zero entry and near zero exit or from equally large numbers of entries and exits. Thereby, while the first case can reflect a situation in which entry is highly attractive but entry barriers are also high, the second can stand for a situation in which, even if there are no barriers to entry, there is no room for more firms and profits are near the competitive level. More important, however, is the criticism based on concerns of having such a measure as a dependent variable in structural industrial studies. The existence of symmetry or otherwise in the determinants of both entry and exit has been questioned by early research. Orr (1974a) in his seminal work on entry, using a net entry measure, excluded industries presenting negative values, maintaining that there is no obvious symmetry between barriers to entry (Bain, 1956) and exit. However, later research by Caves and Porter (1976) argued that barriers to entry are also barriers to exit, especially if there is a degree of 'sunkness' in costs and other commitments related to the development of protection against newcomers in an industry. Shapiro and Khemani (1987) also offer empirical support to Caves and Porter in this respect. Nevertheless, when modelling firm entry and exit, the prime determinants of each need not be the same. As Evans and Siegfried (1992) have pointed out, when gross entry and exit are combined into a net measure, this necessarily forces the same causal underpinnings to be considered. Unfortunately, this non-optional requirement for symmetry in explanation may be unhelpful in discovering the real causality.

Still, McGuckin (1972) has maintained that net entry is useful in explaining changes in industrial structure and performance. If what matters is the impact of firm turnover on industry output and performance, then net entry may be adequate to reflect it. Geroski (1991b) has helpfully indicated that the critical importance between the net and gross measures depends on whether the key processes involved relate specifically to the number of survivors (net entry) or the total number of participants (gross entry).

In the present research the use of a net entry measure was forced by the lack of suitable alternative data. The use of the annual statistical surveys of Greek manufacturing from the National Statistical Service of Greece (NSSG) necessitated the use of net entry. These data do not take into account firms employing less than ten employees. This may result in an underestimation of real activity in terms of net entry, since in smaller size classes there are likely to be a larger number of births and deaths of firms. Analysis was based on the two digit level of the standard industrial classification (SIC) because sectoral variation (as well as temporal variation) in net entry rates appeared also to be absent in higher levels of disaggregation[43]. An alternative source was the sequential manufacturing censuses, which being more detailed cover even the smallest size classes. Unfortunately, when this data source was tried at the same level of aggregation it also did not provide statistically significant levels of sectoral variation. It also had the disadvantage of not being an annual series. Other research on this topic in the Greek context has used gross entry data at the 2-digit SIC level from the Statistical Service of the Federation of Greek Industries (Anagnostaki and Louri, 1995a,b). However, these data only relate to somewhat larger firms[44]. So, in as far as the analysis to be used here utilises an abstract measure of entry such as net entry, it was felt that the annual statistical surveys did permit reliable enough conclusions to be drawn without loss of essence. Table 3.1 presents the descriptive statistics for the net entry rate for the period 1981 to 1991.

[43] Preliminary 2-way analysis of variance carried out on net entry rates defined for 88 3-digit (SIC) industrial sectors over the period 1981-1991 did not reveal statistically significant sectoral variation indicating that the absence of sectoral variation is not due to sectoral aggregation. The relative test value is $F_{(79,711)} = 0.812$. In addition the corresponding test value for temporal variation is also statistically insignificant, $F_{(9,711)} = 1.159$.

[44] This data source is used in chapter 6 to facilitate explicit testing of the symmetry hypothesis and offer some insights for the interaction between entry and exit.

Table 3.1. Descriptive statistics for net entry rates into Greek manufacturing, 1981-1991

	Mean	Standard Deviation	Minimum Value	Maximum Value
(N82-N81)/N81	0.0043	0.0249	-0.0375	0.0552
(N83-N82)/N82	-0.0075	0.0129	-0.0385	0.0112
(N84-N83)/N83	0.0029	0.0194	-0.0311	0.0560
(N85-N84)/N84	-0.0109	0.0111	-0.0251	0.0192
(N86-N85)/N85	-0.0144	0.0151	-0.0405	0.0105
(N87-N86)/N86	0.0411	0.1169	-0.1785	0.2745
(N88-N87)/N87	-0.0009	0.0117	-0.0308	0.0167
(N89-N88)/N88	-0.0069	0.0141	-0.0460	0.0153
(N90-N89)/N89	0.0017	0.0215	-0.0392	0.0635
(N91-N90)/N90	-0.0173	0.0390	-0.1728	0.0150

N is the number of firms in the two-digit industry

The pattern emerging is that the means of the net entry rates are small and most certainly not constant over time. Another important observation is that the average net entry rate was by no means always positive over the study period. The highest positive net entry rate occurs between 1986 and 1987, when incidentally the rate of growth of real GDP was the lowest of the period. In similar fashion, however, the second lowest rate of real GDP growth (1989-90) for the study period also coincides with some lower peak in net entry rates. As a result, it may be assumed that lower rates of real GDP growth result in greater 'activity' in terms of the net entry rate. This pattern is less well identifiable in the period before 1985 where it appears that net entry rates move pro-cyclically with movements in the wider economy. Figure 3.1 helps to visualise the relative relationships.

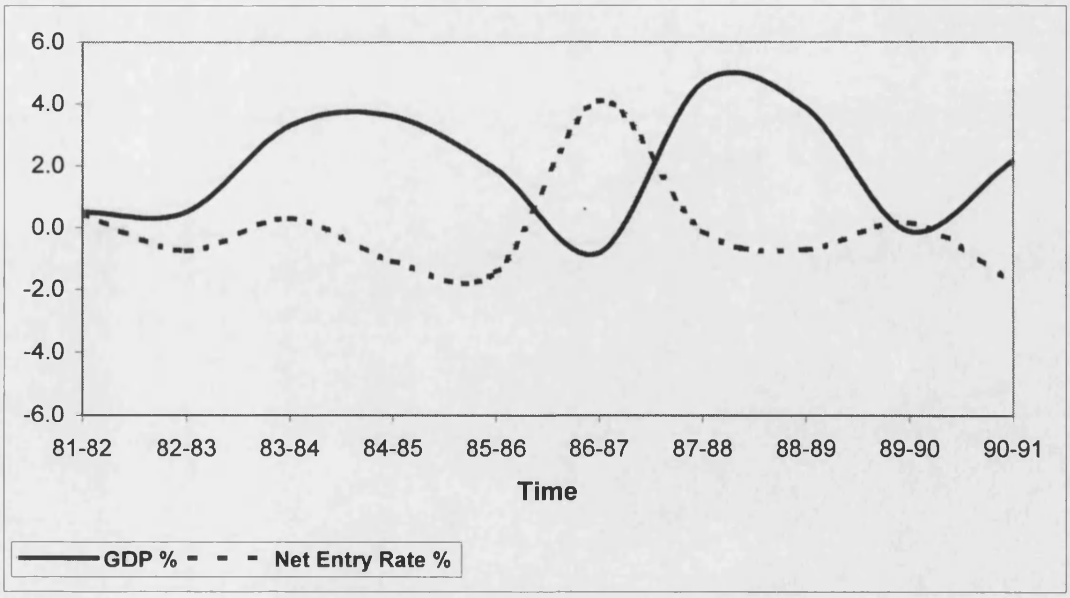

Figure 3.1. GDP–net entry rates for Greek manufacturing against time

Table 3.2 gives the sectoral means and other descriptive statistics of the net entry rate for the same period (20 two-digit sectors of manufacturing). The sectoral means in the net entry rate measure are quite different in that about half the sectors result in average net entry and half in average net exit, and only rarely are the maximum and minimum values by sector of the same positive or negative sign.

Table 3.2. Descriptive statistics for net entry rates by sectors in Greek manufacturing, 1981-1991

	Mean	Standard Deviation	Minimum Value	Maximum Value
Food preparation except beverages	-0.0041	0.0110	-0.0215	0.0086
Beverages	-0.0061	0.0143	-0.0302	0.0255
Tobacco manufactures	-0.0135	0.0974	-0.1728	0.2254
Manufacture of textiles	0.0239	0.0309	-0.1072	-0.0011
Manufacture of footwear and sewing of fabric	0.0088	0.0283	-0.0214	0.0789
Wood and cork	-0.0195	0.0570	-0.1785	0.0164
Furniture and fixtures	0.0153	0.0529	-0.0123	0.1642
Manufacture of paper	0.0164	0.0412	-0.0385	0.1053
Printing and publishing	-0.0116	0.0267	-0.0806	0.0120
Leather and fur products	0.0072	0.0278	-0.0207	0.0772
Rubber and plastic products	-0.0023	0.0275	-0.0212	0.0669
Chemical industries	0.0053	0.0328	-0.0251	0.0900
Petroleum and coal refining	0.0183	0.0678	-0.0385	0.2000
Non metallic mineral products	-0.0004	0.0137	0.0228	0.0233
Basic metal products	0.0309	0.0910	-0.0377	0.2745
Fabricated metal products except machinery	-0.0134	0.0354	-0.1105	0.0105
Machinery and appliances except electrical	-0.0032	0.0087	-0.0145	0.0098
Electrical machinery, apparatus, appliances and supply	-0.0130	0.0121	-0.0365	0.0000
Transport equipment	-0.0080	0.0136	-0.0311	0.0153
Miscellaneous manufacturing industries	0.0011	0.0304	-0.0458	0.0552

So much for the descriptive parameters of the variable of interest — net entry — next it is important to focus on the existence, or otherwise, of temporal and sectoral variations. The net entry rate was examined using analysis of variance in relation to two experimental factors. The first accounts for sectoral differences in the net entry performance across the ten year period, 1982-1991[45]. The second accounts for yearly differences of the net entry rate across the twenty sectors of Greek manufacturing.

The results revealed statistically significant temporal variation in firm net entry rates, but this was not evident for sectoral differences. The interpretation of the results of this initial two-way analysis of variance, shown in Table 3.3, indicates that the time series

[45] The 1981 data are used as a denominator in calculating the net entry rate for the period 1981-1982, and so on.

means by sector do not seem to be statistically different, while the overall yearly means of all sectors are. Data on a dependent variable of a pooled nature are rarely experimental in economic circumstances. As a practical consequence, no replications are available for observations that are assigned to, say, an industrial sector and time period. That is there is only one observation for each sector and year for the variable under study. This, in turn, implies that no direct account can be given for possible interaction effects i.e. the combined effect of double-participation of an observation to an industrial sector and point in time. In the absence of replications what would otherwise have been the interaction effect is labelled as unsystematic variation (or residual, or chance variation). To the extent that interaction, if present, exhibits itself a source of systematic variation, this results in an overestimation of the residual term making, a Type-I error[46] possible. In the case of no replications, the assumption of no interaction is called additivity. The extreme situation, where neither factor is statistically significant, but the non-additivity assumption holds, has been described by Scheffé (1959) as one where a factor (sector) can be averaged over the other (year). Testing for non-additivity in the present research is facilitated by the means of Tukey's test (Hays, 1994, pp. 564-565). The value of this test indicates that a significant interaction effect between years and sectors is present.

Table 3.3. Analysis of variance of net entry rates in Greek manufacturing by years and sectors

Source of Variation	Sum of Squares	DF	Mean Square	F	Significance of F
YEARS	0.049	9	0.005	3.139	0.002
SECTORS	0.037	19	0.002	1.125	0.330
Explained	0.086	28	0.003	1.772	0.014
Non-additivity	0.114	1	0.114	Tukey's F[†]	
Remainder	0.182	170	0.001	106.331	0.000
Total	0.381	199	0.002		

[†] Tukey's F = MS nonaditivity / MS remainder

Ranks of the net entry rate by sector for each of the study years, as in Table 3.4, further demonstrates that there is no stability within the ranking of the sectors from one year to another. For example, the paper industry at the start was ranked second, but only reached number thirteen by the end of the period. Similarly, the miscellaneous industries sector found itself ranked first at the start, but only seventeenth by the end. Some other

[46] The term Type-I error refers to the rejection of a hypothesis when it is actually true.

industries, however, produced considerable gains in rank by the end of the period. Rubber and plastics, printing and publishing, non-metallic mineral products, and machinery were industries that improved their positioning by the end of the period, having travelled around different rank positions over time.

Conversely, some sectors like food, beverages, tobacco, petroleum and coal, basic metal industries, electrical machinery, textiles and footwear achieved rank positions close to their initial ones by the end of the period. Spearman's rank correlation for yearly rank distributions[47] show that the ranks from year to year are almost completely uncorrelated and overall this indicates that autoregressive effects are unlikely.

Table 3.4. Yearly ranking of net entry rates in Greek manufacturing by sectors

	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	90-91
Food	7	4	1	17	10	11	12	17	8	7
Beverage	11	12	2	9	16	13	18	7	9	11
Tobacco	19	18	9	10	19	2	10	18	17	18
Textiles	16	14	12	11	5	17	16	11	18	14
Footwear & sewing of fabric	12	2	5	7	7	7	3	10	2	15
Wood & Cork	5	7	15	13	6	19	13	4	4	6
Furniture	6	5	11	5	9	4	5	6	13	8
Paper	2	19	1	2	4	5	10	2	10	13
Printing & publishing	10	13	9	20	2	16	6	14	6	5
Leather & fur	8	1	6	3	11	8	4	16	15	2
Rubber & plastics	17	16	16	8	12	9	17	12	3	4
Chemical	4	10	13	12	14	6	14	5	12	1
Petroleum & coal	3	17	4	15	18	3	1	15	10	4
Non metallic & mineral	9	6	3	19	13	12	9	9	5	3
Basic metal	3	17	9	1	17	1	19	5	1	4
Fabricated metal (non-machinery)	15	8	14	6	1	18	11	3	7	12
Machinery	14	3	7	4	8	12	7	13	14	9
Electrical machinery	18	9	9	18	4	14	15	8	16	16
Transport equipment	13	11	17	14	3	15	8	1	11	10
Miscellaneous industries	1	15	8	16	15	10	2	5	10	17

Measures of net entry rate, absolute net entry rate, net entry and absolute net entry have also been derived and the averages for the decade ranked. Absolute measures, where the sign of the variable is ignored, tend give a clear indication of the most active sectors[48]. By the end of the period the more active sectors (absolute values of either net exit or net entry) in terms of numbers of firms were found to be textiles, footwear and sewing of fabric, fabricated metal products except machinery, wood and cork, furniture and fixtures,

[47] See table A.1 in the appendix.

[48] See table A.2 in the appendix.

electrical machinery, apparatus appliances and supply. In two earlier studies, Giannitsis (1985, 1988), using a somewhat different definition of net entry found that the five most active sectors in the period 1978-1984 were the same as for the earlier 1969-1978 period. These were those of transport equipment, footwear and sewing of fabric, fabricated metal products except machinery, food, and wood and cork. Three out of five sectors were then the same as for this research.

3.3. Some potential determinants of net entry (exit)

Some attempts are made next to hypothesise relationships that might account for the net entry of firms into Greek manufacturing between 1982 and 1991. Two types of determinants of the net entry rate are employed. Macroeconomic variables, such as the rate of growth of real GDP, the cost of capital, and the unemployment rate have the rationale that, to the extent that temporal variation occurs, this could be the result of sectorally independent influences of wider movements in the economy. Industry or sector-specific variables are also deployed in the anticipation that they could be associated with the net entry performance. The inclusion of such variables can be justified for three reasons. First, it should be recognised that the two techniques of regression and analysis of variance are not the same in that statistical inference is based on a conditional mean in the case of the former and an unconditional mean in the case of the latter. Second, the analysis of variance, previously reported on, does indicate a lack of sectoral variation in the data, but there do seem also to be interaction effects between the cross-sectional and time-series units. Interaction effects issue a warning signal that effects attributed to a factor (years) are best qualified by also specifying the level of the other factor (sectors). Third, industry-specific variables employed here can, of course, at the same time present temporal as well as sectoral variation.

Highfield and Smiley (1987) addressed the question of the type of business climate that leads to a greater increase in the rate of formation of new firms. They provide two macroeconomic scenarios relevant to increasing new firm start-ups. The first is based on the rather naive assumption that the individuals starting up new businesses take into account the prevailing macroeconomic conditions and expect these conditions to persist. According to this scenario, usefully characterised as driven by a kind of 'pull' hypothesis, high rates of growth of real GNP, lower real interest rates, high inflation rates, high new plant and equipment expenditure growth and decreases in the unemployment rate favour higher rates in new firm start-ups.

The alternative scenario is an 'opportunistic' one. Here, decreasing rates relating to expenditures on new plant and equipment may present opportunity for newcomers by reducing entry barriers that have to be met and overcome. Additionally, an increasing unemployment rate may be interpreted by potential entrepreneurs as an opportunity of attracting better quality, and lower cost labour. Or, it could also mean, in a labour market context, that during a period of increasing unemployment, individuals are 'pushed' into undertaking entrepreneurial initiatives as a result of the fear of becoming unemployed (Storey and Jones 1987, Storey 1991). This theorisation concerning the role of unemployment must necessarily be associated more with small firms. In addition, lower rates of growth in real GNP, lower rates of inflation, and high real interest rates could, according to Highfield and Smiley, also lead to an increase in the rate of new firm formation. They concluded that for the US economy, at that time, the second scenario reflects more what actually prevails in practice.

In contrast a number of more recent empirical studies in various country contexts revealed that entry is pro-cyclical in relation to economic growth. These refer to Japan (Yamawaki, 1991), USA (Audretsch and Acs, 1994), Germany (Wagner, 1994) and Portugal (Mata, 1996)[49]. The evidence provided seems to point to a positive effect of gross national or gross domestic product growth (GNP, GDP), a positive effect of unemployment and some negative influence of higher interest rates especially on entry of small firms (Audretsch and Acs, 1994; Mata, 1996). With the notable exception of Yamawaki (1991), all other studies have relied on gross entry definitions of the dependent variable.

It could be argued here that when a combination of cross section and time series data are used in explaining patterns of a net entry measure, the interpretation of whatever results follow should be treated with caution. What the above implies is analysed in the following examples. The first refers to what might be termed a 'recession push'

[49] These studies have been reviewed in section 2.5.3.

hypothesis[50]. Under this hypothesis, lower growth rates of real GNP could lead to an increasing level of new firm formation. It might be anticipated that lower GNP growth should be accompanied by an increasing entry figure when gross entry is used. Thus, there is negative relation between the gross entry rate and lower GNP growth rates.

The question, however, is whether the same negative relation is evident when this explanatory variable has to deal with exit figures. Since there is little, logically, to justify that exit should be obstructed in the case of recession, it should be assumed that there is also a negative relation between exit and lower GNP growth. Thus, it can be deduced that under a 'push' theorisation the sign of the relation holds for both cases — entry and exit.

What might be expected in practice is that recession leads to higher firm turnover — higher levels of both births as well as deaths (entry plus exit). This, in turn, results in higher volatility in the net entry measure providing the base for a higher degree of displacement effect. It can be shown that both the cases of negative and positive net entry can exist under the 'push' hypothesis here modified to encompass also exit. In Figure 3.2, if the relation of entry with GNP is steeper than the relation of exit with GNP, then it follows that net entry rates become a negative function of increasing GNP rates.

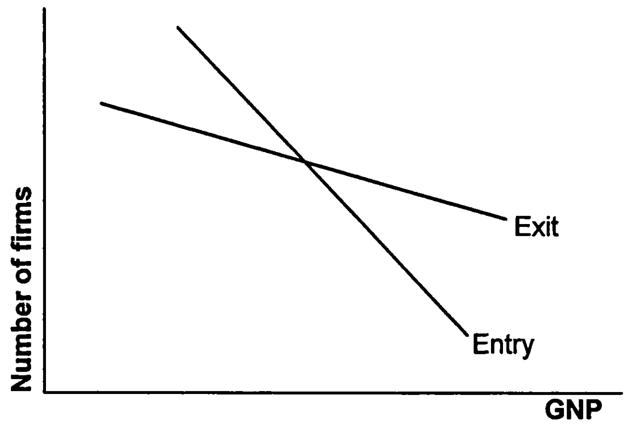

Figure 3.2. Hypothetical relationship between firm entry and exit with levels of GNP where entry is more elastic than exit

But when exit is steeper than entry, net entry rates become a positive function of GNP rates and this may be called a 'pseudo-pull' since net entry rates become higher with higher GNP growth rates (Figure 3.3).

[50] Since both the 'pull' and 'push' hypotheses, as originally stated, referred to gross entry measures, they Continued...

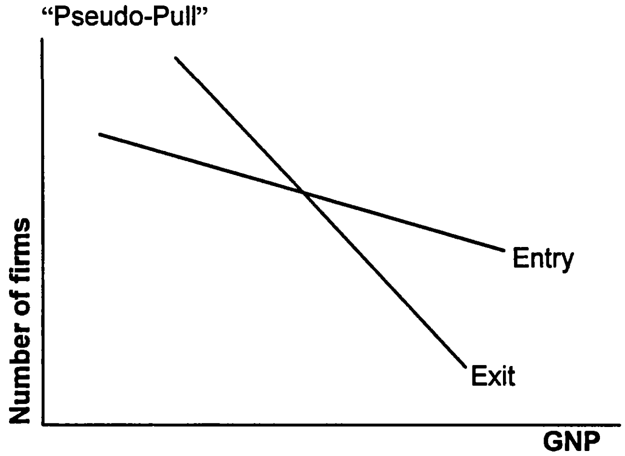

Figure 3.3. Hypothetical relationship between firm entry and exit with levels of GNP where exit is more elastic than entry

What happens logically, then, under a 'push' theorisation is dependent on the values of the relative entry and exit elasticity in response to GNP rates. As far as the alternative hypothesis is concerned, it could be said that higher growth rates of GNP 'pull' individuals to establish their own firms. Under this hypothesis, it is clear that the relation to be expected between GNP growth and entry rates is positive. The important question here, however, is whether the relationship between higher GNP growth rates and exit rates can be positive as well. An intuitive answer to this question indicates that since there is no reason why exit should be facilitated in times of recovery or fast growth, the relationship between exit and ameliorating economic conditions should be far from positive. The rationale behind such an answer is that if firms are 'pulled' into markets they enjoy greater probability of continuing their operations within these markets under favourable economic conditions.

This reasoning ignores, however, the possibility that the process of increasing entry under the 'pull' hypothesis can itself create a tendency towards increased exit. This is because even an expanding economy has finite ability to accommodate new entrants and there should be a point beyond which the increasing supply of firms is not digested by the markets. Furthermore, the existence of this surplus may in turn result in the initiation of exit which may be, in volume terms, far more than otherwise should be. In addition, to the extent that entry and exit from the markets is a selective process determining survivors and losers, it could be that the existence of surplus in the supply of firms during recovery

need to be modified to accommodate the outcome of exit as well.

has the potential to give way to replacement effects as well. So, under a modified 'pull' theorisation both symmetry and asymmetry in the relationship between entry and exit and economic growth can be found. The 'pull' hypothesis under asymmetry is shown in Figure 3.4 where increasing net entry rates or decreasing net exit rates are related to higher GNP.

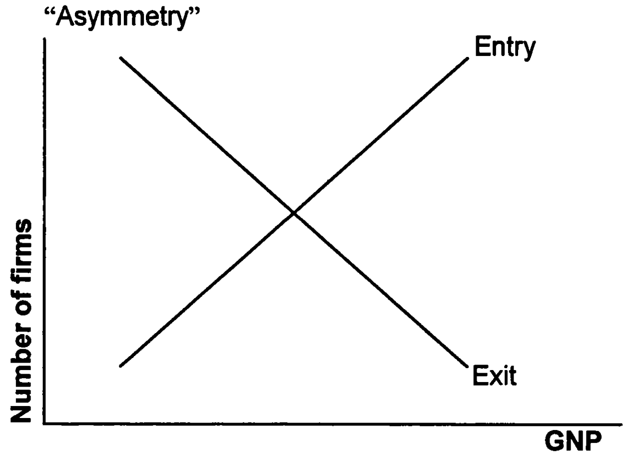

Figure 3.4. Hypothetical relationship between entry and exit with GNP under condition of asymmetry

The opposite is the case when allowance for the existence of symmetry is assumed. In Figure 3.5 when entry and exit are both positive functions of higher GNP growth rates, and the relationship with GNP for exit is steeper than for entry, higher rates of GNP growth are accompanied by lower net entry rates and higher exit rates. Since there may be a surplus in the supply of firms, entry is less elastic in response to higher GNP rates than exit. This might be usefully termed 'pseudo-push' in that lower GNP rates are related to higher net entry rates.

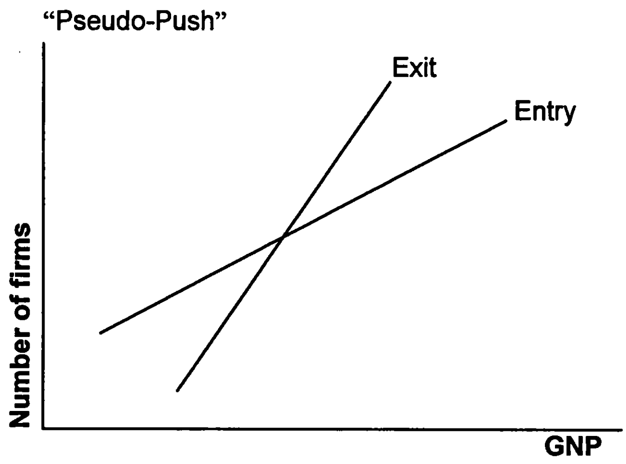

Figure 3.5. Hypothetical relationship between firm entry and exit with GNP under condition of symmetry where exit is more elastic than entry to changes in GNP

A second case under symmetry and within the limits of the 'push' hypothesis could reflect a situation where the entry relation is steeper than for exit (Figure 3.6). Entry is more elastic in responding to recovery than exit and the system is more accommodating of new firms than previously. Therefore, given the ameliorating economic conditions, net entry rates become higher. It can be seen that the results obtained when entry rates are used under this latter variant of the symmetry hypothesis are identical to those of the asymmetry hypothesis.

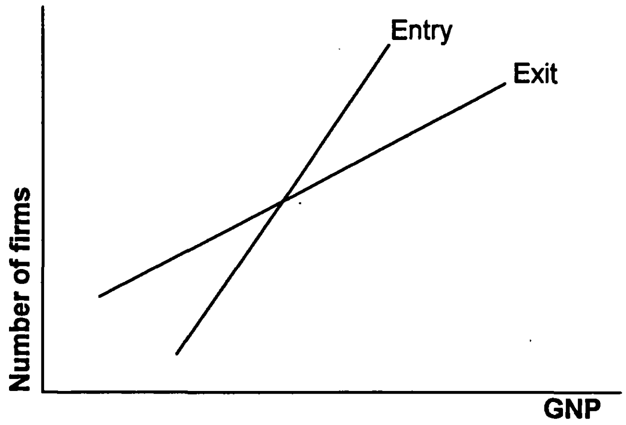

Figure 3.6. Hypothetical relationship between firm entry and exit with GNP under condition of symmetry where entry is more elastic than exit to changes in GNP

The adoption of a symmetry approach has the advantage of taking account of entry as a cause of exit also allowing for a limited capacity of accommodating potential entrants. The latter can additionally explain the case when expansion in the economy is absorbed by increasing capacity of incumbent firms, which can be seen as a form of unmeasured entry.

When the entry curve is steeper than that for exit, this does not mean that the system has an unlimited capacity to accommodate new entrants. Instead it means that for the given stage of economic growth, for a given degree of industrial saturation of the existing industrial mix, the system is still flexible enough to allow for entry elasticity higher than that of exit. Here the supply of firms is unrestricted by the limit determined by factors such as those presented above. When, however, this supply exceeds the tolerance limits of the system, then entry becomes less elastic than exit, leading to lower net entry rates. As the net entry rates decrease, but the economy is still on its way to recovery, new room is made for entrants, entry becomes more elastic and entry rates increase until the point where over optimistic reactions of potential entrants may create oversupply, which in turn readjusts the relations of the relative elasticity of entry and exit.

Although the 'pull' and 'push' hypotheses appear to be controversial, they seem to apply to real world conditions. There is no reason to assume that once one has been proved to hold, this will continue to hold forever and for all the economic players involved. Much depends on the point of the economic cycle an economy is at, what the past has brought, and what the future holds.

The macroeconomic variables deployed are the growth rates of real GDP (RGDPGR), and the price index of investment goods (PINVR). The first captures conditions of the overall state of the economy and demand fluctuations, whereas the second reflects the cost of capital. The rationale behind the introduction of a cost of capital component as a determinant of entry rates is justified because entry usually is also an investment decision. The higher the cost of capital the lower should be the entry rate.

Yamawaki (1991) included, as a second component of the cost of capital, the discount rate of the central bank. In the Greek case this was, during the study period, stable enough not to offer much scope. An alternative was lending rates, which varied more from year to year. However, because of collinearity between the growth rate of the price index of investment goods and the lending rate, the latter was excluded as it produced inferior results.

Unemployment rates, both in-phase and lagged one year, were also used in the calibrations. There were indications that unemployment was positively related to net entry, as in other studies, but the results here were not significant. In addition there were clear problems of severe collinearity with other macroeconomic variables used and as a result the unemployment indicators were excluded from the analysis.

A number of industry-specific variables were also employed. Some refer to sectoral growth and opportunity. Industry growth in terms of employment (EMPLGR) can be thought of as a factor inducing entry in that as the market size increases any entry activity has a greater possibility to go unnoticed by incumbent firms. In this sense, industry growth seems to make room for potential entrants. The price-cost margin (PCM), a proxy for sectoral profitability and defined here as value-added from manufacturing activity minus payroll over sales, is generally expected to be positively associated with net entry rates. It is possible, however, to obtain a negative sign in cases where higher price-cost margins reflect a situation where industry profitability is attributed to high entry barriers (Duetsch, 1975) and/or in industries which are characterised by significant sunk costs (Kessides, 1991). This 'counterintuitive' result has emerged in some previous empirical studies as demonstrated in the previous chapter[51]. Thus, PCM should be seen in conjunction with the effectiveness of barriers to entry. When PCM is high, and both entry and exit are high, this could mean that there are low barriers to entry and exit and what industry experiences in practice is 'hit and run' entry. The latter offers support for the existence of contestable markets. But when both low entry and exit accompany a high PCM, barriers to entry might be high making entry unattractive and exit deterred.

Since a net entry definition is used in this study, it will be worthwhile to see the possible outcomes of the relationship between PCM and net entry rates under both symmetry and asymmetry assumptions. Under the latter, entry is positively related to PCM while the relation between the number of exiting firms and PCM is negative. Thus, it is expected that, to the extent that the asymmetry assumption holds in practice, net entry rates should be a positive function of higher PCM values.

When symmetry is assumed, that is, both entry and exit are positive functions of PCM, then two sub-cases may emerge. When entry is less elastic than exit in response to higher PCM values, the relation between net entry rates and PCM should be negative. Figure 3.5 is helpful in this case (replacing GNP on the horizontal axis by PCM). As a result, although PCM induces entry it does so to a lesser degree than it does for exit. Potential entrants find it difficult to be accommodated in industries where other factors deterring entry become more significant than higher PCM values, or other factors inducing entry. If there is surplus of firms attempting entry, they cannot all be absorbed by an industry, even where barriers to entry are low. The existence of surplus can, in turn, also lead to the replacement of less efficient firms by more efficient ones, overall increasing exit.

The converse is when, under the symmetry assumption, entry is more elastic than exit to changes in PCM and the relation between net entry rates and PCM is positive. This

[51] See review of related evidence in section 2.3.1

means that PCM, as a factor inducing entry, is more effective than others inducing exit and that the particular industry is not yet saturated. Figure 3.6 is illustrative of this case having changed the explanatory variable to PCM. Both the asymmetry hypothesis, and the latter case of a symmetry assumption with a steeper entry curve, result in higher net entry rates. But when entry rates become lower, given increases in PCM, then inference can be made for the existence of symmetry, even when a net entry definition is used. It should be noted that the PCM variable used in this study was taken in logarithmic form (LPCM).

As an entry barrier, the concept of economies of scale in production was represented by the cost disadvantage ratio (CDR). This was defined as value-added per employee in the largest size class available (>100 employees) divided by that in the smallest (10-19 employees). The CDR is usually defined as the average-value added per employee in plants which provide the top 50% percent of industry output, over the average value-added per employee in plants supplying the bottom 50% of the industry output.

The definition used here was dictated by data availability and justified because the highest size class does consistently provide more than the 50% of industry output in all sectors in all study years. The greater the value of CDR, the greater the difficulty potential entrants meet establishing units in the lowest size class and the more difficult is the exit of firms belonging to highest size class if the symmetry assumption holds. The existence of cost advantages favouring larger firm sizes can be, in turn, attributed to the existence of economies of scale in production.

The interpretation of the signs of the relationships between CDR and net entry rates is again susceptible as to whether CDR as a barrier to entry is symmetrical, or not, against both entry and exit. Under asymmetry, higher values of CDR result in lower entry rates and in higher exit rates when there is a low degree of 'sunkness' in costs to achieve production economies of scale. Under asymmetry, it follows that net entry rates become lower as the cost advantages of operating at higher production scales increase. This is shown in Figure 3.7.

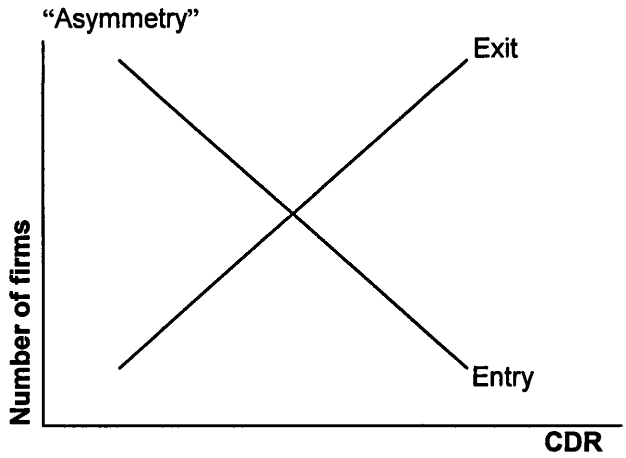

Figure 3.7. Hypothetical relationship between firm entry and exit with CDR under condition of symmetry where entry is more elastic than exit to changes in CDR

When symmetry holds two cases may emerge. The first refers to a situation where entry is less elastic than exit in response to increasing cost advantages by higher levels of production scale. This means that, although economies of scale are a significant barrier to both entry and exit, the variable becomes more powerful when it deals with exit. Higher net entry rates in that case should be attributed to lower exit rates rather than to higher entry rates. Figure 3.3 can be used to illustrate this case substituting CDR. When entry becomes steeper than exit, economies of scale are still a significant barrier to both entry and exit, but this time are more important on the entry side. Net entry rates become lower as economies of scale become more beneficial to size. These lower net entry rates, however, should be now attributed to lower entry rates. Figure 3.2 is helpful here again substituting CDR.

Different outcomes under the symmetry assumption are possible when the net entry measure is used, and these clearly beg the question about the quality of entry and exit. Thus, under the first symmetry case, firms entering an industry are likely to be efficient enough to overcome entry barriers. This means that the firms are of larger size and/or are more productive than usual. Given the second symmetry assumption, however, there are likely to be more under-qualified potential entrants from which the final survivors are selected. The overwhelming majority cannot deliver the requirements of successful entry.

The relationships between other factors affecting entry and exit and net entry rates could be considered in the same vein but space does not permit. Capital requirements for entry were proxied as the ratio of sectoral fuel and energy consumption in monetary values to industry employment over the ratio of the fuel and energy consumption of the total manufacturing to total manufacturing employment (KR). This imperfect measure of capital intensity have been used with some success elsewhere (Shapiro and Khemani, 1987; Droucopoulos and Thomadakis, 1993; Thomadakis and Droucopoulos 1996) based on the rationale that higher consumption of fuel and energy implies a higher degree of mechanisation and, hence, higher use of capital. Capital requirements are thought to present a barrier to entry and under the symmetry hypothesis also an exit barrier.

Product differentiation as an entry barrier was proxied by the sum of advertising, research and trademark-related expenditures over sales (ARDT). Since the NSSG provides a research expenditure figure for each sector that includes both product research and market research, this was preferred as it summarises different aspects of the product differentiation effort (Thomadakis and Droucopoulos, 1996). A high ratio is usually expected to create a disadvantage for potential entrants unless higher advertising outlays serve more as a means of informing buyers about the entry of new products in the market rather than as an entry barrier due to sunk costs that they involve and/or consumers' loyalty in favour of incumbents that they create (Kessides 1986, 1991). Net entry studies provide empirical evidence that supports the ambiguity of the advertising effect. It has often been found that advertising intensity does not result in lower net entry rates (Duetsch, 1984; Geroski and Masson, 1987). Sometimes it is said to lower net entry rates (Duetsch, 1975; Jeong and Masson 1991; Rosenbaum, 1993). Other times it has been found to be beneficial to net entry rates (Gorecki, 1975; Kessides, 1986, 1991). Siegfried and Evans (1994) when comparing advertising results between gross and net entry studies, suggest that if in gross entry studies advertising appears to deter entry, then this can be reconciled with ambiguous net entry results in that advertising can deter also exit.

Following Sleuwaegen and Dehandschutter (1991) and Anagnostaki and Louri (1995a), the effects of trade conditions for each sector on firm entry were examined. Greece is an open economy, especially after EU accession. Import penetration should deter entry, unless increasing import penetration widens the domestic market, increasing the number of units and reducing collusive reaction of incumbent firms to domestic entry. Import penetration (IMP) is defined as the value of imports over the apparent consumption. Export orientation (EXP) is related to greater opportunities to satisfy demand beyond the given domestic limits, thus encouraging entrants. It is defined as the ratio of sectoral exports to sales.

All industry variable definitions utilise published and unpublished data resulting from the annual industrial surveys conducted by the NSSG for the years 1981-1991. For the RGDPGR and PINVR, and IMP and EXP the data sources were the statistical annex of European Economy and Macro-economic Series published by the Bank of Greece respectively.

3.4. Model estimation and results

Since this research deals with both cross-section and time-series data, the regression modelling disturbance terms could be both heteroscedastic, usually the case with cross-sectional data, and autocorrelated, often evident in time-series models. To overcome these problems, a cross-sectionally heteroscedastic and time-wise autoregressive type of econometric model put forward by Kmenta[52] (1986, pp. 618-622) was adopted. The econometric specification assumes heteroscedasticity, cross sectional independence and autocorrelation in the residuals.

$$E(\varepsilon_{it}^2) = \sigma_i^2 \text{, cross-sectionally heteroscedastic} \quad (3.1)$$

$$\varepsilon_{it} = \rho_i \varepsilon_{i,t-1} + v_{it} \text{, first order autocorrelation (AR1)}^{53} \quad (3.2)$$

where ε_{it} refer to pooled OLS residuals for the i=1,...,N cross-sections and t=1,...,T time periods.

52 The econometric model applied here deviates from the cross-sectionally heteroscedastic and time-autoregressive model described by Kmenta (1986) in that when calculating the components of the diagonals of the variance-covariance matrix, instead of using the formulation 12.37 (ibid.), the formulation proposed by Fomby *et al.* (1984) equation 15.2.7 was preferred. See also Greene (1993) equation 16.8 for i=j.

53 This formulation implies that a different parameter (rho) for each industrial sector was used to account for autocorrelation. This was done using partitions of pooled OLS residuals to calculate the autocorrelation parameters and then applying a Prais-Winsten transformation on the model (see Greene, 1993, pp. 457-458). Some econometricians object to the use of different autocorrelation parameters when the time series for each cross-sectional unit is relatively short (see Judge *et al.* 1988). In the present case different rho were preferred to the extent that these vary considerably across sectors and a common rho practice may have obscured these differences. Besides, the main objection to use of cross-section specific rho seems to apply more when contemporaneous correlation is also introduced in the variance-covariance matrix. See also next chapter.

The results of the estimation are presented in Table 3.5. Equation (1) represents a version of the model where only those independent variables that are uncorrelated with each other are included. Equation (2) includes a wider range of explanatory variables that sometimes are modestly inter-correlated. This specification is that used for the commentary which is to follow. Equation (3) is similar to (2) excluding the product differentiation variable which was not significant in equation (2) and when absent from equation (3) does not affect the results, indicating the effects of collinearity are not particularly serious[54]. Finally, equation (4) experiments with lagged structures in a number of variables and this is a point the discussion will return to. As a competitive model, the panel nature of the data used for the estimation of these equations would allow the introduction of industry-specific fixed effects (Hsiao, 1986). This taking the form of industry-specific intercepts would, in turn, incorporate information for a form of cross sectional heterogeneity. However, performing an $F_{(19,175)}$ test between the restricted and the unrestricted (fixed effects inclusive) model (Judge *et al.*, 1988, p. 475) pertaining to equation (1), yields a value of 1.46 indicating the absence of cross-sectional heterogeneity of this form, echoing earlier ANOVA findings[55]. Heterogeneity of variance across cross-sectional units (sector-wise heteroscedasticity) was tested by means of a Lagrange multiplier (LM) test (Greene, 1993, p. 450). The values of this test for formulations appearing in Table 3.5 being higher than a critical χ^2 value for 20 (equation 1) and 19 (equations 2,3,4) degrees of freedom at the 1% level of significance suggests evidence for the existence of significant sector-wise heteroscedasticity[56]. The method of estimation is generalised least squares (GLS) and, as a measure of goodness of fit, an R^2 based on a formulation proposed by Buse (1973) has been utilised. The shortcomings of using some goodness of fit measures in the GLS estimation context are well known, the most obvious

[54] In addition in all cases the determinant of the correlation matrix of right hand side variables is reasonably high.

[55] The corresponding value of the test $F_{(18, 143)}$ for equation (4) being 1.40 offers additional supportive evidence.

[56] Baltagi (1986) proposes that a way to choose between the Kmenta and error components structures (see Hsiao, 1986, Baltagi, 1995) is to test whether groupwise heteroscedasticity is removed when the fixed effects are accounted for. In that case, it is argued that the error structure follows that of error-components model assumptions. In the present research there is little difficulty in choosing between alternative error structures as the fixed effects are rejected in the first place and hypothesis testing provides evidence for groupwise-heteroscedastic disturbances.

probably being that the transformed dependent variable is different to the original one. In addition, those goodness of fit measures based on GLS coefficient estimates applied on untransformed variables are not bounded in the unit interval (Greene, 1993, p. 363). Thus, it has been suggested that goodness of fit measures in the GLS estimation framework are *"purely descriptive"* (Greene, 1993, p. 364) and that it might be better *"not to report an R^2 at all than to report an ambiguous number"* (Judge *et al.* 1985, p. 32). The Buse (1973) formulation has the disadvantage that it is not necessarily a decreasing function of the number of regressors (White, 1997, p. 271).

Table 3.5. Results of GLS estimation accounting for net entry rates in Greek manufacturing 1982-1991

	Estimated coefficients (standard errors)			
Variable name	**(1)**	**(2)**	**(3)**	**(4)**
LPCM	-0.010043** (0.005146)	-0.015117*** (0.005686)	-0.015226*** (0.005895)	-0.0117** (0.005811)
CDR	0.0075786*** (0.002758)	0.0088973*** (0.002707)	0.0087517*** (0.002756)	0.009142*** (0.002811)
RGDPGR	-0.003597*** (0.0008401)	-0.0038449*** (0.0008789)	-0.0038615*** (0.0009012)	-0.0041*** (0.000904)
PINVR	-0.17013*** (0.03492)	-0.19105*** (0.03700)	-0.19061*** (0.03800)	-0.21508*** (0.039241)
EMPLGR	0.048041** (0.02095)	0.031826 (0.02303)	0.031538 (0.02362)	0.05681** (0.024625)
ARDT	—	-0.047502 (0.1008)	—	-0.99315*** (0.369201)
KR	—	0.062720* (0.03849)	0.063937* (0.03916)	0.004729 (0.03649)
IMP	—	0.00017175* (0.00009230)	0.00017614* (0.00009534)	0.000647** (0.000348)
EXP	—	-0.00017484 (0.0001615)	-0.00017091 (0.0001657)	-0.00047** (0.000267)
CONSTANT	0.004158 (0.01001)	-0.0083191 (0.01324)	-0.0091942 (0.01362)	0.00884 (0.010626)
LM χ^2	121.83	103.84	104.28	96.59
Buse R^2	24.82	0.2854	0.2850	0.3222
Determinant	0.91	0.62	0.68	
Observations	200	190	190	171

*** Significant at 1% ** Significant at 5% * Significant at 10%
Where IMP and EXP are used the printing and publishing sector was not included since there were no data provided. In formulation (4) one year lag applies to ARDT, IMP, and EXP

In equation 2, the proxy for sectoral profitability (LPCM) was negative and statistically significant signifying that across industries exit is more responsive to alterations in the profitability levels than entry, both being positively associated with higher margins. This seems to reflect a situation where entry barriers are more important than factors inducing entry and/or there is an excessive supply of entrants that cannot fulfil requirements of successful entry in more profitable industries probably because barriers to entry become more significant as barriers to survival (Geroski, 1995). This result can be combined with the sign and the significance level of the cost disadvantage ratio. The CDR was found to be significant and positive pointing to a direct impact on net entry rates. Furthermore, CDR should be a harder barrier to exit than entry. When entry responds successfully to higher PCM values, it is likely to apply only for the more efficient firms.

Capital requirements (KR) were found to be of moderate significance and positive, reinforcing the conclusions drawn above for the relationships between PCM and CDR and net entry rates. Industry growth in terms of employment was found to be positively related to net entry rates in agreement with prior expectations and results in previous studies.

Import penetration proves to be of only moderate significance and positively related to net entry rates. This result confirms earlier findings by Anagnostaki and Louri (1995a), their study using gross entry and exit, finding that import penetration was negatively related to both entry and exit. Moreover, it was found that import penetration appears to be less important as an explanation on the entry side, perhaps referring to the hypothetical situation presented in Figure 3.3 (substituting IMP). In that case both entry and exit are negatively related to higher IMP rates but exit is more elastic than entry. Manufacturing firms in Greece, then, are less discouraged to entry than they are forced to exit under international competition. Conversely, export orientation was of moderate insignificance and negatively related to net entry rates. The hypothetical relationship described in Figure 3.5 seems to match these results (substituting EXP). In this case both entry and exit are positively associated with increasing export orientation, but exit is more elastic than entry. Sectors characterised by a better export performance may attract entry, perhaps reflecting a high number of low quality, uncompetitive firms which may soon contribute to exit. The more firms attempt to enter into export intensive sectors, the more fail to survive, a finding also drawn by Anagnostaki and Louri (1995a).

Product differentiation, as captured by ARDT, was not found to be a significant barrier to either entry or exit. Its negative sign, however, denotes that product differentiation acts in a symmetrical manner, but it might be more important when entry is concerned.

The effect of real GDP growth on net entry rates is significant and negative suggesting that the mixed pattern appearing in Figure 3.1 is dominated by the post 1985 trends. This probably owes much to the considerable amount of variation in net entry rates brought about by the two recessionary peaks of 1986-87 and 1989-90, following the introduction of an austerity program in 1985. The introduction of the austerity program, aiming to control inflation and bound fiscal and trade deficits, appears two years after to have only partially achieved its targets — inflation was down to 15.7% (from 25%), the fiscal deficit was reduced but the trade deficit was still much too high. This was achieved at the expense of both agricultural and manufacturing production, the latter resulting from decreasing demand due to the effect of reductions in real disposable income. Facing lower demand prospects might have a discouraging effect on entry and a direct effect on exit that might, overall, have suppressed net entry rates during the two recessionary years included in the study period. However, in reality this is not really the case. 'Push' factors, such as decreasing manufacturing employment and, most important, decreasing pace of increments in product unit labour costs in 1986-1987, appear to have effectively offset the negative effect of diminishing 'pull' factors leading to an overall increase in net entry rates. In addition, it has been argued that decreasing labour costs resulted in the reversal of decreasing trends in manufacturing profits prior to 1986-1987 (Federation of Greek Industries annual reports). Not coincidentally, the higher real GDP growth recorded between after 1987 and before 1990 has been accompanied with higher inflation, higher labour costs, higher industrial production and also higher, but somewhat lagging behind output, manufacturing employment. This period is one where net entry rates decrease despite the availability of 'pull' factors. The reversal of these trends in the economic environment, and 1989-1990 marking a new upturn in net entry rates, provides some grounds to conclude in favour of the 'push' theorisation, at least concerning the post 1985 period. However, some caution is still required as it has been the general consensus in Greece that during the study period manufacturing has undergone some serious restructuring related to a crisis in profits over the 1980-1987 period and demand fluctuations thereafter. What seems to be important is that higher net entry rates, although they might conveniently attributed to 'push' factors in operation, coincide with lower growth rates in manufacturing production. This, in turn, might carry suggestions that the effect of wider movements in the economy might not be unanimously felt across different sizes of firms, implying that higher net entry rates during recessions might create considerable movement in the lower end of the size distribution of manufacturing firms.

The proxy for capital effects (PINVR) appears to be significant and negative. Lower net entry rates were associated with higher cost of capital conditions, and this conforms to theoretical expectations.

The possible role of time lags in the independent variables was explored by incorporating time lags up to three years in the model. Lagged, adaptive and rational forms of expectations were used to produce a better estimated proxy for perceived profitability in each one of the industries concerned. The results obtained, however, did not confirm these hypotheses. Thus, as for Yamawaki (1991), the PCM values used as the explanatory variable refer to time t and were taken as corresponding to net entry for the period from t-1 to t. Arguably, however, although this time-definition of PCM has been used elsewhere, it does tend to obscure causalities. It is difficult to distinguish between the role of PCM as a cause of entry and the determination of the ex-post level of PCM as the result of entry and exit activity. The entry definition in use here encompasses both entry and exit action. This, coupled with the fact that PCM was negatively related to net entry (exit is more elastic than entry in response to PCM values), means that the selection of PCM values at time t can be justified, arguing that exit is more quickly responding to changes in profit levels than is entry (Shapiro and Khemani, 1987). Time lags were also tried in other independent variables. Among them, one-year lags were found to perform better when applied to the product differentiation, import penetration and export orientation variables and results are given in the fourth column of Table 3.5. The main difference between these results and those of pertaining to formulations 2 and 3 in the same table concern mainly the significance levels of KR and ARDT and EXP. The product differentiation proxy performs better when it is lagged. Export orientation is also improved when lagged. The opposite is, however, the case for the capital-requirements proxy, which becomes highly insignificant. The overall explanatory power of the model is increased at the expense of higher multicollinearity between some of the independent variables. The signs of the relationships, however, seem to hold in all the different model specifications.

3.5. Conclusions

Gross firm entry measures are clearly of the highest value in process terms, but it is argued here that net entry is worthy of study in its own right as it reflects the outcome of the combination of processes. Certainly it need not be interpreted simply as entry as is often the case. Dealing with a net entry definition makes the attempt to model and explain variations in firm entry across industries and over time a difficult task. Different assumptions about the mechanisms behind firms' entry and exit can lead to seemingly identical results when net entry is used. As a result, it has been argued throughout this chapter that great care should be taken in the interpretation of relationships found in the empirical studies. Mention must be made of different hypotheses and their outcomes in order to denote the cases where no straightforward answer can be given about the validity of a particular assumption. Within the limits of this research, a series of different assumptions have been analysed providing indications for the existence of cases where no decision can be made about the adoption of particular hypotheses or the exclusion of others.

Net entry rates in Greek manufacturing industries do appear to be characterised by significant temporal variation but not sectoral variation. The absence of the latter appears to characterise net entry rates in the Greek situation at this time, although in other net entry research contexts sectoral variation has been shown to be present (Yamawaki, 1991). A large number of industrial sectors were found to be by the end of the study period in the same position in net entry rate ranks as they were at the start. This indicates that the benefits of the sectoral policy applied during the study period, aiming to enhance new firm creation in selected sectors, did not result in stable and/or positive net entry patterns in these sectors.

The existence of profitable business opportunities was not shown to be a sufficient condition leading to higher net entry rates. But the existence of cost advantages of operating at larger scales did tend to result in lower exit rates, while at the same time promoting successful entry of perhaps more efficient firms. Industry growth had a positive impact on net entry rates which is in agreement with results of other studies and theoretical expectations.

Cost of capital conditions had a negative impact on entry rates. The overall condition of the economy, as reflected by the real growth of GDP, had a significant negative effect on net entry rates. This may be attributed to a modified 'push' hypothesis where both entry and exit are negative functions of improvements in such conditions.

The results of the present research on import penetration and export orientation tend to agree with those of earlier studies. Export orientation seems to offer some attraction to potential entrants but many entrants might not be qualified to overcome barriers to survival in highly export-oriented sectors. On the other hand, import penetration seems to affect entry less markedly than exit. This may also indicate that over-optimism governs the entrepreneurial initiatives in the case of Greek manufacturing. The model used was not efficient in capturing individual responses to conditions prevailing in manufacturing and the economy in general. This signifies that models of greater flexibility are required for advancement in this area in future research. Furthermore, analyses comparing entry conditions of different size classes across industries over time will also be helpful in enhancing understanding of the causalities of the phenomenon under study. The latter might help to clarify better the findings of this chapter pertaining to the role of wider economic conditions. Net entry rates might to some extent increase due to large firm fragmentation strategies as a response to economic recession and/or superior performance of smaller firms during an economy's downturns. Some research effort in this direction is undertaken in chapter 5.

Chapter 4.

Net entry behaviour in consumer, intermediate and capital goods industries †

4.1. Introduction

A recent review of research on firm entry and exit recognises that entry and exit are highly positively correlated, with net entry rates being but modest fractions of gross entry and exit (Geroski, 1995). Entry and exit are the linked parts of an industry evolution process where large numbers of new entrants may displace large numbers of older firms without markedly changing totals. Entry and exit seem to present significant amounts of sectoral variation, although this does not appear to persist in the long run. It is such sectoral variation, however, which has enabled a number of studies to use panel data to account for unobservable industry heterogeneity in the determinants of entry and exit.

Explorations of entry and exit processes in Greek manufacturing industries has demonstrated that they are positively correlated, that there is some degree of symmetry in their determinants (Anagnostaki and Louri, 1995a), but also as seen in the previous chapter that net entry rates exhibit mainly temporal and not sectoral variation. In Greece, firm entry rates are a story of 'industry homogeneity' for net entry rather than the familiar 'industry heterogeneity' often seen in gross entry and exit. No industries persistently exhibit higher or lower net entry during the 1981-1991 period. Furthermore, the evidence for non-additivity of the error of unconditional analysis of net entry using a two-way-classification analysis of variance, indicates that the two processes are not only positively related but also that net entry values are averaged over the period in a manner that produces similar means. If net entry rates within a sector are unstable in time on the one

† This chapter draws on Fotopoulos, G. and Spence. N., n.d., Net entry behaviour in Greek Manufacturing: consumer, intermediate and capital goods industries, *International Journal of Industrial Organization* (forthcoming — refereeing final revision stage).
Thanks are due to J. Magnus (Centre of Economic Research, Tilburg), J Kmenta (University of Michigan), and two anonymous referees.

hand, and across-industry invariant over time on the other, then it is likely that some kind of process links net entry rates of different sectors in time. Such a process would account for the apparent inter-industry homogeneity of net entry rates over time.

The research in this chapter aims to examine whether or not net entry rates across sectors are contemporaneously correlated. An explanation of inter-industry homogeneity of net entry rates is sought in terms of the existence of significant correlation of net entry rates in time across industries, conditional on barriers to entry and other regressors often employed in such analyses. This will throw more light on a model that deals to a great extent with chance variation.

To undertake this task the determinants of net entry rates of firms in Greek manufacturing industries are examined across three industry groups — consumer, intermediate and capital goods manufacture. This classification serves two aims. The first is pragmatic. Having only ten years of observations of net entry rates, analyses are precluded at the fine sectoral scale of, say, 20 two-digit classes. The econometrics used here require that the number of cross sectional units be less than the number of time series available for each industry, as having more results in a singular variance-covariance matrix (Baltagi, 1986). The second is more purposeful in that it serves to examine whether the determinants of net entry rates are different across the three industry groups.

In previous applied research important differences between two groups, broadly termed consumer and producer goods industries, have been revealed when the determinants of profit margins are examined (Bain, 1956; Domowitz et. al. 1986, 1988, Schumacher, 1991). This provides motivation to analyse the determinants of net entry rates in each of the above three groups because traditional entry models are based on the difference between anticipated profits and the entry forestalling level of profits (conditioned on the height of entry barriers). There is, as yet, no other study into the determinants of net entry using this kind of stratification within the limits of the methodological assumption that there is within-group contemporaneous correlation of net entry rates conditioned on barriers to entry and other potential explanatory variables.

The next section details the industry classification used and points up some descriptive fundamentals of the data. This is followed by details of the modelling of entry and exit attempting to justify the equation choice for net entry. Section 4.4 presents the results of the estimation. The chapter concludes by placing the results in the context of previous research.

4.2. Industry classification and data characteristics

The data used here are net entry of firms into manufacturing industries in Greece between 1981 to 1991. The grouping of the 20 two-digit industrial sectors is based on Hasid (1987). Consumer goods consist of food industries, beverage industries, tobacco, manufacture of textiles, manufacture of footwear, wood and cork industries, furniture and fixtures, leather and fur products, and miscellaneous manufacturing industries (codes 20 to 26, 29 and 39). Intermediate goods include manufacture of paper, printing and publishing, rubber and plastic products, chemical industries, and petroleum and coal refining (codes 27, 28 and 30 to 32)[57]. Producer goods consist of non metallic mineral products, basic metal industries, fabricated metal products except machinery, machinery and appliances except electrical, electrical machinery, apparatus appliances and supply and transport equipment (codes 33-38).

This classification mainly has a technology-based rationale, but the national dependency on foreign supply of manufactures, as well as the openness of the sectors to international competition, can also be seen as auxiliary criteria. Thus, industries belonging to the first group can be thought of as 'traditional,' employing production processes that are less knowledge — and technology — intensive and present relatively low income-elasticity of demand. The second and the third groups involve an enhancement of the degree of complexity of the technology used.

Table 4.1 offers a picture of group differences in relation to a selection of variables that will be employed later in the econometric analysis. Net entry was formulated as $(N_{it} - N_{it-1})/N_{it-1}$ where N represents the number of firms in each sector (i) and t refers to time. This formulation of the net entry rate (NER) was preferred to absolute net entry since the denominator accounts for different industry sizes in terms of numbers of firms in existence. However, it must be born in mind that criticisms presented in the previous

[57] Note that in some of the subsequent analyses the intermediate goods printing and publishing sector (SIC, 28) was omitted because of difficulties in obtaining data for one of the explanatory variables – import penetration.

chapter together with the argument asserting that different assumptions of the mechanism behind firms' entry and exit lead to seemingly identical results when net entry is used apply also in the present research context. The first two sets of columns in Table 4.1 describe the data for net entry rates (NER), along with price cost margins (PCM)[58]. Intermediate goods exhibit the lowest PCM across time while the highest are enjoyed by producer goods. The between-group variation is highly significant and modest temporal variation is also evident. The picture for the NER is completely different. Net entry rates (group averages for each time period) fluctuate markedly in time but there is no statistically significant difference amongst the group means. On the other hand, the NER in many cases amount to less than one percentage point and peak in all industry groups in 1986-1987, when real GDP growth was the lowest for the study period.

Average firm size is different across the three groups with intermediate and producer goods having considerably larger firms in terms of employment. Moreover, it appears that there is highly significant between-group variation in what pertains to average firm size, and temporal variation is also significant at the 5% level of significance. Minimum efficient size (MES) was proxied here using an approach based on Pashigian (1969) utilising a weighted-average measure of the form:

$$M = \sum (A_i / n_i) * (A_i / A) \tag{4.1}$$

For Greek manufacturing industries data are available on an annual basis for size classes defined in terms of employment as follows:

- Stratum 1 consisting of firms employing 10-19 employees,
- Stratum 2 consisting of firms employing 20-29 employees,
- Stratum 3 consisting of firms employing 30-49 employees,
- Stratum 4 consisting of firms employing 50-99 employees and
- Stratum 5 consisting of firms employing 100 employees and over.

[58] See section 3.3 for definition of this variable.

Table 4.1. Descriptive statistics for the consumer (1), intermediate (2) and producer (3) goods industries in Greece 1982-1991.

	NER			PCM			Average Size			MES		
Time period	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
1981-1982	0.29	2.01	-0.30	22.79	17.23	26.06	42.96	65.03	67.96	109.74	173.64	208.30
1982-1983	-0.36	-2.03	-0.43	23.20	16.69	28.93	43.65	65.28	68.61	109.91	178.90	213.54
1983-1984	0.34	1.04	-0.23	23.92	14.04	25.87	43.71	65.71	70.04	112.44	181.64	226.43
1984-1985	-1.15	-0.90	-0.88	23.57	13.16	27.50	43.05	64.64	70.23	111.20	181.65	236.28
1985-1986	-1.72	-2.05	-0.90	25.43	18.41	27.49	43.90	64.97	69.28	110.32	152.33	230.20
1986-1987	3.38	11.55	2.25	25.17	18.49	26.06	40.84	59.73	61.79	119.61	206.73	232.98
1987-1988	0.04	-0.10	-0.44	24.56	18.97	27.20	41.54	59.84	62.06	116.46	210.00	230.75
1988-1989	-1.16	-0.37	-0.03	23.85	18.58	27.50	43.29	63.75	61.01	119.08	225.07	221.18
1989-1990	-0.45	0.38	0.79	25.47	20.04	26.99	42.92	65.12	59.88	113.0	231.61	218.92
1990-1991	-3.08	-0.12	0.97	26.01	22.84	27.68	44.66	60.27	57.11	113.84	208.51	205.62
$F_{time\text{-}wise}(9,18)$		4.41***			2.05*			2.47**			1.198	
$F_{group\text{-}wise}(2,18)$		1.67			93.54***			1483.47***			135.14****	

*** significant at 1% ** significant at 5% * significant at 10%

Since the size classes are defined in terms of employment, Pashigian's approach was operationalised by defining as A_i the total employment of the i-th size class and n_i as the number of firms in the i-th size class. It follows that in this case the average employment size of firms is weighted by the share of employment accounted for by the firms in the i-th size class. Data for sales and/or value-added were also available for each size class, but were not used in calculating the size class shares since the size classes themselves are defined in terms of employment.

Minimum efficient size is also shown to be small for consumer goods compared to the others. Between-group variation is again highly significant, but it is worth noting that when this weighting measure is used for MES, accounting for size distribution of firms, temporal variation does not seem to be in this case of much significance. Differences in MES imply differences in the extent of economies of scale across the three groups.

The other variables used to explore differences across groups and over time have been defined in the fashion described earlier in section 3.3. Table 4.2 shows that, as expected, product differentiation (ARDT) accounts for a smaller proportion of sales for producer goods than for others.

Trade terms are also different across the three groups. Export orientation (EXP) seems to be higher in the 'traditional' sectors of Greece and also reveals no significant temporal variation over the study period. On the other hand, import penetration (IMP) appears to be stronger in its influence for producer goods. Consumer goods industries start comparing with producer goods according to import penetration from 1987 afterwards, whereas the intermediate group persistently lags behind the other two groups in this respect.

Finally, capital requirements (KR) increase from consumer goods via intermediate goods towards the producer goods industries. The between-group variation is again highly significant but the same does not apply to temporal variability.

Overall then, the picture is one of clear-cut differences amongst the three industry groups and that, with the notable exceptions of ARDT and IMP, these hold over time.

Table 4.2. Group descriptive statistics for product differentiation, trade conditions and capital intensity proxies of manufacturing sectors in Greece 1982-1991.

	ARDT			EXP			IMP			KR		
Time period	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
1981-1982	1.10	1.29	0.56	18.45	11.96	13.50	23.34	23.82	32.80	2.39	5.09	8.27
1982-1983	1.14	1.10	0.56	23.26	9.00	14.29	26.54	22.40	34.21	2.41	5.24	8.56
1983-1984	1.28	0.95	0.53	25.70	11.17	15.02	27.79	25.18	35.54	2.38	5.68	8.46
1984-1985	1.52	1.06	0.56	24.25	11.84	14.51	28.36	26.13	37.90	2.34	5.81	8.18
1985-1986	1.27	1.21	0.58	31.08	8.24	14.13	33.18	25.12	39.32	2.35	5.49	7.94
1986-1987	1.47	1.49	0.59	33.96	8.94	14.42	39.70	26.25	41.56	2.22	5.60	7.10
1987-1988	1.52	1.68	0.63	26.03	6.41	13.01	32.82	22.47	41.17	2.10	5.04	6.66
1988-1989	1.83	1.76	0.58	32.71	9.12	17.10	42.86	25.54	48.1	1.89	5.06	5.77
1989-1990	1.67	2.10	0.68	31.26	8.98	18.25	43.08	27.73	51.73	1.90	5.10	5.77
1990-1991	2.05	2.36	0.80	35.57	10.64	19.00	49.00	29.28	53.41	1.86	4.52	5.70
$F_{time\text{-}wise}(9,18)$		4.53***			1.42			6.74***			0.68	
$F_{group\text{-}wise}(2,18)$		52.93***			83.05***			44.39***			30.10***	

*** significant at 1% ** significant at 5% * significant at 10%

4.3. Modelling entry and exit and the specification of a net entry equation

A general model of entry is usually calibrated as a function of the difference between the expected profitability and the level of profits that can be sustained in an industry without attracting entry. The higher this difference is, the higher is the likelihood of entry into that industry. The unobservable expected profits can be captured by current or past industry profitability, usually lagged one year, under the assumption that potential entrants carry rather naive expectations of what the future holds. Difficulties of estimating the expected level of profits have been widely considered in the literature (Geroski, 1991a; 1991c; Geroski *et al.* 1990, Highfield and Smiley, 1987; Mata, 1991). It is generally thought that these naive expectations should be regarded as unsatisfactory since research based on such an assumption has usually only provided insignificant estimates of expected profitability. An alternative angle is based on the assumption of adaptive expectations. This involves obtaining estimates for expected post-entry profitability by regressing current levels of profits or margins on lagged values up to a certain number of lags. Such estimation procedures are determined by data availability (especially time series length), the consistency of the signs of the estimates and their significance levels (Masson and Shaanan, 1982). A more sophisticated version of the adaptive-expectations model is that based on rational expectations (Geroski, 1991c, Jeong and Masson, 1991). This involves using structural variables as factors determining the predicted values of expected profitability alongside the above lagged profitability values. As far as the barrier to entry proxies are concerned, their 'timing' varies in applied work published to date, although it has been recognised that such structural variables are likely not to vary in their effects over the medium run (Geroski, 1983).

An alternative to the limit price modelling, just discussed, is Duetsch's (1975) approach where entry is seen as a function of current profitability, the latter being, in turn, determined as a function of barriers to entry and other factors thought likely to induce entry, such as industry growth and size. Here there is potential to reduce collinearity amongst the regressors. The possibility of interaction between some of the variables representing entry barriers has also been recognised by Geroski *et al.* (1990).

Modelling exit, on the other hand, has been much less developed. What, however, seems to be of fundamental importance and as argued in the previous chapter is the extent of symmetry between the determinants of entry and exit. The role of industry profitability in determining exit of firms has been debated. Whereas Evans and Siegfried (1992) maintain that exit occurs because of expected industry unprofitability, Dunne and Roberts (1991) provide empirical evidence for strong correlation between entry and exit in the presence of high profits, thus suggesting that higher profits can perhaps generate greater turbulence in the markets.

When modelling net entry, however, expectations for good model performance rely heavily on the assumption of symmetry of independent variables when explaining both entry and exit. The complications that arise from the 'mixed' nature of net entry as the combined effect of entry and exit have often been blamed for poor explanatory power of regression results (Duetsch, 1975) and stimulated the discussion that took place in the previous chapter. These complications make the 'timing' of proxies of expected post-entry profitability even more vague. When modelling entry, theory points to the necessity of taking lags to account for expected profitability, or even better, of utilising adaptive or rational expectation estimates. When dealing with exit, however, these devices may not be particularly helpful because perhaps exit is faster in its response to profit conditions than entry (Shapiro and Khemani, 1987; Rosenbaum and Lamort, 1992). On the other hand, the argument that consistently shrinking price cost margins over several years before the occurrence of exit can lead to the decision of exit still has credibility. But it is clear that this rationale does not capture exit in the presence of high industry profits nor does it recognise the distinction between entry as a well thought through and prepared decision and exit as a more or less forced action resisted as much as possible. It is relevant, then, to research analysing multiplant, multiproduct firms and/or diversification-keen multinational firms choosing to exit as matter of strategic decision, which may lead to further diversification into new fields.

In modelling net entry, Duetsch (1975) utilises price cost margins in phase with net entry, and the same is also evident in Yamawaki (1991) and Orr (1974a). The last mentioned study, although restricting net entry rates to positive values, does not utilise lags since both entry rates and profits were measured as three year averages (each calculated over the same three years). In Geroski (1991c), although net entry penetration rates were used as a dependent variable, a rational expectation model was employed to produce estimates for expected profitability. The author expresses some reservations as to whether the decision of exit is well described by such formulations. This, however, is not evident in the Jeong and Masson (1991) study estimating net, as well as gross entry, adopting at the same time the rational expectation solution.

In specifying an estimable net entry equation, the following form is adopted:

$$NER_{it} = f(PCM_{it}, BE_{it}, X_{it}, M_t) \quad (4.2)$$

NER_{it} is the net entry rate between t-1 and t, PCM_{it} is the industry price-cost margin in the same periods as net entry. BE_{it} is a vector containing entry barriers, X_{it} is a vector containing factors generally thought to induce or to deter entry (other than barriers to entry), and M_t is a vector containing macro-economic factors potentially affecting net entry rates.

Taking PCM in phase with net entry rates might make PCM endogenous in the net entry equation. This means that net entry and PCM are co-determined and PCM is correlated with the residuals of the net entry equation, rendering the OLS estimates inconsistent. There are, however, some reservations about the endogeneity of PCM in the present context. PCM is supposed to be determined by, along with other factors, entry-barrier proxies, the latter being used here as elsewhere to explain net entry. Although both PCM and the structural variables often employed to capture entry barriers are quite stable over time, presenting at the same time significant sectoral variation, the same is not evident for net entry rates. For PCM to be endogenous in the net entry equation, net entry rates should present at least some sectoral variation. This would be necessary to identify at least some sectors which persistently exhibit higher or lower than average net entry rates, and associate this persistency with inter-industry differences in PCM, which might or might not be persistent over the short and medium run. The descriptive statistics provided earlier do not provide evidence of this here, and elsewhere findings do not suggest that PCM is either correlated with the residuals in a net entry equation (Rosenbaum, 1993) or determined by net entry rates (Geroski, 1988). Moreover, to test the possible correlation of PCM with the net entry equation residuals seems to require if not the specification of the full-system of structural equations, at least the deployment of valid instrumental variables (Geroski, 1982). Since the list of variables used is rather exhaustive of the data sets available, this research has faced difficulties in supporting instruments that satisfy the condition that these should not directly be included in the entry equation and not be caused by PCM. An alternative that suggests itself would be to impose a year lag on PCM in order to circumvent the problem of possible correlation with the residual term. When this was attempted PCM was found to be insignificant in all formulations but retains its sign.

The entry-barriers vector contains product differentiation (ARDT), capital requirements (KR) and economies of scale proxies. Economies of scale (ES) are proxied here by dividing the estimated MES as defined in the previous section by the total employment in each industry. Then, following Caves *et al.* (1975), a cost disadvantage ratio (CDR), defined as productivity (value-added over employment) in the size classes below MES, over productivity in the size classes above MES, was estimated. Having defined CDR, the economies of scale proxy employed in the regressions (SCALE) is permitted to take on the value of ES when CDR < 0.8 and zero otherwise. This formulation has the advantage of giving credit to the economies of scale proxy only in cases where scale matters.

In previous research several other measures of economies of scale have been suggested. Weiss (1963) suggested as a proxy of minimum efficient plant the size of plant at the midpoint of the output or shipments size distribution. Comanor and Wilson (1967) defined this somewhat differently as the average plant size amongst the largest plants accounting for 50% of industry output. This measure produces estimates that are in excess of the Weiss midpoint. Davies (1980) has criticised both proxies since in all industries 50% of output appears by following these measures to be produced by plants at suboptimal size. Neither of these proxies could be operationalised with accuracy in the present study since the cut-off point is difficult to determine with data available. As a result of using size classes defined in terms of employment, the 50% of industry output cut-off is well within the largest size class in the majority of cases.

Saving (1961), defines MES using what is termed the survivor technique, maintaining that the size of plants which have minimum average cost will be those which will survive in the market place. Hence, it is argued, that what is needed is simply to find the specific size class of plants gaining more of total industry output, indicating that this contains the optimum size. The problem here is that the number of firms in each size class and the temporal variations are not accounted for. Additionally, it does not take into account the problem of declining shares of size classes. Shepherd (1967) has criticised the survivor technique on the grounds that it only indicates the border of optimality and not optimal size *per se*. Here, the use of an employment size dimension instead of one based on output is likely to introduce bias caused by innovation and technological aspects that tend to decrease size of plants in employment terms. Thus, Shepherd (ibid.) maintains that only if innovation is absent or if it maintains constant labour-output ratios, the survivor technique will be unbiased. Apart from these weaknesses, the survivor technique was not applied here since longer time series than those obtainable are required in order to obtain some clues about ranges of optimality. The argument about bias still can most certainly levelled at the proxy used in this research. However, the introduction of CDR, accounting for productivity below and above the estimated MES, may be seen as an effort to alleviate this problem. A last alternative to be discussed is that proposed by Gupta (1981) and Fuss and Gupta (1981) and is based on estimating long average cost curves for each industry before making inference about MES. This technique was deployed mainly due to the unsuitability of data in hand. The interpretation of signs in the relationships between SCALE and entry rates, when a net entry definition is used, is again dependent on SCALE as a barrier to entry being symmetrical or not against both entry and exit and follows the rationale put forward in the previous chapter.

In the vector X_{it}, industry growth from the preceding year in employment terms (EMPLGR), import penetration, and export orientation are also included as determinants of net entry rates. In particular, import penetration (IMP) was thought to deter entry, unless it contributes to the widening of the domestic market, increases the number of players and reduces the collusive reaction of incumbent firms to domestic entry. Export orientation (EXP) is generally thought to enhance opportunities to satisfy demand beyond the given domestic limits, and thus to encourage potential entrants.

Finally, macroeconomic factors are also included to account for the effect of wider movements in the economy on net entry rates. They pertain to real growth in gross domestic product (RDGGR) and the rate of change in the price index of investment goods (PINVR), defined in fashion with that accords that of the earlier research.

4.4. Model estimation and interpretation of results

A Lagrange multiplier test (Breusch and Pagan, 1980)[59] based on a pooled model that combines all the 2-digit sectors indicates that the hypothesis of diagonal variance-covariance matrix should be rejected (λ=622.92 χ^2 with 171 degrees of freedom). This means that there is significant correlation of 2-digit industrial sectors in time, and together with the finding of the absence of significant sectoral variation of net entry rates over the same period provide the motivation for estimation that allows for contemporaneous correlation. However, this is feasible, as explained in an earlier section, only when the industry groups are treated separately satisfying the condition that the number of cross sectional units is less than the number of time series used.

The utilisation of the cross-sectionally correlated and timewise autoregressive model, suggested by Kmenta[60] (1986, pp. 622-625) is appropriate, testing in parallel the hypothesis of fixed effects in estimating the net entry equation defined in the previous section for each of the three industry groups. This model can be seen as a special case of the seemingly unrelated regression model (SUR) presented by Zellner (1962) in that the estimated coefficients are essentially the same across cross sectional units but the model allows for contemporaneous correlation in the variance-covariance structure. That is, the residual relating to different industrial sectors are correlated in time. Thus, the formulations pertaining to assumptions of group-wise heteroscedasticity (3.1) and autocorrelation (3.2) are augmented by the introduction of the additional contemporaneous-correlation assumption formulated as:

$$E(\varepsilon_{it}\varepsilon_{jt}) = \sigma_{ij} \text{ for } i \neq j, \text{ contemporaneous correlation} \qquad (4.3)$$

59 Greene (1993, p.455) suggests that the strictly appropriate basis for computing the correlation is the one using the OLS residuals of a pooled model and this suggestion was followed.

60 Recently Beck and Katz (1995) criticised the use of this particular econometric technique in political science research, claiming that its use when the number of time series available does not significantly outnumber those of cross sectional units, seriously underestimates the coefficient standard errors. As analytical results cannot be derived to explore the small sample properties of the cross-sectionally correlated and timewise autoregressive model, the authors rely on simulation (Monte Carlo) evidence to support their claim. They propose, as an alternative, a generalisation of the White (1980) method for obtaining, consistent with the model-assumptions, standard errors in the case of panel data. However, Keener *et al.* (1991) point out that the White (1980) estimator can be seriously biased in modest sample sizes and some research effort is on its way to rebut the Beck and Katz (1995) claims (personal communication with Jan Kmenta).

where again ε_{it} refer to pooled OLS residuals for the i=1,...,N cross-sections and t=1,...,T time periods.

Although the technique allows for a different autocorrelation parameter to be estimated for each cross-sectional unit, the approach followed here is to restrict the autocorrelation parameter to be the same across all cross sectional units due to short length of time series[61]. The same auto-correlation coefficient is estimated as:

$$\rho = \sum_{i=1}^{N}\sum_{t=2}^{T}\varepsilon_{it}\varepsilon_{i,t-1} \Big/ \sum_{i=1}^{N}\sum_{t=2}^{T}\varepsilon_{i,t-1}^{2} \tag{4.4}$$

Testing for autocorrelation when panel data are used is more troublesome than for the usual time-series case. In fact Bhargava *et al.* (1982) produce a modification of the Durbin-Watson test for the fixed-effects model. Arellano and Bond (1991) also offer some serial correlation diagnostics for dynamic panel data models[62]. However, both diagnostics do not seem to confront the estimation framework adopted here. For this reason this study relies on the autocorrelation coefficient itself and, unless this is of meaningless size, the models are transformed to account for the possible effect of autocorrelation.

Having estimated the common auto-correlation parameter, the model is transformed (Prais-Winsten) and then GLS estimation is applied. Since the assumptions of the model are quite strong and corrections for cross-sectional dependency could affect the estimation results dramatically, it was thought best not to apply the model on an ad-hoc basis, but to carry out all the appropriate tests concerning the model assumptions before proceeding to the suggested model corrections. A Lagrange multiplier test for group-wise heteroscedasticity was undertaken (Greene, 1993). Testing for cross sectional dependency within each of the three sectoral groups was facilitated by the means of the Lagrange multiplier — B-P lambda (Breusch and Pagan, 1980) performed in each case. As the

[61] The addition of the contemporaneous assumption increases considerably the number of auxiliary parameters to be estimated and handled by the econometric model. This would indicate the use of a common autocorrelation parameter as more sensible practice. See Kmenta (1986, p.621) and Judge *et al.* (1988, p. 465) and references therein for further discussion of the point.

[62] That is, a lagged dependent variable is included in the right hand side of the estimated equation.

degree of complexity when compared with estimation in the earlier chapter is now increased, no goodness of fit measure is deliberately provided, meeting criticisms for the ambiguity of such measures mentioned in section 3.4. Table 4.3 describes the results of estimation for the consumer-goods industries.

Table 4.3. Model estimation of net entry of firms in consumer goods industries in Greece, 1981-91

	Estimated Coefficients (standard errors)	
VARIABLE	**equation 1**	**equation 2**
PCM	0.043945***	—
	(0.01415)	
SCALE	-0.97243***	-0.86320***
	(0.094213)	(0.1130)
ARDT	-0.15012***	-0.13526***
	(0.008894)	(0.01474)
KR	-1.0622***	-1.1003***
	(0.1438)	(0.1424)
EMPLGR	0.012181***	0.012984***
	(0.002844)	(0.004457)
PINVR	-0.18989***	-0.18825***
	(0.01351)	(0.01875)
RGDPGR	-0.0036378***	-0.0035395***
	(0.0002747)	(0.00040895)
IMP	0.00011237**	0.000099275*
	(0.00006079)	(0.00006171)
EXP	-0.00036048***	-0.00029902***
	(0.00005824)	(0.00007336)
CONSTANT	0.067159***	0.075464
	(0.007362)	(0.005991)
N of cases.	90	90
Condition index	24.327	15.909
B-P λ	106.2073	105.6879

*** significant at 1% level ** significant at 5% level * significant at 10% level

The cross-sectional homogeneity hypothesis was accepted ($F_{8,78}$ 1.007). This suggests that there are no fixed-effects attributed to unobservable industry traits that should be taken into account. Therefore, the assumptions of the Kmenta model are examined next. The common autocorrelation coefficient was negative but very small (-0.0059) suggesting that autocorrelation does not present a serious problem. Both the assumptions of cross-sectional homoscedasticity and independence were rejected on the grounds of the hypothesis testing results. The Breusch-Pagan Lagrange multiplier test has a value of 106.2 which is well above the critical value of a chi square distribution for 36 degrees of freedom (51.0), leading to the rejection of the hypothesis that there is no cross-sectional dependency. The assumption of cross-sectional homoscedasticity was also rejected when it was tested by the means of a Lagrange multiplier test (χ^2 67.15 with 9 degrees of freedom).

Estimation of equation 1 was undertaken in the presence of moderate to strong multicollinearity. The highest condition index (Belsley *et al.* 1980) was 24.3, which is below the warning cut-off of 30 usually used to identify situations where multicollinearity is severe enough to cause serious problems. However, when a variance decomposition analysis was carried out, the variance proportion of PCM being above 0.5 meant that the estimate of this variable might not be accurate. Other variables were also found to be involved in linear associations. Since PCM was found to be involved in linear relations with other RHS equation variables, estimation was repeated without PCM (Duetsch, 1975). It can be seen that the results are only modestly changed, the main difference being the reduction in the significance level of the import penetration proxy IMP.

As a result, PCM appears to be a positive and significant determinant of the net entry rates. A positive sign probably means that under the symmetry hypothesis both entry and exit are positively related to higher PCM, but entry is more elastic in its response than exit. Nevertheless, the same positive sign for the net entry rate could also be possible under conditions of asymmetry. In this case entry becomes positively related to PCM, whereas exit is negatively associated. Exit can be positively related to PCM to the extent that firms, being attracted by higher margins, attempt to enter into the market at sub-optimal size. These firms are subsequently penalised as many sub-optimal entries are then forced to exit.

In contrast, the economies of scale proxy was found to be negative and significant. This indicates that economies of scale, under the symmetry hypothesis, operate both as a barrier to entry and exit. Exit is less elastic than entry meaning that for marginal increases in the economies of scale barrier across industries, the reduction in the number of firms that exit is lower than its counterpart accounting for the number of firms that enter. The same sign could also be theoretically justified under the asymmetry hypothesis discussed previously. It seems therefore, that scale matters in accounting for net entry rates in consumer goods industries, but no clear-cut interpretation about whether or not the symmetry hypothesis holds can be given.

The variable ARDT was found to be significant and negative as a determinant of net entry rates in the consumer goods industries, indicating that product differentiation creates a barrier to entry. If the symmetry hypothesis is the underlying force generating such an outcome then this might be associated with the existence of sunk costs in product differentiation related expenditures that creates barriers to both entry and exit. However, if a symmetric interpretation framework is preferred, then the combination of entry and exit numbers associated with increases in ARDT is such that entry is more elastic than exit, implying that product differentiation is more effective as an entry rather than as an exit barrier. The factor KR is also significant and negative in the same fashion as the other barriers to entry.

Industry growth, measured in terms of employment, a factor hypothesised to induce entry, was found to be significant and positive. Import penetration also appears to be positively related to net entry, but only of moderate statistical significance. Although this result seems odd it is not unusual, turning up elsewhere and in other studies. This indeed was the empirical outcome in the previous chapter when all the 2-digit (SIC) sectors of Greek manufacturing were considered and related to earlier findings by Anagnostaki and Louri (1995a) who found that import penetration is negatively related to both entry and exit. Interestingly, a positive effect of import penetration on net entry rates was also found in Rosenbaum (1993) study for US manufacturing industries. The conclusion drawn in the previous chapter that manufacturing firms in Greece are less discouraged to enter industries than they are forced to exit them under international competition seems particularly true for the consumer goods industries. This might be so to the extent that especially for Greek consumer goods industries, is often the case that manufacturers are also at the same time the recipients and distributors of imported manufactures, particularly in the clothing and footwear sectors.

Export orientation, on the other hand, appears to be a negative and significant force in explaining net entry rates. The sign of the relationship was also negative in the previous study for manufacturing as a whole. This may indicate that across consumer goods industries those sectors characterised by a better export performance attract entry, but this, in turn, might be characterised by a high number of less qualified firms attempting entry. These, as they fail to deliver the requirements of successful entry, may not last long in the competitive market, and thus soon contribute to exit[63]. The implied positive relationship between gross entry and export orientation also found in Anagnostaki and Louri (1995a) contrasts with the findings for Norwegian manufacturing industries where a significant negative relationship was found between gross entry of various entry-types and export orientation (von der Fehr, 1991).

Finally, the two macro-economic factors employed here both present negative signs and are, at the same time, highly significant. Again, it seems that consumer-goods industries closely resemble the patterns for the total of Greek manufacturing revealed in the previous chapter.

Consider next the analysis of the intermediate goods sector. The hypothesis of industry homogeneity for net entry rates conditional on the RHS variables was again accepted ($F_{3,27}$ 0.627). But there is a suggestion for both negative autocorrelation (estimated ρ is -0.18) and a non-diagonal variance-covariance structure. The Breusch-Pagan test for cross sectional dependency is 12.9 which leads to the marginal rejection of the null hypothesis of no cross sectional dependency at a 5% level of significance. Homoscedasticity was also rejected since the Lagrange multiplier test statistic following a chi square distribution was 15.95 lending it significant at the 1% level for 4 degrees of freedom.

Equation 1 in Table 4.4 refers to an estimation containing all the previously RHS variables. These results render PCM to be negative and significant in determining net entry rates for intermediate industries. Here the interpretation of PCM is susceptible to the role of entry barriers. In other words when PCM are higher, but barriers to entry are also high, entry can be deterred even in the presence of high profits, or, where entry is attempted without fulfilling the requirements of successful entry, to lead to subsequent exit. The possibility of such an outcome has been discussed in Duetsch (1975) and was found to hold in the case of Greek manufacturing as a whole in the previous chapter.

[63] See also Anagnostaki and Louri (1995a).

Table 4.4. Model estimation of net entry of firms in intermediate goods industries in Greece, 1981-91

	Estimated coefficients (standard errors)	
VARIABLE	**equation 1**	**equation 2**
PCM	-0.30543***	—
	(0.07485)	
SCALE	-0.58517***	-0.43370
	(0.2333)	(0.3080)
ARDT	-0.42053**	-0.89901***
	(0.1982)	(0.3287)
KR	0.061034	0.065352
	(0.04642)	(0.08271)
EMPLGR	-0.052711	-0.065566
	(0.04737)	(0.08045)
PINVR	-0.63022***	-0.52779***
	(0.06572)	(0.07741)
RGDPGR	-0.0098292***	-0.0091452***
	(0.001574)	(0.001733)
IMP	0.00022589	0.00020126
	(0.0002924)	(0.0004773)
EXP	0.00067709	0.0022240*
	(0.0008286)	(0.001264)
CONSTANT	0.19084***	0.10588***
	(0.02297)	(0.01498)
N of cases	40	40
V.I.F	5.68	3.63
Condition index	25.56	17.33
B-P λ	12.97	7.12

*** significant at 1% level ** significant at 5% level * significant at 10% level

Economies of scale were found to be a negative influence on net entry rates. This may indicate a case entry being more deterred than exit with marginal increments in scale. The sign of SCALE, when combined with that of PCM, seems to indicate a situation where higher profit margins are to some extent protected by economies of scale barriers. In other words entry in a sub-optimal size class can result in subsequent exit of less qualified incumbents or other recent but sub-optimal entrants. Overall it seems that size matters in determining profitable and successful entry.

The variable ARDT is negatively signed and significant, as was the case for consumer goods. Both the capital requirements (KR) and industry growth proxies (EMPLGR) were not found to significantly determine net entry in the intermediate goods sectors. Export orientation holds a positive sign and appears to be of moderate significance only in the absence of PCM (equation 2), while import penetration was insignificant in both equations. Finally, both PINVR and GDPGR were found to be highly significant, exhibiting negative signs — the same as for consumer goods.

The results of the estimations for regressions for the capital goods industries are given in Table 4.5. Equation 1 provides the results of the estimation when all the available variables are present. Multicollinearity diagnostics reveal that there exists moderate to strong multicollinearity, in particular the higher condition index is 20.6. The smallest characteristic root responding to the above condition index contributes 0.67 and 0.51 to the variance proportions of PCM and EXP respectively, leading to concerns about the efficiency of the estimates obtained from this equation.

Table 4.5. Model estimation of net entry of firms in capital goods industries in Greece, 1981-91

	Estimated coefficients (standard errors)	
VARIABLE	**Equation 1**	**equation 2**
PCM	-0.02343	—
	(0.0309)	
SCALE	0.59334**	0.58156**
	(0.3114)	(0.3140)
ARDT	-0.33598	-0.26266
	(0.2575)	(0.2435)
KR	0.054435	0.031031
	(0.04916)	(0.03882)
EMPLGR	-0.12161***	-0.12059***
	(0.02578)	(0.02621)
PINVR	-0.15328***	-0.16231***
	(0.03731)	(0.0365)
RGDPGR	-0.0021465***	0.0021755***
	(0.0007506)	(0.0007695)
IMP	0.00020333	0.00011259
	(0.0001751)	(0.0001293)
EXP	0.00018504	0.00048289
	(0.0005007)	(0.0003211)
CONSTANT	0.01218	0.0072962
	(0.01526)	(0.01431)
N of cases	60	60
Condition index	20.62	15.35
B-P λ	34.37	34.32

*** significant at 1% level   ** significant at 5% level   * significant at 10% level

As far as the econometric assumptions are concerned, the Lagrange multiplier test generates a value of 34.37, when the critical value for 15 degrees of freedom is 25.0 so leading to the rejection of the null hypothesis that there is no cross sectional dependency. The heteroscedasticity Lagrange multiplier test (58.93) exceeds the critical value for 6 degrees of freedom. providing evidence for heteroscedastic disturbances. The common autocorrelation parameter was estimated to be -0.343, indicating negative autocorrelation. Once more the F-test between the restricted (pooled OLS) and the unrestricted model fails to provide evidence against the null hypothesis of industry homogeneity ($F_{5,45}$ 1.02).

Profit margins possess a negative sign and have an insignificant effect. The negative sign of PCM indicates a case where profits might be protected by entry barriers. The economies of scale proxy (SCALE) was found to be significant and positive in both formulations reinforcing the conclusion drawn above for PCM. That is, for marginal increases in the level of this barrier, the reduction in the number of exiting firms is larger than the corresponding reduction in the numbers of those attempting entry. The same sign also holds for the capital requirements proxy (KR) but this variable is not significant.

On the other hand, product differentiation effort, as summarised by ARDT, does not seem to be of any statistical significance as an entry (exit) barrier, in contrast to the estimation results for both the consumer and intermediate industries.

Industry growth has a negative and significant effect on net entry rates. Industry growth under these circumstances would appear to be being absorbed by expansion of incumbents rather than entry of new firms. Thus, entry should be less elastic than exit in its positive response to industry growth. Import penetration was not found to be an important determinant of net entry rates for this sector and the same applies to export orientation. Finally, the macro variables employed were found to be negative and highly significant following similar results of both the consumer and intermediate goods industries discussed earlier.

Apart from evidence provided by visual inspection of tables 4.3 to 4.5, it should be said that some formal test might be needed to assess whether or not the estimated coefficients of the variables employed are statistically different across the three industry groups. This necessitates the questioning of the 'poolability' of the three groups. To apply a 'poolability' test on these models is not, however, straightforward. On the one hand, the econometric estimation of every single group equation invokes assumptions that entail to the use of a different variance-covariance matrix in each case. On the other, even if the assumptions were entirely uniform, the same structure could not be applied in a model that contains industries of all the groups due to the singularity of the resultant variance-covariance matrix (see section 4.1). Nevertheless some testing might be still possible if the partial variance-covariance matrices used for estimating each of the group equations were combined, resulting in a block diagonal matrix that contains the former matrices in the diagonal and zero values elsewhere. This matrix can then be used to estimate the restricted model that contains all sectors across groups. In this fashion, the singularity problem is avoided since the model still allows for within-group heteroscedasticity and autocorrelation, but restricts contemporaneous correlation to be defined only within each group but not across groups (zero off-diagonal elements in the block diagonal matrix).

To illustrate, this could be presented as $E(\varepsilon_{itr}\varepsilon_{jtr}) = \sigma_{ij}$ for i≠j for same t and r where, r=1,...,3 industrial groupings. The resulting $NT \times NT$ variance-covariance matrix for the restricted model is $\Phi_{restricted} = \begin{bmatrix} \varphi_{consumer} & 0 & 0 \\ 0 & \varphi_{intermedite} & 0 \\ 0 & 0 & \varphi_{producer} \end{bmatrix} \otimes I_T$ where $\varphi_{consumer}$ is the 9 by 9 matrix (before Kronecker multiplication) used for getting the GLS results in Table 4.3, $\varphi_{intermediate}$ is the 4 by 4 matrix used for estimation of the intermediate sectors group (Table 4.4) and $\varphi_{capital}$ is the six by six. matrix used for the last group of industries (Table 4.5), ⊗ stands for the Kronecker product and I_T is an identity matrix of order (T×T).

The results of estimating the restricted model using the above formulation for its variance-covariance structure appear in the appendix since it should be seen more in the light of facilitating the poolability testing rather than providing estimates for all industrial sectors combined together during the study period. Having these results at hand and combining them with those appearing in the first column of tables 4.3 to 4.5, the following Chow-type test was performed for testing the poolability hypothesis:

$$F = \frac{\left[\left(SR - \sum S_r\right)/(m-1)k\right]}{\left[\sum S_i/(n - mk)\right]} \quad (4.5)$$

where m refers to the number of groups, n is the total number of observations of the restricted model, k is number of regressors, and SR and S_r is the sum of squared residuals of the restricted and each of the unrestricted models respectively. The value of the test is highly significant ($F_{20,160}$=15.59) indicating that the hypothesis of inter-group homogeneity should be rejected, and so providing evidence that there are significant differences between the group coefficients estimated independently.

4.5. Conclusions

Net entry rates in Greek manufacturing industries for the 1981-1991 period are characterised by the absence of significant between-industry variation. This can be mainly attributed to the use of a net entry measure rather than to some kind of bias due to the high degree of industry aggregation used. This absence of variation in net entry rates should be regarded a special characteristic of Greek manufacturing industries for the study period selected.

The aim of this chapter was to investigate net entry rates for selected industrial groups whether or not there is cross-sectional dependence in time and to incorporate it in an estimation. In reviewing the data the key finding for consumer and capital goods industries was indeed the presence of a high degree of cross-sectional dependency, but this was not always evident for intermediate goods.

Continuing to compare the results across the three groups, it is clear that in all cases the macroeconomic variables specified were found to negative and highly significant. These findings are in agreement with earlier results and seem to indicate that entry is less discouraged than exit incurred during wider economy downturns, whereas amelioration of economic conditions may significantly reduce the 'push' factor that increases firm generational turnover.

A highly significant determinant of net entry in the case of consumer and intermediate goods industries is PCM, but not for capital goods. Moreover, PCM was in fact found to be positive only in the case of consumer goods, the opposite being the case for intermediate and capital goods sectors where profits appear to be protected by entry barriers and entry seems to be deterred.

Economies of scale appear to be of some significance in all cases providing evidence for their importance as a barrier to entry. Whereas SCALE has a negative sign when consumer and intermediate good industries are considered, it turns out to be positive in the case of capital goods. A possible interpretation is that for marginal increments of scale there is less exit than entry. This implies that attempting entry into sub-optimal size classes decreases from consumer to capital goods producing industries. The proxy for capital requirements related barriers (KR) appear to be significant and negative only for one group — consumer goods. It seems, thus, that in these sectors higher capital requirements result in lower net entry rates. Product differentiation as an entry barrier (ARDT) was found to be a significant determinant of net entry rates only for consumer and intermediate groups, however, it holds a negative sign across all sectors.

Industry growth in employment terms appears to be significant only for consumer and producer goods. It should be mentioned that it is positively related to net entry only in the case of consumer goods. Negative signs for both the intermediate and capital goods sectors may indicate that either industry growth is being absorbed by incumbents or entry, itself, creates effectively exit as industry expands.

Conditions of trade do not have an unequivocal effect in all the three groups. In particular, export orientation was found to be a significant determinant of net entry rates for the consumer industries. Its sign is negative leading to the conclusion that although increased exportability offers an important attraction to potential entrants, it is difficult attain by all those attempting entry. Export orientation does not appear to be a significant determinant of net entry rates when the intermediate and producer goods industries are considered. It does, however, change sign becoming a positive factor.

Import penetration was found to be a significant influence on net entry rates only in the case of consumer goods industries. It has a positive sign which might be interpreted as follows. Import penetration is negatively associated with both entry and exit, the latter being more elastic than entry. This seems to indicate that in the consumer goods industries entry is oriented towards covering market niches not satisfied by imports. In addition, it can also be argued that there is a considerable degree of overlap between domestic manufacturers and distributors of imports, since the last mentioned activity can keep domestic firms in business. This seems logical as the distribution networks are all in place and firms can benefit from the synergy effects of producing and distributing simultaneously. The results concerning trade conditions tend to support earlier findings for manufacturing as a whole in Greece.

Chapter 5.

Accounting for net entry by establishments of varying size †

5.1. Introduction.

There has been increasing recent interest in understanding the determinants of entry and exit of firms according to their size. However, the empirical evidence so far is confined mainly to the advanced industrial world; Mata's (1991) study of Portuguese manufacturing industries is the notable exception. This research does not offer an unequivocal understanding of the determinants of entry (exit) of firms of various sizes. It seems that dealing with size-defined groups of firms within industries often makes the experience gained from studies of size-indifferent entry not particularly helpful.

Conventional modelling of firm entry based on 'limit profits' approaches define the magnitude of barriers to entry using size-indifferent entry measures. It may well be, however, that the perceived height of entry barriers is a notion related to the special characteristics of those who perceive it. Not all types of firms perceive entry barriers in the same way, and maybe firm size is an important distinguishing trait.

Adopting the view that 'size matters' in understanding entry (exit) patterns, the aim of this chapter is to discover the determinants of net entry patterns of various size-defined groups of establishments in the case of a less industrialised country — Greece. The hypothesis to be tested is that proposed by Acs and Audretsch (1989b, p. 468) that *"the determinants of entry are not independent of firm size."*

In this research, data availability constraints force the use of net entry rates which inevitably increases the degree of difficulty in interpretation. However, as in the previous

† This chapter draws on Fotopoulos, G., and Spence, N., *n.d.*, Accounting for Net Entry into Greek Manufacturing by Establishments of Varying Size, *Small Business Economics* (forthcoming — refereed and accepted for publication).
Thanks are due to two anonymous referees.

chapters some effort has been made to deal with net entry as a variable worthy of investigation in its own right, and one which is not treated simply as gross entry.

The next section reviews in some detail the empirical evidence from studies concerned with firm size on entry. Definitional issues and descriptive statistics along with analysis of variance results are given in sections 5.3 and 5.4 respectively. In section five, hypotheses concerning potential determinants of net entry rates are stated. Section 5.6 contains the results of the econometric analysis.

5.2. Current understanding of entry and exit of firms according to size

New firms in an economy have been often treated as homogeneous (Gorecki, 1975). This is certainly an erroneous assumption in that an entry by a large firm can offset the entry of many smaller (Acs and Audretsch, 1989b). However, in the years after Orr's (1974a) seminal work considering entry into Canadian manufacturing industries there have been but only a handful of empirical studies seeking to distinguish between the determinants of firms' entry and exit by size.

Research in industrial economics makes it clear that firms of different size, and especially small firms, should be regarded as a behaviourally distinct group within industries and not as 'scaled down' versions of their larger counterparts (Storey, 1990). Moreover the existence of firms operating at sub-optimal size can be attributed, amongst other things, to superior responsiveness to cyclical fluctuations (Mills and Schumman 1985), to production technologies that are more flexible (Piore and Sabel, 1984; Dosi, 1988; Acs *et al.* 1990), to persuasion of product innovation strategies (Caves and Pugel, 1980), and to a tendency to occupy product niches different from those occupied by larger firms (Pratten, 1991). Additionally, Brown and Medoff (1989) and Brown *et al.* (1990) point out that small firms can be partially compensated for their inherent size disadvantages by adopting lower employment remuneration policies.

White (1982) analyses the question why small firms flourish in some sectors and not in others. His results indicate that small businesses appear to be more important in less capital-intensive industries, those less vertically integrated, and those in fast growing industries serving local markets. Interestingly, advertising intensity was not found to be source of particular disadvantage for small firms, indicating that smaller firms may have found alternative survival strategies. Acs and Audretsch (1990) find that high entry barriers exert a significant and negative influence on small-firm shares, but that small firm innovation as a strategy can be positive. Droucopoulos and Thomadakis (1993) discover that capital intensity appears to be a significant barrier to the presence of small and medium size firms, whereas the relative operating efficiency of small firms is strongly positive and advertising intensity possibly so.

An obvious link between the former studies of entry and exit determinants of different sized firms and the latter considering the presence of firms of different sizes can be established. Since entry and exit to or from an industry can affect the shares of firms of particular size classes within industries, then it is possible to compare, amongst other factors, the performance of barriers to entry in determining entry rates in different size classes with their role determining the relative size classes' performance.

MacDonald (1986) was interested in gross entry and exit determinants in the 'competitive fringe' of some 46 American food industries. The evidence produced reveals that capital intensity presents a significant barrier to the entry of small firms, but where the disadvantage of operating at a smaller scale (in labour productivity terms) is moderated, then entry is encouraged. On the other hand, profitability appears to be an insignificant determinant and even presents a negative sign. Product differentiation also is not a significant entry barrier. But industry growth was found to be a significant inducement of entry. For exit, capital requirements proved a significant exit barrier and industry growth a negative, but insignificant, influence.

Acs and Audretsch (1989a) considered the net entry rates of small firms in 247 US manufacturing industries. Cross-sectional evidence seems to indicate that past industry profits induce entry only in firms employing at least 250 employees and not in the case of the smallest enterprises. Similarly capital intensity deters only when the smallest firms are concerned. Industry growth remains by far the most important inducement to entry. This study also demonstrates that higher industry concentration and R&D intensity strongly deters entry for small firms, but the same is not evident for advertising intensity. What seems, however, to compensate small firms for their inherent size-related disadvantages is the adoption of product innovation strategies. Interestingly, a higher degree of unionisation was found to favour small firm entry. The authors, recognising deficiencies of using net entry rates, later utilised gross entry data in a similar study (1989b). Confirming the net entry results, lagged industry growth appears to be a greater inducement to entry than is lagged profits. Innovation seems, again, to deter smaller firms, but as before, where smaller firms contribute a relatively high share of innovation, the relationship with small firm entry becomes positive. As opposed to the earlier results, however, product differentiation proves a significant entry barrier when considering gross entry. The same is true for concentration, but only for small firms. However, neither capital intensity nor the small-firm cost disadvantage was found to exert much influence.

Mata (1991) provides results for some 73 Portuguese manufacturing sectors that do not support the view that strategic deterrence or aggressive behaviour, proxied by the concentration ratio, comprises an important determinant of entry. Most of the 'conventional' barriers to entry proved to be significant in deterring entry, but only in the case of small firms. Sunk costs' proxies, however, prove a significant barrier only for large-scale entry, which is unsurprising as they were measured by second hand markets for machinery and equipment. Storey and Jones (1987) point out that small-scale entrepreneurs usually enter the market by buying cheap, second-hand equipment. To the extent that past profitability is important, Mata's evidence supports the view that entrants' perception of industry profits does differ by size. This, proxied by lagged profits, appears to matter only when small firm entry was concerned. Exactly the opposite was the case when industry growth was examined and found to be a significant inducement only for large firms. Industry size, on the other hand, had a uniform positive effect in both the size classes and suggests itself as the only common determinant of entry.

The analyses above all deal with entry using cross sectional analysis but Wagner (1994) uses a panel of 29 manufacturing industries for the regions of Lower Saxony. He addresses questions about industry-specific effects by adopting a least squares with dummy variables technique to allow for time-invariant industry characteristics, which may be not captured by the variables employed, and could also be collectively important in determining gross entry rates. The results reveal that small firm entry occurs in industries which are characterised by higher degrees of growth, past profits and concentration in times of higher unemployment and higher interest rates. Both the capital intensity and R&D variables were negative, but the latter was not significant at any conventional level. The introduction of industry-specific dummies to account for time-invariant sectoral effects alters the magnitude of the coefficients and their significance levels but not the signs. Thus, profits, capital intensity and concentration become insignificant while industry growth becomes significant. These results, however, did not hold when alternative robust estimation techniques were used in order to detect and delete the influence extreme cases. Moreover, these results seem also to be affected by the introduction of industry dummies, when both R&D and capital appeared negative and insignificant, industry profits significant and negative, and concentration significant and positive. Wagner favoured the robust estimation techniques, even at the expense of fewer observations, leaving the pooled design unbalanced and susceptible to selectivity bias. He argues that it is the basic pattern that is important in the estimations, leaving 'special cases' or 'idiosyncratic events' to case studies.

The evidence so far does not offer a totally clear picture. Past industry profits do not have an unequivocal effect on small firms, entry barriers are hardly significant and when they become significant this applies to small rather than larger entrants. Industry growth, on the other hand, plays a significant role in determining entry rates, but again it is not universally accepted whether this role is more significant for smaller rather than larger firms. However, with the Portuguese exception, research to date indicates that smaller firms develop different strategies attempting to enter and survive within markets.

By far the most interesting observation is that inference is mainly driven by the insignificance of traditional variables and the focus is more about what does not explain variation in firm entry by size than what does.

5.3. Defining entry by size of entrants

Greek manufacturing data makes available net entry of firms by size, defined by the NSSG in terms of the number of employees and the stratification follows that employed in section 4.2 to facilitate an approximation of MES. As no data exist for establishments employing less than 10 employees, this deprives the analysis from using a size class that is likely to present considerable turbulence (entry plus exit). The data do refer to establishments and not to firms. This could be somewhat problematic since multiplant firms may not behave in the same way as single-plant firms, but most Greek firms are in fact single-plant (Droucopoulos and Thomadakis, 1993).

Since the data refer to the number of establishments in each year only a net entry measure defined for each size class is feasible. However, these size classes do permit a more disaggregated approach since previous studies have either used a sliding cut-off point between small and large firms or just a single one. Apart from the caveats associated with the use of size-independent net entry measures that have been discussed so far, dealing with net entry defined for different size classes imposes certain additional problems. The first is the need to account for different 'industry sizes' as the purpose is to explain differences in net entry rates between industrial sectors. The second is to account for different 'sectoral size-structures' as it is accepted that firms are not uniformly distributed between size classes across industries. Both relate to the choice of appropriate denominator when computing net entry rates. One solution is to divide by the number of firms in existence for the sector as a whole in the base year. Here different sectoral size structures on the right hand side of the equation need to be accounted for. Thus, an indicator of the 'strength' of firm presence in the particular size class should be developed. This is the procedure adopted by Acs and Audretsch (1989a, p264) who make the self-critical point that *"dividing net change in the number of firms for each size class by the number of firms in that size class, rather than the entire industry, would provide a better measure of the impact that entry has had on the existing stock of small firms."* However, they justify their choice by arguing that *"standardising the amount of entry in each size class by the total number of firms in the industry reveals more about the subsequent price and output effects, or the overall industry effects, as a result of entry"* (ibid.).

Both arguments are attractive. In the present study, however, a size-class-specific denominator is preferred for two reasons: first, that when dealing with very small amounts of net entry more observations tend to be closer to zero when a sectoral than a size-class-specific denominator is used, second, that when five different size classes use the same industry specific denominator, net entry rates are artificially increased for those classes presenting higher differences in the numerator.

Thus, the net entry rate (NER) is defined as:

$$NER_{jit} = \frac{N_{jit} - N_{ji\,t-1}}{N_{ji\,t-1}} \tag{5.1}$$

for every j=1,…,5 size classes, where i=1,…,20 two-digit industrial sectors, and t=1,…,9 time periods, (the period 1982-1991 defines only nine net entry rates) and N stands for the number of firms in existence.[64]

The third and probably most important problem associated with this definition is that it cannot be detected if changes in the number of establishments in an industry's size class over time are solely due to net entry into an industry size class or due to inter-size class mobility of already operating establishments. The movement of an establishment from one size class to another will reduce the number in the originating industry size class, and generate an increase in the destination size class. But both the exit from the origin-size class and the entry in the destination-size class are sustained within an industry and do not relate to entry and exit from an industry. If, instead of panel data, a cross-section on a number of industries is used to deal with changes in the number of firms in a size class by industry between two points in time (Acs and Audretsch, 1989a), the problem of unaccounted inter-size class mobility within industry is not avoided. Unless information is used to exclude from the sample those firms moving size class, a cross-sectional analysis of net entry by size class might be even more contaminated by inter-size class mobility within industry. This accentuates the larger the time span between the two points in time and the finer the classification in size classes becomes.

Therefore, the number of establishments in an industry's size class can change as the result of a) entry and exit of establishments from an industry that coincides with entry and exit from a size class in that industry, b) intra-industry but inter-size class mobility and c) a combination of the first two reasons. If the change in the number of

[64] Alternative definitions of net entry rates have been suggested by an anonymous referee. In particular $NER_{jit} = \frac{N_{jit} - N_{ij\,t-1}}{(N_{ijt} + N_{ij\,t-1})/2}$ (bounded by +2 and -2) and $NER_{jit} = \ln\left(N_{jit} / N_{ji\,t-1}\right)$, being symmetrical around zero were thought advantageous. The latter, being asymmetrical around zero, was thought may lead to unusual regression results. In neither the statistical nor the econometric analysis used here did these definitions lead to significantly different results.

establishments in an industry's size class was to be entirely described by the first of the causes then the term net entry might suffice. However, given the nature of the data here the term 'growth' might more accurately describe changes in the number of establishments operating in an industry's size class. Thus, the question really posed in the present research on net entry relates to the determinants of the growth in number of establishments in an industry/size class. In what follows, the term net entry is used for convenience in place of the, perhaps, more appropriate growth rate.

The consequences of unaccounted inter-size class mobility depend much on whether or not the traditional Orr-type model of entry is sufficient. If it is, then the question becomes whether or not entry (exit) barriers can serve as inter-size class mobility barriers as well. Caves and Porter (1977) argue that entry barriers might possibly be incorporated in a more general theory of inter-scale mobility of firms, but they do believe that firms in an industry are likely to differ in traits other than size. It is due to these specific traits that firms resemble each other in shaping groups within an industry. Barriers to entry can then be defined at the group level, not only in terms of protection from potential entry from outside the industry, but also from potential within-industry movers coming from other groups. If size is not over-emphasised at the expense of other firm characteristics then it could be a useful classification tool. Caves and Porter (ibid.) use other than firm size characteristics to define groups within an industry and then assign to these groups differential degrees of entry barriers. Given this, it can be argued that the review of evidence in the second section of this chapter is helpful in asserting that to the extent that different size classes differently experience entry barriers then *ex post* size classes can be treated as industry-groups. This is recognised in the literature of strategic groups as far as *"scale-economy barriers themselves suffice to define groups because they explain why entrants could rationally choose sub-optimal scales when larger firms and lower-cost sellers are present"* (ibid. p. 253). In that scale economies are size-related, this offers enough justification for size as a classification key and for entry barriers to be treated as mobility barriers. Porter (1979) examines the theory of strategic groups by using a size-related measure (size classes accounted for 30% of an industry's sales) to define leaders and followers in an industry and accounting for the differential impact of entry barriers in determining profitability. In Greece, Droucopoulos and Thomadakis

(1993) find considerable differences in the effect of entry barriers when size-class market shares are examined.

Another strand of fast-growing literature — industry demographics — views entry barriers as barriers to survival and growth. This theorisation of entry barriers might be of great assistance in helping to resolve the empirical puzzle where high entry rates coincide with high entry barriers (Geroski, 1995). Furthermore, it can be combined with the notion of entry paths (Caves and Porter, 1977) in explaining not only why many entrants fail shortly after entry, but also why entry at a sub-optimal scale occurs at all.

In short, despite the constraints imposed by the data, it is worthwhile examining the determinants of growth in the number of firms operating in an industry by size class in time across industries.

5.4. Net entry patterns in Greek manufacturing industries by size class

Geroski (1995) maintains that the driving force of variation of entry across industries and time lies in the 'within' rather than 'between' industries variation. This implies that inter-industry structure of entry measures may not be as stable in time as for structural variables often employed to assist inference on the determinants of entry (profitability along with entry barriers).

Fairly unstable inter-industry variation over time on entry has been reported in previous work for the UK (Geroski, 1991a) and Germany (Wagner, 1994). Geroski compares inter-industry correlation coefficients of entry measures, namely gross entry, gross penetration, gross entry rate, net penetration, net entry rate, net penetration across years to conclude that industries do not persistently show high or low entry rates over time. Furthermore, decomposing the variance for each of these variables over 79 three-digit UK industries for the 1975-9 period he finds that the proportion of total variation accounted by industry-driven variation (between industries) was as high as 49% for gross entry penetration and as low as 21% in the case of net entry rates. He concluded that inter-temporal variations in entry may exceed cross-sectional variation. Unfortunately, the author does not provide the relative figures for between-year variation and no direct test as to how significant both the systematic sources of variation (industry, time) are.

However, in all cases, even though inter-temporal variation is said to be the driving force in this study, between-industry variation was always significant when allowance was given for industry-fixed effects in entry autoregressive models. As a consequence, the effect of time-invariant, inter-industry-variable factors is, conditional on other regressors, collectively significant in explaining variation in net entry rates Between-industry variation is probably smaller than inter-temporal variation, but it remains a significant source of variation.

Wagner (1994 p. 215), on the other hand, drawing on inter-temporal correlation of various measures of entry intensity concludes that *"...inter-industry structure of total entry, small firm entry, and entry by small firms is not constant over time [because] Often the coefficient of correlation between the same entry intensity measure for two years is either about zero or negative."* The coefficients themselves do not support this view and later the research successfully utilises a least squares with dummy variables model to account for time-invariant industry-fixed effects. The successful utilisation of an industry-fixed effects model seems to require that, conditional on other covariates, there should be a sufficient, fairly permanent, between-industries component in entry flows observed across time. This seems to imply that although the inter-industry structure of various entry measures in Lower-Saxony is not constant over time, it is at least stable enough.

The foregoing provides the context for examining patterns in net entry rates, (more accurately growth patterns) in the number of establishments by size class and sector across time for Greek manufacturing.

Table 5.1 provides sectoral averages for the 1982-1991 period for all 2-digit industrial sectors and size classes.

In one fifth of the industrial sectors the only gains recorded stem from the smallest size class (SIC:30,33,37,38). Interestingly, none of these sectors can be classified into the light-industry group that is supposed to enjoy lower entry barriers. About a quarter of the sectors (SIC:20,21,29,34,39) exhibit some gain in the largest of the size classes. In all cases the same sectors also presented gains in the smallest size class, apart from beverages. Two sectors stand out having gains in all size classes except the largest one, namely the footwear-clothing industry and manufacture of paper, and two that present losses in all size classes are fabricated metal products except machinery and manufactures of textiles. The fourth of the size classes considered presents distinctive behaviour in two industry cases where it is the only size class that enjoys some increase in the number of operating establishments over the period. These cases concern wood and cork industries and printing and publishing. In two other industries both the fourth and smallest size classes are the only cases with gains. These industries are chemicals and petroleum and coal refining, the latter having the maximum mean value in the sample (27.5% increase in size class 4). Both industries are considered as having quite high entry barriers.

Table 5.1. Sectoral means for net entry rates into Greek manufacturing, 1982-1991

SIC	Industrial Sectors	Size classes				
		1	2	3	4	5
20	Food preparation except beverages	0.27	-0.72	-2.60	-1.27	-0.94
21	Beverages	-0.51	-1.83	-1.69	2.74	0.02
22	Tobacco manufactures	5.91	2.13	-3.79	-8.54	-0.24
23	Manufacture of textiles	-1.96	-2.11	-1.70	-0.66	-5.75
24	Manufacture of footwear & sewing of fabric	0.36	3.28	2.70	3.09	-2.28
25	Wood and cork	-1.11	-5.41	-5.64	2.38	-8.68
26	Furniture and fixtures	1.96	4.27	-1.29	-4.80	-6.18
27	Manufacture of paper	2.37	2.85	1.23	3.31	-4.00
28	Printing and publishing	-0.39	-3.95	-2.03	0.06	-2.97
29	Leather and fur products	1.42	-0.77	-1.10	-5.26	3.70
30	Rubber and plastic products	1.53	-0.44	-2.81	-0.79	-3.50
31	Chemical Industries	2.13	-3.09	-0.92	3.28	-1.08
32	Petroleum and coal refining	4.72	-2.22	-1.39	27.51	-4.81
33	Non metallic mineral products	1.03	-0.28	-1.99	-5.85	-1.90
34	Basic metal products	10.40	1.48	5.16	-1.57	1.64
35	Fabricated metal products except machinery	-0.26	-2.07	-3.95	-2.22	-5.24
36	Machinery and appliances except electrical	1.22	-0.51	-3.92	-7.48	1.34
37	Electrical machinery apparatus, appliances and supply	1.36	-1.45	-4.78	-5.01	-4.24
38	Transport equipment	0.66	-0.52	-2.51	-2.31	-4.94
39	Miscellaneous manufacturing industries	1.38	-2.76	-4.04	-2.22	4.26

Figures have been multiplied by 100 and indicate percentage points

Since the data used in this research are pooled, it would be useful to examine also what happens in the other dimension involved — that of time, and Table 5.2 gives the single-year interval averages for all manufacturing industries in each of the size classes.

The first size class always exhibits percentage growth in the number of establishments operating. Almost the opposite is the case for all other size classes. In particular, the number of establishments has declined in size class two except for 1986-1987 and 1989-1990. For the third size class, the only positive figures relate to

1983-1984 and 1988-1989 and these coincide with the periods that also produce positive values for the largest size class. On the other hand, size class 4 presents large gains for 1986-1987. Within the size classes, there is some degree of year to year variation. What stands out is that in all but one size class manufacturing averages for net entry rates peak in absolute terms in the 1986-1987 period. Interestingly, this coincides with the lowest rate of growth of real GDP in the study period (-0.8%).

Table 5.2. Annual means for net rates in Greek manufacturing, 1982-1991

Time period	Size classes				
	1	2	3	4	5
1982-1983	1.28	-1.36	-4.20	-4.60	-1.87
1983-1984	0.86	-1.60	0.91	-1.53	0.42
1984-1985	0.63	-1.70	-3.48	-4.10	-2.14
1985-1986	0.10	-3.47	-4.11	-1.97	-1.38
1986-1987	10.48	7.24	-1.36	12.29	-9.48
1987-1988	0.37	-0.70	-0.10	0.59	-0.74
1988-1989	0.07	-0.19	0.02	-1.95	0.70
1989-1990	0.70	0.50	-0.19	-0.21	-4.25
1990-1991	0.12	-5.08	-4.19	-1.05	-1.88

Figures pertain to percentage points

Figure 5.1 helps to draw the picture of time-fluctuation in all size classes along with wider movements in the economy suggested by real GDP growth. Thus, for both the first two size classes the peak is positive and the same is also evident for the fourth size class. In contrast, the largest size class follows closely the economy-wide fluctuations presenting a deep trough in the 1986-87 period[65], whereas at the same time size class 3 does not seem to peak at all. There is certainly a suggestion that wider movements in the economy relate to net entry rates, but the picture is somewhat confusing as there is no clear-cut dichotomy established between the response of smaller and larger size classes. Thus, although the smallest size classes seem to exhibit a superior performance during the economy's downturn the same is also evident for the second largest size class considered. What seems to be a crucial impediment precluding clearer inference of these patterns is not knowing the extent to which gains in the fourth size class are the result of inter-size

[65] The situation described in Figure 5.1 was compared with the fluctuation of average net entry rates constructed by gross entry and exit data provided by the Federation of Greek industries (FGI). The federation keeps record of all establishments that publish accounts in all 2-digit manufacturing sectors. Although there is no direct employment-size correspondence, the FGI record relates to somewhat larger firms that account for about 90% of total assets in Greek manufacturing. For these firms the relevant plot presents also an important downward movement in the 1986-1987 period. Unfortunately the FGI does not disclose data for a size breakdown of the firms in their records.

class mobility originating from the fifth size class. It is quite plausible that, moving from smaller to larger size classes, entry and exit becomes less entry and exit from an industry and more within-industry entry and exit from size classes.

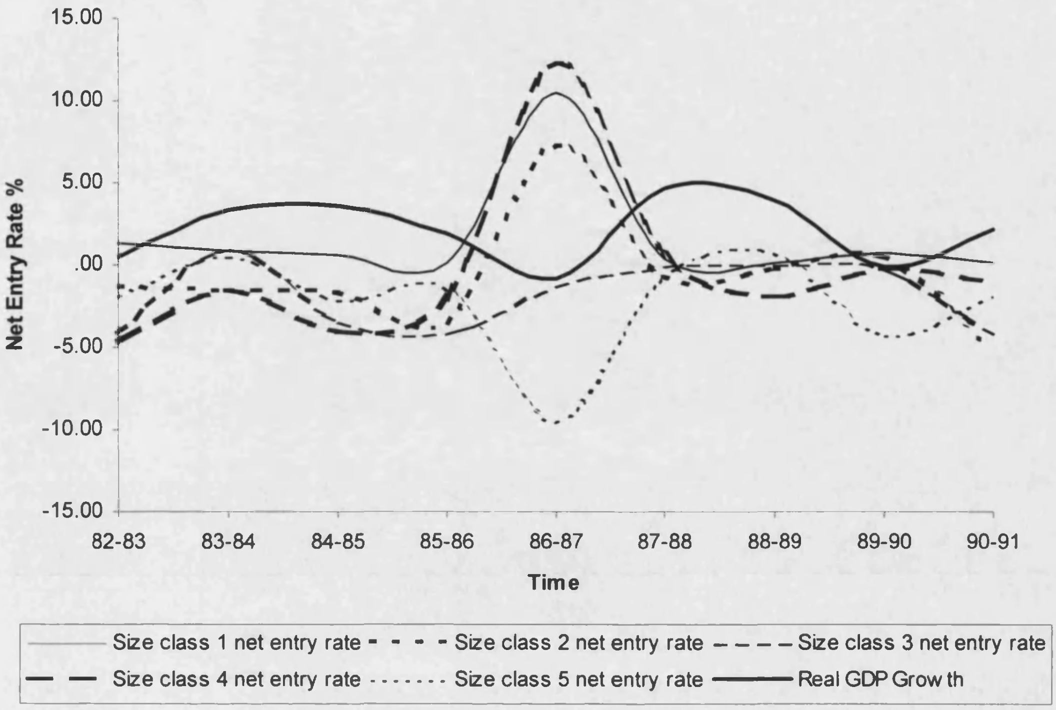

Figure 5.1. Annual net entry rate averages for Greek manufacturing industries and growth rate of real GDP over time

It could be argued that there is some degree of within-size-class, across-industries variation, but, more important, average total manufacturing net entry rates by size class seem to fluctuate considerably in time. Variation over time seems to have been influenced by the inclusion of two recession-years. An explicit account for the statistical significance of potential sources of variation is required to determine whether or not the industry-means in Table 5.1 are statistically different to conclude if, unconditionally on other regressors, industry fixed-effects are significant. The same also applies in terms of time-fixed effects to the time-means presented in Table 5.2.

Tables 5.3 and 5.4 present the results of a variance-decomposition exercise for each of the size classes. The variance of a variable X can be decomposed as:

$$\frac{1}{NT}\sum_i\sum_t(x_{it}-\bar{x})^2=\begin{cases}\frac{1}{NT}\left(\sum_i\sum_t(x_{it}-\bar{x}_i)^2+T\sum_i(\bar{x}_i-\bar{x})^2\right)\\ \frac{1}{NT}\left(\sum_i\sum_t(x_{it}-\bar{x}_t)^2+N\sum_t(\bar{x}_t-\bar{x})^2\right)\\ \frac{1}{NT}\left(\sum_i\sum_t(x_{it}-\bar{x}_i-\bar{x}_t+\bar{x})^2+T\sum_i(\bar{x}_i-\bar{x})^2+N\sum_t(\bar{x}_t-\bar{x})^2\right)\end{cases}\tag{5.2}$$

where

$\bar{x}_i=\frac{1}{T}\sum_t x_{it}$ is the cross sectional mean

$\bar{x}_t=\frac{1}{N}\sum_i x_{it}$ is the year mean, and

$\bar{x}=\frac{1}{NT}\sum_i\sum_t x_{it}$ is the grand (overall) mean

The total sample variation and the between-industry and between-year variation are presented. The last two sources of variation are systematic in the sense that they are controlled for by industry-fixed and time-fixed-effects. The highest proportion of between-industry variation is exhibited by the first size class followed by the fourth and fifth. The highest proportion of between-time variation expresses itself, again, in the first size class, but it is followed by the second and to a lesser extent by the largest size class.

Table 5.3. Net entry rates into Greek manufacturing 1982-1988: variance decomposition accounting total sample variation and its systematic sources

Size Class Employment Range	**Grand Mean**	**Total sample variation** $\sigma^2=\frac{1}{NT}\sum_i\sum_t(x_{it}-\bar{x}$	**Between-industry variation** $B_n=\frac{1}{N}\sum_i(\bar{x}_i-\bar{x})^2$	**Between-year variation** $B_t=\frac{1}{T}\sum_t(\bar{x}_t-\bar{x})^2$	B_n/σ^2	B_t/σ^2
10-19	1.624	64.641	7.166	9.949	0.110	0.153
20-29	0.705	113.259	5.846	10.418	0.051	0.091
30-49	1.853	75.227	6.173	3.994	0.082	0.053
50-99	0.280	500.922	52.947	22.213	0.105	0.044
Over 100	2.289	108.332	10.955	8.371	0.101	0.077

It is evident that both the systematic sources of variation present just a small fraction of total variation in all cases. This can be visualised in column three of Table 5.4 where the amount of total variation unaccounted for by industry and time effects is all cases over 70%. The minimum amount of unsystematic variation is exhibited by the first size class (73%) and to some lesser extent by the fifth (82%) and fourth (84%) size classes respectively. Comparing the shares of both systematic sources of variation to total variation in Table 5.3 reveals that in only the two first size classes is the proportion of time-driven variation higher than that from inter-industry differences of net entry rate means over time. The same relationships hold when both sources of systematic variation are expressed as proportions of the overall unsystematic variation as opposed to total variation (columns 4 and 5 of Table 5.4).

Table 5.4. Unsystematic sample variation and 2-way analysis of variance related tests for industry and time fixed effects

Size class	Unsystematic variation $\sigma^2 - B_n - B_t$	$\frac{\sigma^2 - B_n - B_t}{\sigma^2}$	$\frac{B_n}{\sigma^2 - B_n - B_t}$	$\frac{B_t}{\sigma^2 - B_n - B_t}$	Industry Fixed effects $F_{(19,152)}$	Time fixed-effects $F_{(8,152)}$	Non additivity	Tukey's $F_{(1,151)}$
1	47.524	0.735	0.150	0.209	1.206	3.977***	41.048	957.094***
2	96.994	0.856	0.060	0.107	0.482	2.040**	31.969	74.237***
3	65.059	0.864	0.094	0.061	0.759	1.167	1.320	3.128*
4	425.761	0.849	0.124	0.052	0.994	0.991	301.761	365.758***
5	89.005	0.821	0.123	0.094	0.984	1.787*	12.198	23.981***

*** significant at 1%, ** significant at 5%, * significant at 10 %

This does not necessarily imply that, whenever the proportion of between-time industry variation to total variation (or to total unsystematic variation) exceeds that of between-industry variation, the former is statistically more significant than the latter. What crucially determines the statistical significance of each of the systematic sources of variation, apart from the magnitude of the effect itself as compared to the total unsystematic variation is the degrees-of-freedom correction. Multiplying each of the figures appearing column 4 of Table 5.4 by 152/19 yields the relevant F test for between-industry variation for each size class. Multiplying the fifth column by 152/8 yields the relevant F-test for between-time variation.

Both F-tests relate to two-way fixed-effects analysis of variance procedures. In all but two cases both the industry and time effects as hypotheses were rejected. Time-driven variation was found to be significant in the case of the first two size classes and to a lesser extent for the largest. The implications are that net entry rates indeed fluctuate more in time rather than across industries and that given the statistical insignificance of industry fixed-effects it may be concluded that inter-industry structure of net entry rates is quite unstable over time[66].

However, before concluding, a further refinement is needed. Testing for non-additivity by the means of Tukey's test demonstrates that even the lowest values of the test, that for size class 3, provides confidence (90%) that the additivity assumption is rejected, the other cases being much clearer. A Type-I error remains possible in case of insignificant ANOVA F-tests. The absence of significant industry-driven variation when using net entry rates defined by size class complements patterns found for size-independent net entry measures deployed in the previous empirical chapters.

5.5. Consideration of some model specification issues

The inclusion of the variables employed in this research follows the tradition established in the years after Bain's (1956) definition of entry barriers and Orr's (1974a) applied work. The interpretation of results on these variables becomes troublesome, however, when it comes to the investigation of net entry rates by employment size class. Matters are even more complicated here since growth in the number of establishments operating in size classes between two points in time may not entirely due to net entry *per se,* but also do to inter-size class mobility within industries. The nature of the variables is briefly considered next and they are offered with no strong preconception about the sign of the regressors employed, given a net entry context.

Price cost margins (PCM) have been included in the right hand side vector of regressors as an index of industry profitability. It is assumed that net entry is positively related to higher industry profits depending, however, on the extent to which the latter are attributed to even higher entry (exit) barriers. As is often the practice when net entry is used, PCM were taken in 'phase' with net entry (Yamawaki, 1991; Orr, 1974a; and Duetsch 1975) and also with a one year lag. Where the adoption of lags delivered better results, these were then preferred for presentation. Industry growth from the preceding

[66] This can be further pursued by taking inter-temporal Spearman rank-correlation coefficients of net entry rates by size class, rather than simple correlations. It was found that hardly any rank correlations between consecutive time periods were significant and this supports the argument for unstable inter-industry patterns of net entry over time The correlations can be found in Table A.4 in the appendix.

period is expressed in employment terms (EMPLGR) and is expected to have a positive impact on net entry rates. This is so unless the opportunities created by industry expansion are being exploited by the expansion of already established firms, rather than new entrants and/or when industry growth prospects result in an overreaction of potential entrants which leads to higher firm turnover and, thus eventually, to lower net entry rates. The definition of product differentiation (ARDT) and capital requirements proxies (KR) used in this research follows that in previous chapters. However, the direction of their effect on size-specific net entry rates is difficult to predetermine.

As a new variable an industry size proxy is also employed to account for different sectoral sizes. The latter is important to the extent that industry size is related to displacement effects within industries (Baldwin and Gorecki, 1983; Shapiro and Khemani, 1987). Industry size is proxied here as the relative share of industry value-added to total manufacturing (SI).[67] In addition, an index of relative efficiency is required to capture productivity differences and indicate the advantages or disadvantages of operating in a particular size class. Entry can be seen as a twofold decision. First, comes the question of the industry to be entered, and second, the concern about the size of entry. The index of relative efficiency (RE) should be seen as related to the latter. It is defined here as the ratio of size class specific value-added to employment ratio over the industry's value-added to employment ratio[68]. The higher the value of this index, the lower the disadvantage of establishments entering the particular size class within an industry. Since the index gives the relative productivity of labour for each size class, it should be recognised that it is not free of ambiguity, given that all firms do not use the same technology within an industry. Those more capital-intensive firms will achieve higher labour productivity.

The index of relative efficiency reflects, then, both the factor mix and labour efficiency. A way to disentangle the index of relative efficiency in a more meaningful

[67] Alternative empirical definitions of the industry size variable, such the logarithm of sector sales, the number of firms in existence (independent of size class) and the logarithm of total sectoral employment, could potentially give similar results, but would have significantly contributed to multicollinearity problems.

[68] When the sales to employment ratio of each size class over the relevant sectoral ratio was used as a proxy of relative size class efficiency, the results suffered from a higher degree of multicollinearity.

manner was suggested by Droucopoulos and Thomadakis (1993). They regressed the index of each size class on an index of class-specific relative capital requirements (RKR_{jit}). This idea of auxiliary regression was also used here. The relative index of capital requirements is defined as the size class fuel and energy consumption to employment ratio over the relevant sectoral ratio. The relation thus becomes:

$$RE_{jit} = b_0 + b_1\, RKR_{jit} + U_{jit} \qquad (5.3)$$

For every j=1,...,5 size classes, where i=1,...,20 two-digit sectors, t=1,...,9 time periods. The residual of the regression (U) can then be used to proxy relative efficiency after the effect of different technology has been removed.

Labour market characteristics (Storey and Jones, 1987; Shapiro and Khemani 1987; Acs and Audretsch 1989a, 1989b; Anagnostaki and Louri 1995a) and their effect on net entry rates by entrants' size are also considered. A measure of relative labour costs for each of the 20 two-digit industrial sectors is constructed as the average wage of the industry over the average wage for the total manufacturing (LA).

Prospects for differentiated effects of macro-economic conditions on different size classes are also explored. In particular, the growth rate of real GDP (RGDPGR) from the preceding year and the growth rate of the price index of investment goods (PINVR) were used.

5.6. Estimation and results

Geroski (1995) explains that while both the profitability and entry barriers proxies present little variation in time and most of their variation is between-industry variation, the variable whose variation they seek to explain — entry rates — has as a main source of variation, fluctuations over time. He also recognises that although panel data are more advantageous than cross-sections in that they incorporate the time dimension, they usually provide a low overall fit.

Despite this argument, the vast majority of empirical studies that use panel data have successfully employed industry-fixed effects. In almost all, justification is provided by means of some statistical test for their collective significance. This, in turn, implies that there should be a quite important time-invariant element in entry rates conditional on other regressors. However, if the between-industry variation is only a modest fraction of the fluctuation over time that entry rates are claimed primarily to present, then industry fixed-effects cannot deal with the latter, as they are only capable of purging the model of between-industry variation.

In this research previous statistical analysis cast no doubt that a) time is unconditionally the most significant source of variation in the present research, b) unless a serious Type-I error was committed in the analysis of variance, industry-fixed effects are not statistically significant, implying that inter-industry structure of net entry rates is quite unstable in time, and c) unsystematic or chance variation retains the biggest share of total variation in all size classes.

This necessarily means that the model employed here should deal to a great extent with unsystematic variation, on the one hand, and time variation, on the other. Both the real GDP growth (RGDPGR) and the price index of investment goods (PINVR) are deployed to capture the effect of time through the notions of firstly, macro-economic conditions and secondly, the cost of capital. In the presence of these industry-invariant variables, time dummies were not introduced to avoid perfect-multicollinearity. The role of unemployment would have been also considered in these formulations. However, it was excluded to avoid higher degrees of linear dependencies in the RHS of the estimable equations[69]. Other RHS variables, although characterised mainly by sectoral variation, are by no means time-invariant and are included to explain some of the unsystematic variation, especially in a situation where the interactive effect of cross-sections and time series seem to be important (see the non-additivity test in section 5.4).

The estimation technique applied is GLS along the econometric model assumptions pertaining to groupwise-heteroscedasticity and autocorrelation put forward in the third chapter. The results of these estimations are reported in Table 5.5.

These results reflect estimation in the presence of moderate multicollinearity. However, carrying out variance decomposition analysis, suggested for such cases by Belsley *et al.* (1980), revealed that variance proportions did not lead to significant loss of

[69] The unemployment rate for the total economy was found to be significantly correlated with both PINVR (0.52) and RGDPGR (0.32).

accuracy in estimating regression coefficients. All the condition indices were lower than the cut-off point of 30, usually used to identify severe situations. The highest condition indices for each of the five size class equations are cited in Table 5.5 along with the highest of the variance inflation factors (VIF) and the determinant of the variable correlation matrix in order to support the argument.

Table 5.5. GLS estimates accounting for net entry rates into Greek manufacturing 1983-1991 by size class

Variable name	Size class 1	Size class 2	Size class 3	Size class 4	Size class 5
PCM	-0.062044*	-0.045081	-0.0058106	0.13072*	-0.11205*
	(0.04004)	(0.05114)	(0.004947)	(0.08313)	(0.06224)
SI	-0.17347**	-0.28002***	-0.027178*	0.10871	-0.082828
	(0.08928)	(0.09335)	(0.01004)	(0.1371)	(0.1127)
EMPLGR	0.086161***	0.017446	-0.00068080	-0.029320	0.066983
	(0.03585)	(0.03764)	(0.005548)	(0.06599)	(0.05494)
RKR	-0.0072277	0.0089739	0.00049080	-0.075248***	-0.0040952
	(0.009571)	(0.01362)	(0.0009602)	(0.02310)	(0.006633)
U	-0.048817*	0.035940	0.00070142	0.011031	0.0011642
	(0.02899)	(0.02866)	(0.002450)	(0.03424)	(0.02933)
ARDT	-0.031311	-0.15114	-0.018053*	0.19800	0.10538
	(0.1129)	(0.2877)	(0.01008)	(0.3450)	(0.2134)
LA	0.0033551	0.022117***	-0.0024676*	-0.027378	0.017380
	(0.008009)	(0.009420)	(0.001375)	(0.01917)	(0.01406)
RGDPGR	-0.0060287***	-0.0079542***	-0.000049460	-0.011891***	0.011005***
	(0.001226)	(0.001718)	(0.0002474)	(0.003024)	(0.002381)
PINVR	-0.18611***	-0.31589***	-0.039024***	-0.56957***	0.52323***
	(0.06495)	(0.07686)	(0.01036)	(0.1308)	(0.1006)
CONSTANT	0.081593***	0.051622**	0.0086351***	0.17159***	-0.11930***
	(0.01938)	(0.02257)	0.002736	(0.03674)	(0.02361)
Buse R^2	0.3089	0.2247	0.0621	0.1957	0.1853
R^2 between observed and predicted	0.3590	0.2800	0.1711	0.2874	0.3041
Number of obs.	180	180	180	180	180
Determinant	0.5584	0.6516	0.6168	0.5033	0.4689
VIF	1.2759	1.2682	1.2486	1.5205	1.5101
Condition Index	16.291	16.167	16.145	15.266	14.760
F(19,151) for industry fixed effects	0.84	0.86	1.02	0.55	1.33

Notes: standard errors in parentheses.
*** significant at the 1%** significant at 5%*significant at 10% 2-tailed tests.
In the size class equations 4 and 5 one year lag applies to PCM.

Additional testing for the collective significance of omitted time-invariant industry-specific characteristics was facilitated by the means of an F-test. The evidence once more offers no support for industry-fixed effects. Sector-wise panel heteroscedasticity was tested by means of a Lagrange multiplier test. In all cases the value of the test was significant at the 1% statistical level suggesting considerable residual variance heterogeneity of this form and justifying the assumptions of the econometric model adopted[70].

The sign and the magnitude of the estimated variable coefficients appear to be considerably different across different size classes.

First, consider the smallest size class. The PCM variable has a negative, moderately significant, effect on the net entry rates. This indicates that both entry and exit are symmetrical in their response to higher profit margins. Moreover, if both entry and exit are positively related to PCM then the negative sign of net entry rates clearly depends on the relative entry and exit elasticity. That is, exit might be steeper than entry in its response to higher margins. The height of entry barriers is important as a determinant of such a result, in both that it deters entry, and post-entry survival and mobility. In the presence of entry barriers, entry is less discouraged than exit is forced, probably due to subsequent exit of less qualified recent entrants or less efficient incumbents. Dunne and Roberts (1991) find that high profits attract entry but also high profits are associated with frequent exit in the US manufacturing industries.

Industry size is found to be negative and significant, which seems at the first glance rather odd. However, it has been pointed out in other studies (Schwalbach, 1990; Thomadakis and Droucopoulos, 1996) that industry size can be associated with the existence of scale economies, thus leaving less scope for smaller firms. If this is the case, to the extent that the industry size proxy reflects an industry's share of value added, then the negative sign obtained here can be seen as the outcome of a process where entry of smaller firms is more elastic than exit, both being negatively related to size.

Industry growth, in contrast to industry size, seems to exert a significant and positive effect on net entry rates. Given the hypothesis that newer, and hence smaller, industries grow faster (White, 1982), the above findings seem important in supporting the notion that small faster growing industries offer better grounds for smaller new participants. This may imply that industry growth may be associated with higher industry profitability (Bradburd and Caves, 1982), which is not necessarily accessible by entrants

[70] The values of the test for the five size classes are 265.53, 235.27, 130.92, 789.69, 170.52 respectively. These values should be compared with the corresponding χ^2 critical value for 20 degrees of freedom.

at the expense of existing firms. Thus, industry growth might have attracted more entry to the extent that small entrants assume that an aggressive reaction is less likely than otherwise would have been the case.

In contrast, the index of relative capital intensity was found to be negative but not significant, whereas the index of relative efficiency (for reasons other than differences in capital utilisation) is also negative, but of moderate significance. This seems to indicate, where small firms are not at a great disadvantage *vis-à-vis* their larger counterparts, that net entry rates become lower, possibly because of higher turnover in the smallest size class. In other words where small firms can find their way in competing in industry segments both entry and exit are positively related to higher efficiency, but exit is more elastic than entry. Higher efficiency provides a welcoming signal to small entrants but not all of them can be accommodated.

Labour costs do not present a significant effect on net entry rates, (while there is trace of a positive effect). Small firms may well be more efficient in finding cheaper ways of labour compensation (part-time and seasonal workers, family participation) or they may prefer to substitute labour for capital to improve factor-mix utilisation.

Finally, an ameliorating macro-economic environment does not seem to favour small firm net entry rates. The coefficient of the growth rate of real GDP is negative and highly significant. Put another way, it seems that smaller size classes perform better during downturn in the economy. The higher costs of capital also exert a significant negative effect. Since these last results are of great importance in understanding the movement of firms of different sizes into industries, this discussion will be returned to.

The majority of signs discussed above hold in the case of the two next larger size classes. However, important gradations concerning the magnitude of the effects can be traced. For PCM, the effects remain negative but not significant at any conventional level. Industry size, as a negative influence on net entry rates, increases its significance as size class increases, and the opposite is the case for the positive effect of industry growth. The industry-size-industry-growth effect trajectory may be because as size increases there is less scope for alternative small firm strategies to confront competition, this becoming more direct and the presence of firms becomes better noticed. Industry growth reduces to an unimportant factor in offsetting entry barriers and, indeed, turns into a negative effect for the middle size class.

The variables RKR and U remain insignificant but change their signs implying that, as small establishment size increases across industries, firms tend to approach an industry norm. The index of relative efficiency allows for more surviving firms and higher relative capital intensity might also facilitate such increased survival. For higher values of U, entry is more elastic than exit, both being positively related to U and exit more elastic than entry both being negatively related to RKR. Interestingly, ARDT becomes moderately significant for the middle size class. The negative effect of product differentiation may indicate that middle-sized firms suffer most from this barrier, since their product aims at broader markets than the more protected specialised niches served by smaller firms. Relative labour costs remain a positive influence for the second size class, but become highly significant. This might point to a better exploitation of labour here, either through lower wages or higher productivity. This tendency is reversed, however, when the analysis reaches the middle size class. Here, the effect of higher relative labour costs is of moderate significance, but negative. This raises the question of the 'formalisation' of the middle size class establishments. These results certainly highlight distinctive behaviour of net entry rates for the third size class where tendencies observed in the smallest size classes are reversed. But the overall state of the economy remains a negative force affecting net entry rates in size classes two and three.

The most striking finding concerning the econometric results for the largest size classes (four and five) is that hardly any variable other than the price cost margins are found to be significant at any conventional level. The relative capital intensity of size class four is the only exception.

Here the use of one-year lags in PCM provides more significant results. This contrasts with the results obtained for smaller size classes, particularly the smallest, where 'in-phase' PCM presented a negative, moderately significant effect. The signs for size classes four and five are different, however, being positive for the medium size establishments and negative for the large ones. The positive sign obtained the second largest size class seems to imply that more firm enter this size class than exit from it for higher margins. The opposite is the case for the largest size class. Duetsch (1975) uses the term 'blockaded entry' to characterise situations where the negative relation between net entry rates and PCM is determined by the height of entry (exit) barriers. Duetsch's view necessarily assumes that, if entry is to be blockaded, the relationship between entry and PCM should be negative and far more negative and significant than the relationship between entry and barriers to entry proxies. However, results for other variables like RKR, SI and ARDT do not appear to strongly support this argument. On the other hand, the relative capital intensity (RKR) is found to exert a significant negative influence on the growth rate in the number of operating establishments in the size class immediately below the largest.

Given the caveats associated with the nature of the dependent variable in use, it might be wiser to treat the patterns of growth in the number of establishments operating in the two largest size classes as the result of entry and exit from the size classes (within-industry movements) rather than entry and exit from the industry. In this case entrants and exiting firms share at least one important feature, that of size. Barriers to entry (exit) defined at the industry level do not seem particularly important since both those firms residing in the size class, as well as movers, can attain minimum efficient size of production. More pertinent are individual firm effects (Amato and Wilder, 1990). Firm characteristics are more likely to determine the competitive conditions at the top of the firm size pyramid, rather than the overall entry condition at the industry level.

A most interesting finding when comparing the empirical results across the five size-class equations is that only large firms present a positive sign for both RGDPGR and PINVR. The econometric results for these two variables across size classes closely resemble Figure 5.1 previously discussed. The combination of both the diagrammatic presentation of the patterns and the econometric results rise two issues: a) intra-industry inter-size class mobility might have some contribution to explaining these patterns and b) macro-economic shocks seem to have a disproportionate effect on different size classes.

The first point relates to the idea that facing decreasing demand large firms, given their irrecoverable capital commitments (sunk costs), may decide to terminate a number of employees in order to bound overheads, instead of exit from an industry. This might offer an explanation for both the negative impact of the demand shock in 1986-1987 period on the largest size class and the positive impact on the immediately smaller size class 4, to the extent that size classes are employment defined. As a counter-argument, however, it could be claimed that downsizing itself might be limited by the way the production lines of mass producers are organised. If rigid enough mass production lines might not be easy to restructure and terminating jobs might not salvage the situation depending on factors such as the length of the shock, how unexpected it was, the level of inventories, etc.

The second point relates to increases in the number of establishments in all other size classes. This far more than offsets the decrease in the largest size class even if a trickle down downsizing effect is assumed. It seems, then, that size classes relating to smaller firms have a net increase beyond that which can be attributed to inter-size class mobility. This points to superior responsiveness of smaller firms to demand fluctuations (Mills and Schumann, 1985), probably through their inherited flexibility in shifting or rearranging production (Carlsson, 1989). Moreover, the applied literature points out in related contexts that new firm formation might be facilitated during downturns, because prospective firm proprietors would otherwise have faced serious hazards of being unemployed, because of greater supply of cheaper labour (Storey, 1991), and because of greater supply of cheaper second-hand equipment released due to demand shortages leading to closure of many firms (Binks and Jennings, 1986a). This reasoning which might be applicable in the present research appears to conform more to what Highfield and Smiley (1987) have described as an 'opportunistic' scenario. Their time-series analysis for US manufacturing suggested that sluggish macro-economic conditions reflected by lower growth rates of GNP, lower inflation rates and growth in the unemployment rate relate to higher rates of new firm formation. In the present context, however, it is worth noting that even if the 'opportunistic' scenario is to serve as an explanation, this certainly does not apply to all size classes, since the largest firms seem to be anything but 'opportunistic'.

The results of this research, although similar save for the largest to that of Highfield and Smiley, contradict the results of other research which has considered the role of wider economic growth. Higher growth rates of GNP are associated with higher entry rates in Japan (Yamawaki, 1991), in the US (Audretsch and Acs, 1994) and in Portugal (Mata, 1996). What seems, however, to have been a more uniform result across studies concerned with effect of overall economic conditions on entry is the negative effect of cost of capital proxies (Highfield and Smiley, 1987; Yamawaki, 1991; Wagner, 1994; Audretsch and Acs, 1994, Mata, 1996). The results in the present study support this finding in that PINVR, as a proxy of capital cost, was found to be negative for all but the largest size class.

It has been stated that net entry rates, when defined at the size class level, are vulnerable to the possibility of unaccounted intra-industry inter-size class mobility. In order to alleviate this problem a minimal degree of simultaneity was allowed by using SUR estimation, which treats the equations of all the five classes as a system. In particular, the method allows for correlation between the residuals of the same industry, the same study year, but different size classes. Each of the separate equation variables were initially subjected to a double transformation to remove the effects of group-wise heteroscedasticity and autocorrelation (where applicable) prior to SUR estimation. The existence of significant correlation between size class residuals[71] in the fashion described above was tested by the means of a Breusch-Pagan Lagrange multiplier test (Breusch and Pagan, 1980). The value of the test was 57.672 pointing to significant cross-equation residual correlation. Overall, the results of SUR estimation presented in Table 5.6 confirm those of the GLS estimates presented earlier (Table 5.5), but produce limited efficiency gains. The use of SUR can be criticised on the grounds that the majority of the variables are common between the size classes. Only U and RKR differ across all the size classes and the lags taken in PCM distinguish profitability conceptions between the last two size classes and the rest.

Nevertheless, the use of transformations to remove heteroscedasticity and autocorrelation induces the values of the same variable to be different across the equations. What then facilitates the reasoning for the marginal gains in efficiency in the present case is that *"...efficiency gain tends to be higher when the explanatory variables in different equations are not highly correlated but the disturbance terms corresponding to different equations are highly correlated"* (Judge *et al.* 1985, p. 468). This implies that even after the transformations prior to SUR estimation the values of the same explanatory variable were often highly correlated across the size class equations.

[71] See also Table A.5 in the appendix for inter-size class correlation matrix of actual net entry rates.

Table 5.6. SUR estimates for net entry rates by size class: 20 two-digit Greek manufacturing industries 1983-1991

Variable name	Size class 1	Size class 2	Size class 3	Size class 4	Size class 5
PCM	-0.063637**	-0.047040	-0.0042653	0.11256***	-0.094138***
	(0.03327)	(0.04664)	(0.004578)	(0.07405)	(0.05827)
SI	-0.19756*	-0.29529*	-0.029029*	0.12113	-0.12284
	(0.07359)	(0.08524)	(0.009520)	(0.1247)	(0.1083)
EMPLGR	0.070968*	0.014163	-0.00024313	-0.016431	0.068574
	(0.02942)	(0.03431)	(0.005219)	(0.05980)	(0.05263)
RKR	-0.0077348	0.011818	0.000096379	-0.076812*	-0.0050304
	(0.007761)	(0.01208)	(0.0008846)	(0.02065)	(0.006192)
U	-0.051645**	0.040360***	0.00076850	0.0072414	-0.00082902
	(0.02344)	(0.02527)	(0.002241)	(0.03041)	(0.02756)
ARDT	-0.035571	-0.17327	-0.015367***	0.18148	0.088901
	(0.09355)	(0.2681)	(0.009578)	(0.3152)	(0.2068)
LA	0.0034882	0.018998**	-0.0023416***	-0.031194**	0.016057
	(0.006593)	(0.008619)	(0.001302)	(0.01725)	(0.01346)
RGDPGR	-0.0059375*	-0.0079116*	-0.000061983	-0.012824*	0.010824*
	(0.001007)	(0.001567)	(0.0002325)	(0.002735)	(0.002282)
PINVR	-0.18621*	-0.31920*	-0.039330*	-0.57847*	0.50931*
	(0.05341)	(0.07030)	(0.009769)	(0.1183)	(0.09643)
CONSTANT	0.082951*	0.055070*	0.0088550*	0.18387*	-0.11530
	(0.01595)	(0.02055)	(0.002562)	(0.03310)	(0.02255)
R^2	0.3575	0.2779	0.1675	0.2840	0.3023

Notes: Standard errors in parentheses.
* significant at the 1% ** significant at 5% ***significant at 10% 2-tailed tests.
In the size class equations 4 and 5 one year lag applies to PCM.

The present research augments the empirical literature by providing evidence that wider movements in the economy have a disproportionate effect on the growth in the number of establishments of various size classes. Future research might benefit from use of gross instead of net entry, longer time series for each cross section so as to encompass more economic cycles, and probably from some effort to account for differential effects of wider-economic conditions on industrial sectors.

5.7. Conclusion

The analysis here has had to confront basic difficulties arising from the use of net entry rates defined at the size class level. The fundamental difficulty is that net entry cannot be distinguished from inter-size class mobility of establishments within an industry. In fact, this research is really more properly labelled as dealing with growth in the number of establishments in individual industry size classes. As regards the literature on entry (exit) by size, this is only the second example where a pooled model has been used. Furthermore, the degree of size disaggregation here is considerably finer than used before. However, unlike previous research, the data used here were characterised by the absence of significant industry-specific systematic variation. This is clearly a peculiarity of the Greek data for this time.

In the absence of between-industry systematic variation, the models have revealed that there are likely to be considerable differences among the mechanisms governing net entry rates for different size classes. In particular, the results for the smallest firms indicate that price cost margins were only fractionally significant in determining net entry rates. Conversely, industry growth appeared to be by far the most significant inducement for net entry rates — confirming previous research. Barriers to entry proxies (ARDT, RKR) were not found to be particularly significant for small firms. An exception was industry size, which implies significant economies of scale to be operating in larger industries. This result holds for the three smallest firm size classes and supports the view that smaller firms perceive different rules of competition compared to their larger counterparts.

There is evidence suggesting that the perception of industry profitability by firms entering or exiting differs according to firm size. However, the observed pattern here is not directly analogous to that for previous research in Portugal, where past industry profitability was significant only in the case of small firms. Here, the significance of PCM re-emerges in the case of the medium-sized and largest establishments. What is also of interest is that only in these last cases does lagged profitability perform better in the models than the 'in-phase' values.

The index of relative efficiency was found to be of moderate significance only for the two smallest size classes but the relationship does not have the same sign in both classes. The index of relative capital requirements was found to be negative and significant only in the case of medium-sized establishments and product differentiation was just negative and significant when the largest of small firms were concerned.

The labour-costs proxy was shown to be significant in three of the classes, but again the sign of the relationship varies. The interpretation may be that for small firms there might be alternative ways of cheaper labour remuneration, and the largest firms may provide higher compensation for the labour inputs employed. For the size classes in between higher relative labour costs have a negative effect on net entry rates.

Finally, the results for the wider economic conditions proxies make evident that large firms are different in respect of their net entry patterns in response such conditions. The reasons behind this different behaviour are difficult to explain. It is certainly the case that, unlike large firms, small and medium firms exhibit a positive response to macro-economic downturns.

Overall, the results obtained seem to indicate that there is a gradation in the responses of different size classes to stimuli defined at the industry level. Some limited evidence is offered that small firms are different in that they manage to overcome entry barriers, perhaps adopting different survival strategies, and that large firms are well aware of market conditions and are in an advantageous position to overcome many of the problems. Size classes in the middle of the distribution offer rather mixed results due to size-related advantages and disadvantages.

The nature of the analysis here has, necessarily, often been speculative. There have been occasions where alternative accounts have had the same potential in explaining the outcomes of the econometric analysis. Difficulties have arisen due to the nature of the data, the use of the net entry concept and the size class disaggregation. However, an effort has been made to treat net entry as a distinct and proper variable, and to analyse possible scenarios behind the observed net entry figures.

Almost inevitably these results call for additional work using gross entry and exit data which might facilitate a better explanation of the determinants of firm entry and exit across the size distribution spectrum. Unfortunately this will not be possible for Greece. Perhaps more important is the conclusion that research to date seems to have discovered what does not explain entry by industry size class rather than what does. New explanatory variables, perhaps those defined at the industry or firm level, are much needed.

Chapter 6.

Entry and exit of firms: symmetry, turbulence and simultaneity †

6.1. Introduction

There has been a long-standing interest in understanding the links between entry and exit and their determinants. Both entry and exit have been seen as parts of market selection processes which promote industrial restructuring and evolution. A number of studies have indicated that entry and exit are often highly positively correlated, implying that underlying structural differences across industries produce similar inter-industry patterns for both entry and exit. Such an outcome clearly demands an understanding of the possible determinants of the relationship between entry and exit. The relationship itself could be analysed along two axes. The first relates to the question as whether or not entry and exit are positively related due to the possibility that the determinants of entry function the same way as determinants of exit i.e. symmetry. If so, this is of key importance. If barriers to entry are also barriers to exit, due to specificity and durability of capital investments that give rise to sunk costs, then, *ex ante,* there is a strong indication of both what potential entrants need to overcome to enter and why the incumbents are so reluctant to leave. *Ex post* entry, exit is also deterred since the less the entry is, the less the force for displacement becomes and hence less the exit (Shapiro and Khemani, 1987). The second relates to whether entry and exit coexist in a manner such that not only does entry force exit through displacement, but also exit makes room for more entry — in other words entry and exit are simultaneous.

† This chapter draws on Fotopoulos, G., and Spence, N., *n.d.*, Entry and Exit from Manufacturing Industries: Symmetry, Turbulence and Simultaneity — Some Empirical Evidence from Greek Manufacturing Industries, 1982-1988, *Applied Economics* (forthcoming — refereed and accepted for publication).
Thanks are due to L. Matyas (Monash University, Melbourne) and to an anonymous referee.

The aim of the research in this chapter is to analyse the relationships between entry and exit in Greek manufacturing industries along both of these axes. Although there have been a number of studies examining both entry and exit, inferring the existence and extent of symmetry between the determinants of entry and exit, the empirical evidence on the issue of simultaneity is limited since it is dependent on only a handful of studies, these referring mainly to advanced economies such the US and Canada. The present research also discusses the issues of symmetry and simultaneity within the context of industry turbulence and volatility since this latter aspect, it is argued, provides a more comprehensive framework for understanding changes in the identities of firms operating in an industry.

The next section provides a framework for the relationship between entry and exit by examining the concepts and issues involved. This is followed by a review of the limited empirical literature on these issues focusing on specific methodologies. Description and analysis of the data used are provided next. In particular, a number of entry and exit measures are constructed and their variance decomposed to give some insight into the sectoral and temporal dimensions of entry and exit in this research context. This provides also some justification for the selection of the dependent variables to be used in the econometric analysis to follow. Moreover, the notions of industry turbulence and volatility are introduced and their variance decomposed to help understanding of the persistence of differences of entry and exit patterns across industries. This will help to speculate upon the extent to which changes in the identities of operating firms might occur across industries.

Model formulations, and the results of econometric estimations are given in section 6.5. The empirical results obtained by estimating the entry and exit equations support the symmetry hypothesis. The results also encourage speculation that there should be a considerable amount of displacement in the sense of changes in the identities of operating firms. When, however, both entry and exit equations were estimated within a framework of a simultaneous equations system, the results obtained do not support the view that entry and exit are both parts of a feedback mechanism. Thus, it seems that changes in the identities of firms may result from 'natural churning' rather than from any direct simultaneity. This notion will be explored in detail. It will be shown that these changes in identities seem to occur at the industry fringe of larger sectors.

Results obtained for seemingly unrelated estimates reinforce the argument that entry and exit are parts of the industry selection process responding similarly not to only factors accounted for by the model formulations but also to common factors which are left unaccounted for by these same formulations. The empirical findings of the present research generally match those of earlier, influential research, by Austin and Rosenbaum (1991) and Rosenbaum and Lamort (1992) on the interdependence of entry and exit in US manufacturing industries.

6.2. The relation between entry and exit of firms in manufacturing industries

A number of studies have pointed out the positive relation between entry and exit (Caves and Porter 1976; Shapiro and Khemani, 1987; Dunne *et al.* 1988; Sleuwaegen and Dehandschutter, 1991; Dunne and Roberts, 1991; Austin and Rosenbaum, 1991; Evans and Siegfried, 1992; Rosenbaum and Lamort, 1992; Kleijweg and Lever, 1994; Anagnostaki and Louri, 1995a). Conventional wisdom views entry as taking place when super-normal profits are positive and exit when they are negative. Logically this should mean that the relation between entry and exit should be negative.

However, Dunne and Roberts find that high profits attract both entry and exit and the same signs were found in Austin and Rosenbaum, and in Rosenbaum and Lamort, although profits were not always significant in the exit formulations (these signs hold even after allowance was given for interaction between entry and exit by introducing an entry term in the exit equation and vice versa).

What is responsible for this surprising result? Geroski (1995), amongst others[72], seeks to provide a possible explanation for such a relation. He maintains that entry and exit may be parts of an evolutionary process where large numbers of new firms displace large numbers of existing firms without adding a great deal to the number of competing firms in the short-run. Displacement, in turn, seems to imply some change in the identities of the operating firms. In the literature there are three metaphors in use concerning the notion of change in the identities of operating firms as an integrated part of industry

[72] See extensive discussion in section 2.2.4.

evolution. The first can be traced back to Marshall (1920) who described industry evolution using a 'forest' metaphor where the young trees struggle upwards to displace their older rivals. Under such a scenario entry is responsible for exit of incumbent firms in the medium to the longer run. Could it also be the other way around? That is, does exit in turn make room for new entry? If the relationship between entry and exit holds in both these directions, then the change of the identities of firms in manufacturing industries may be due to some simultaneous displacement-vacuum effect. Alternatively, if this effect is to be rejected, then entry and exit of firms might be seen as contemporaneous processes, two parallel actions, within a framework of industry turbulence.

Audretsch (1995b) uses the notion of a 'revolving door' to describe a situation where the bulk of new entrants subsequently contribute to exit from the industry. Such a change in the identity of firms within an industry in the short run is attributed to industry turbulence, to natural churning rather than to a displacement-vacuum effect. In other words, today's exits are likely to be yesterday's entries. This view seems to imply less actual displacement subject to the extent that there is a close match between the identities of entering and exiting firms in the short-run.

The question arises as to whether or not these metaphors are mutually exclusive? Audretsch (1995b) offers a way to reconcile them by viewing the industry selection process as a 'conical revolving door'. The top part represents the largest firms within an industry and revolves slowly, whereas the lowest part representing the small firms revolves much faster. This qualitative interpretation seeks to focus attention on the nature and characteristics of the entering and exiting firms and how these firm-specific traits can be then studied along with the industry-specific ones. This clearly goes beyond analysis possible at the industry level.

But at the industry level, it is clear that the difficulty of displacement increases when moving from the bottom to the top of the conical revolving door. Moreover, if the change in the identities of firms taking place at the bottom has little to do with effective displacement (born new-died new) then causality between entry and exit increases with movement towards the top. Then, a proposition can be formed that, the greater the difficulty for displacement is, the more probable is that entry is endogenous in an exit equation, given that changes in the identities of firms moving towards the top of the cone have already occurred. However, a proposition like this still misses much. Together with an understanding of the factors underlying industry turbulence, it really needs to encompass an understanding of the determinants of intra-industry mobility to the extent that displacement and competition stem not only from outside an industry (new entries) but also from within an industry due to the mobility of already established firms (Caves and Porter, 1977). The latter is of key importance, since unless it is a case of large-scale entry, considerable time may be required for entrants to grow up and mature before they impose a considerable displacement threat to incumbent firms.

This discussion seems to leave three possibilities for the interdependence between entry and exit. The first implies that entry and exit might not be simultaneously related. Entry may lead to subsequent fail and exit of the most recent entrants. In this sense, entry barriers seem to be important as barriers to survival rather than to entry itself. The second implies that there might be some causality involved between entry and exit. There might be cost heterogeneity that gives rise to some advantage of entrants over some, but certainly not all, the incumbents, probably at the industry fringe (Shapiro and Khemani, 1987). The third gives way to the possibility of displacement of even larger incumbents by either somewhat large-scale entrants, or by grown-up survivors of the entry process at some point in the past.

Shapiro and Khemani (1987) maintain that the interdependence between entry and exit can be sustained even in the absence of cost heterogeneity. Displacement may be limited due to investments in durable and specific assets by incumbents creating 'first mover advantages'. But if the durability and specificity of capital result in sunk costs (Eaton and Lipsey, 1980) then this may deter both the entry of new competitors as well as the exit of the heavily committed incumbents. To the extent that barriers to entry are also barriers to exit (Caves and Porter, 1976), this establishes an important source of interdependence between entry and exit through the symmetry implied by entry barriers towards both entry and exit. Whether or not this kind of symmetry, when observed, reveals something more about a causal interdependency remains, however, unclear.

Nevertheless, the realisation of the symmetry hypothesis, in turn, leads to the conceptualisation of industry turbulence. The concept of turbulence has been defined in a number of studies (Caves and Porter, 1976; Gudgin, 1978; Beesley and Hamilton, 1984;

Audretsch and Acs, 1990; Dunne and Roberts 1991) as the sum of entry and exit taking place in an industry. Caves and Porter (1976) indicate that if industries differ in their rates of turbulence then entry and exit should be positively related and barriers to entry operate as barriers to exit.

The concept of turbulence can be seen as one that offers a more general framework for the analysis of intra-industry dynamics. Within the broader condition of industry turbulence, actual displacement in the sense that the new trees challenge the old ones in the forest may or may not occur. Higher degrees of turbulence mean higher degrees of trial and error entry activity, but this does not necessarily involve successful entry and displacement. However, if, under the analogy of the revolving door, the identities of exits match those of the most recent entrants, then this narrows considerably the conceptualisation of effective displacement. On the other hand, if within an environment of turbulence, the match of the identities of entry and exit firms decreases as time elapses, displacement becomes more likely as an outcome.

Industry-turbulence has been recognised as generally beneficial to industry evolution. For Beesley and Hamilton (1984) 'seedbed industries' will be those with higher birth and death rates — turbulence — and typified by more innovative and novel ventures. Gort and Klepper (1982) and Klepper and Graddy (1990) support the notion that the decline in the number of new firms along with decline in the number of exits leads to the overall decline of total number of firms. This, in turn, they argue, is associated with a mature and declining stage of an industry from a life-cycle viewpoint.

Audretsch and Acs (1990) provide evidence that the key to understanding intra-industry dynamics and cross-sectional differences in industry levels of turbulence is found in the source of knowledge that produces the innovation. Thus, much observed turbulence depends on whether an industry is characterised by an entrepreneurial regime favourable to innovation activity of new entrants but not to that of incumbent firms, or by a routinised regime where the bulk of innovations arise in incumbent firms (Winter, 1984). Evidence suggests that, in industries characterised by the latter, less firms attempt entry, coupled with a limited trial and error process leading consequently to fewer exits and lower rates of turbulence. The findings of Dunne and Roberts (1991), on the other hand, signify that industries differ significantly in the ease of entry and exit, and consequently in the degree of turbulence, because of underlying differences rooted in levels of technology and sunk costs.

6.3. The interdependence between entry and exit in manufacturing industries at the industry level

The possibility of displacement and more generally of the interdependence of entry and exit, although crucial for understanding intra-industry dynamics, has not been extensively studied.

An early initiative to examine, empirically, the interdependence between entry and exit, along with the testing of the symmetry hypothesis, was carried out by Shapiro and Khemani (1987). The entry equation used follows the tradition of the Orr (1974a) model, and the exit equation was similar but not identical. In fact the entry and exit equations differ in the incentives used for exit where industry growth and price cost margin measures were taken in phase with exit. In the entry equation, price-cost margins were taken as time lags, and lagged industry growth was divided by industry minimum efficient plant size to create a variable aimed to capture the extent to which industry growth can be absorbed by additional capacity creation. Given that the entry and exit equations did not contain exactly the same variables, allowance was made in estimation for correlated residual terms, leading to seemingly unrelated regressions estimation. The results of these formulations revealed considerable degrees of symmetry in the behaviour of entry barriers as determinants of both the entry and exit. This was the first widely quoted result in support of the symmetry hypothesis — barriers to entry also being barriers to exit. Shapiro and Khemani advanced the analysis by investigating the interdependence between entry and exit. In doing so they augmented the exit equation by adding an entry variable to the RHS. However, the same was not the case in the entry equation. Instead Shapiro and Khemani used an idea of potential exit in the RHS of the entry equation. To proxy this notion of potential exit, following Baldwin and Gorecki (1983), they used industry sales as a measure of industry size. The rationale was that the potential of successful displacement is a function of the number of firms in operation (industry size). The number of firms in existence, although the obvious variable to choose, was rejected on the grounds that this itself might be conditioned by the barriers.

In terms of research on entry and exit interdependence, Shapiro and Khemani were well aware that, in the presence of 'sound symmetry' (both signs and significance levels of the variables supporting the symmetry hypothesis), the introduction of entry and exit terms into the RHS of the exit and entry equations respectively might reduce the significance of the barriers to entry variables. Whereas this was avoided in the entry equation, it was not in the exit formulation. The entry and exit equations in the absence of an obvious feedback link were then estimated as a recursive system. The results revealed that entry seems to be an important determinant of exit but the degree of observed symmetry was substantially reduced. On the other hand, the logarithm of industry sales in the RHS of the entry equation, as proxy of potential exit, was significant and positive. The interpretation became, then, that potential displacement is more probable the larger an industry is. The important and long lasting conclusion made concerning entry and exit interdependence is that barriers to entry restrict displacement and exit.

Austin and Rosenbaum (1991) followed a three-step procedure to examine the interdependence of entry and exit. First and second, entry and exit equations were estimated with and without interaction terms. A novel element was the introduction of a variable to proxy the relative size of the non-fringe in an industry since entry and exit were assumed to be more active at the industry fringe (Dunne *et al.* 1988). Their results offer some qualified support for the symmetry hypothesis. Barriers to entry tended to keep their sign across the entry and exit equations, but were not always significant. When allowance for interaction was taken, the results remained unchanged and the overall fit of the entry and exit equations increased. When, however, as step three, the entry and exit components appearing in the RHS of the exit and entry equations respectively were assumed to be endogenous, the results proved not to support the simultaneity between entry and exit across the two study periods used. The conclusion was that while entry and exit rates, given a significant amount of fringe activity, are related in the sample, whether or not they are simultaneously determined is unclear.

Evans and Siegfried (1992), using a somewhat different definition of variables and making a distinction between different types of entries and exits (new business starts, diversifying firms using new plant facilities and diversifying using existing plant facilities), estimated a simultaneous equation system to investigate the interdependence between entry and exit. Their methods of using limited information techniques (single equation-two stages least squares estimation) rarely discovered any variable, other than those on the RHS of the endogenous type, to be significant. The notable exceptions were, occasionally, research development and assets over sales proxies. Overall, the authors conclude that the entry and exit behaviour of US manufacturing is quite insensitive to industry conditions. Concerning the role of the RHS endogenous variables, the evidence provided by Evans and Siegfried supports the view that there is a significant effect of both entry on exit and exit on entry, but this holds only for other than diversifying firms. Unfortunately, the authors do not provide single equations estimations without RHS endogenous variables to see the extent to which their introduction affected the barrier to entry variables.

A somewhat different approach to the set up of the empirical entry and exit equation was put forward by Rosenbaum and Lamort (1992). Whereas the entry equation closely follows the tradition established in the empirical literature, the exit equation is quite different. Instead of putting the same barrier to entry variables used in the entry equation also into the exit one, these authors used variables that are more closely related to the notion of sunk costs. The barriers to exit variables deployed were the advertising to sales ratio (recognising to that once committed there is little chance of recovering past advertising expenditures in the event of exit), assets liquidity (assuming an inverse relation to sunk costs), and the primary product specialisation ratio (high degrees of this ratio being associated with higher capital specificity and hence sunk costs, Eaton and Lipsey, 1980). The entry and exit equations differ also in the usual formulation of structural characteristics, such as profits (margins) and market growth, in similar fashion to Shapiro and Khemani (1987). In addition, a measure of the industry fringe was introduced in both the entry and exit equation to take account of higher turbulence at the lower end of an industry's size distribution of firms, as in Austin and Rosenbaum (1991), but in an inverse manner.

The authors base their analysis on five stages. First, the entry and exit equations are estimated separately. The introduction of entry barriers in the entry equation and vice versa comes next. The introduction of interaction terms in both equations follows, and fourthly, the interaction terms as are considered as endogenous in a system of simultaneous equations. The first three stages of the analysis reveal that entry responds to inducements and entry barriers, but not to exit barriers. Exit, in turn, responds to inducements and exit barriers. When interaction terms are included, entry becomes significant in the exit equation and vice versa. However, when these interaction terms are considered as being endogenous in a system of equations, they become insignificant. Moreover, testing the hypothesis of exogeneity does not reject the hypothesis of no correlation between the RHS interaction terms and the disturbance terms in each of the structural system equations. Therefore, as a fifth stage of analysis, Rosenbaum and Lamort (1992) investigate the notion that entry and exit are not causally linked but instead are two related phenomena occurring in some markets being affected by the business environment. Accounting for contemporaneous correlation between the disturbance terms of the entry and exit equations, the authors obtained more efficient (SUR) estimates of the determinants of entry and exit rates. The overall conclusion was is that markets that enjoy high entry rates have also high exit rates, but entry and exit do not respond to each other.

Apart from the study of Canadian manufacturing (Shapiro and Khemani, 1987) and those for US manufacturing (Austin and Rosenbaum, 1991; Evans and Siegfried, 1992; Rosenbaum and Lamort, 1992), all described above, the only known European research trying to sort the correlation between entry and exit into a causal relationship through the use of simultaneous equations is that by Kleijweg and Lever (1994)[73] for Dutch manufacturing industries. Using pooled cross section-time series data and distinguishing between different types of entries and exits, this study concluded that there is a significant interaction between entry and exit, given that general exit was found to be a positive determinant of new firm entry and vice versa. Love's (1996) empirical research also supports that entry and exit are simultaneously determined. However, the latter research, based on a cross section of British counties, does not account for industrial sectors and follows a rather 'entrepreneurial-labour market' approach which differs considerably from the one discussed here. The Sleuwaegen and Dehandschutter (1991) study for Belgian manufacturing industry offers evidence for displacement of incumbents by new entrants, but not in simultaneous context, rather using lagged entry and exit variables in the exit and entry equations respectively.

[73] In a revised version of this work (Kleijweg and Lever, 1996) there is no explicit simultaneous estimation of the entry and exit relationship. Rather some cross-equation correlation of entry and exit equations is introduced by using a SUR estimation framework. Lagged entry is used to determine current exit and vice versa and hence no endogeneity has been accounted for.

The empirical research accumulated so far pertaining to the possible interdependence of entry and exit in manufacturing industries does not offer unequivocal evidence of the processes involved. Furthermore, it seems to point to two different hypotheses about the high positive correlation observed between entry and exit in manufacturing industries. The first assumes that entry and exit are part of system of equations where there is a feedback mechanism running from entry to exit and vice versa. High levels of entry might lead to displacement of existing firms by new entrants, and hence to exit. But also high levels of exit may create room for more entry to take place. Thus, high levels of entry and exit might be simultaneously determined. The second hypothesis is that of natural churning, which is higher industry turbulence due to underlying business conditions. Entry and exit can be highly positively correlated in time across industries but the 'causality' is not clear, as the concept of turbulence is broader than that of the displacement-vacuum effect.

6.4. The relation between entry and exit in Greek manufacturing industries 1982-1988

In the present research gross entry and exit data between 1982 and 1988 provided by the Federation of Greek Industries (FGI) are used. The data unfortunately apply only to the two-digit level of industrial classification, but they do cover up to 3500 firms accounting for about 90% of total assets in Greek manufacturing industry. More up to date data are available, but their use is precluded by a major review in 1989 which resulted in a reallocation of new firms in a manner problematic for consistent time series.

Tables 6.1 and 6.2 provide descriptive statistics of entry and exit rates in Greek manufacturing industries for the 1982-1988 period. Annual entry (exit) rates were defined as the number of firms that enter (exit) an industry in year t over the number of firms in existence in the same industry in time t-1. Table 6.1 provides annual summary statistics for all manufacturing sectors for both entry and exit rates, which are each bounded from below by zero in all years. In five out of seven years it can be seen that the outcome of the entry and exit processes results in a gain of manufacturing firms when evaluated in terms of yearly means.

Table 6.1. Descriptive statistics for entry and exit rates into Greek manufacturing industries 1982-1988

	Minimum	Maximum	Mean	Standard Deviation
Entry Rates				
ER 82	0	15.00	7.47	4.12
ER 83	0	12.85	5.10	3.71
ER 84	0	8.57	4.42	2.52
ER 85	0	14.44	6.94	4.00
ER 86	0	14.81	7.37	4.06
ER 87	0	14.82	5.71	4.11
ER 88	0	20.00	8.73	5.16
Exit Rates				
XR 82	0	10.66	5.45	3.36
XR 83	0	10.95	6.03	2.86
XR 84	0	11.95	6.31	3.07
XR 85	0	10.98	4.60	2.56
XR 86	0	11.76	4.65	2.77
XR 87	0	12.50	5.04	3.58
XR 88	0	12.64	5.75	3.56

Table 6.2 contains descriptive statistics individually for each of the 2-digit sectors over the entire study period. Here the sectoral means are quite different from one another and there are some sectors where both entry and exit rates are bounded from below by zero, as in the case of tobacco and basic metal industries.

Table 6.2. Descriptive statistics of entry and exit rates by sector: Greek manufacturing industries 1982-1988

	Entry Rates					Exit Rates			
	Minimum	Maximum	Mean	Standard Deviation		Minimum	Maximum	Mean	Standard Deviation
ER 20	4.14	9.45	5.96	1.70	XR 20	2.36	5.93	4.43	1.28
ER 21	2.41	10.47	6.26	3.26	XR 21	1.18	11.96	4.44	3.63
ER 22	0.00	11.11	1.58	4.19	XR 22	0.00	0.00	0.00	0.00
ER 23	2.84	10.43	6.19	2.45	XR 23	2.35	7.66	5.28	2.07
ER 24	8.21	16.95	12.95	2.99	XR 24	3.07	8.40	6.00	1.96
ER 25	1.52	13.33	5.90	4.11	XR 25	0.00	12.12	6.28	3.97
ER 26	4.88	17.24	10.74	4.45	XR 26	1.37	12.64	6.18	3.68
ER 27	2.82	8.22	6.18	2.07	XR 27	1.41	10.96	5.55	3.53
ER 28	3.62	10.24	7.36	2.44	XR 28	1.57	10.24	5.61	2.89
ER 29	3.33	14.81	8.37	5.05	XR 29	3.57	10.71	6.15	3.17
ER 30	3.35	9.71	6.85	2.73	XR 30	2.73	7.91	5.19	1.95
ER 31	1.91	5.16	3.73	1.17	XR 31	1.19	4.67	3.65	1.14
ER 32	0.00	5.88	2.47	3.08	XR 32	5.56	12.50	8.34	3.02
ER 33	5.45	10.96	8.03	1.91	XR 33	3.54	7.71	5.30	1.32
ER 34	0.00	5.26	2.18	2.72	XR 34	0.00	10.53	3.61	3.91
ER 35	3.09	11.35	6.21	2.66	XR 35	3.21	8.36	5.61	1.72
ER 36	0.88	11.32	7.08	3.71	XR 36	0.88	9.09	6.03	2.97
ER 37	2.72	9.42	5.66	2.51	XR 37	2.07	8.84	4.64	2.19
ER 38	1.98	15.00	6.07	4.67	XR 38	1.18	11.88	7.45	4.54
ER 39	4.11	20.00	10.90	5.17	XR 39	5.71	10.67	8.30	1.58

In five out of twenty sectors the numbers of firms entering is lower than those exiting — namely, wood and cork, chemicals, petroleum and coal refining, basic metals and transport equipment manufactures. A more detailed analysis on industry and time means of entry and exit along with other variables of interest is given in what follows.

The FGI data have been used in an earlier study by Anagnostaki and Louri (1995a), which examines the validity of the symmetry hypothesis for of Greek manufacturing industries. However, in what follows there are several important methodological differences compared to this research. The previous study excluded all observations of zero value in both entry and exit equations. This resulted in an unbalanced pooled design in the sense that the time series of cross sections were of unequal length. To the extent that these missing observations were not missing at random but rather excluded as a result of the use of a logarithmic transformation of the dependent variables, this may introduce selectivity bias (Hausman and Wise 1979; Heckman, 1979). Perhaps more important, having some 15% percent of observations on zero entry and exit deleted from the sample to facilitate the estimation, does result in a considerable loss of information (Chappell *et al.* 1990).

Whereas in Anagnostaki and Louri, entry and exit rates were used in the regression analyses, the present research following suggestions of Khemani and Shapiro (1986) and Shapiro and Khemani (1987) instead uses absolute values of entry and exit. This choice was made to account for industry size as an important determinant of entry and exit in the RHS of the equations and also to account for different industry sizes. Furthermore, if industry size, proxied by the stock of firms, is itself conditioned by the entry barriers, then according to Khemani and Shapiro (1986) using the stock of firms as a denominator may result in entry and exit rates being relatively stable across industries. This, in turn, may result in a bias of barriers to entry estimators towards zero regardless of many important differences in entry barriers that might exist. Therefore the present approach, adopted elsewhere (Orr, 1974a; Baldwin and Gorecki, 1983; Mata, 1991; von der Fehr; 1991), attempts to exploit the data from a different angle and augment the valuable empirical evidence for entry and exit in the Greek case.

In order to describe best the entry and exit data available to this study, a number of variables that are related to the entry and exit process were constructed. These are the number of firms entering an industry in each of the study years (EN), the absolute value of the number of exiting firms (EX), the entry rate (ER), the exit rate (EX), the net entry rate (NER), a measure of industry turbulence (TR) and a measure of industry volatility (VR). The industry turbulence rate is defined as the sum of an industry entry and exit rate in time t, and the net entry rate as their difference. Moreover, following Dunne and Roberts (1991), the measure of industry volatility is defined as $VR_{it} = TR_{it} - |NER_{it}|$ for every i=1,...,20 two-digit industrial sectors and t=1,...,7 study periods. The industry volatility rate, then, is defined as the difference between the turnover rate and the absolute value of the net entry rate. The rationale for this definition is that it might be a reasonably good proxy for industry turbulence in excess of industry growth or contraction. If the factors underlying across-industry differences in net entry rates usually vary over time, then net entry rates as the result of market selection processes (entry-exit) can be seen as stemming from changes in total market size. Industry turbulence, on the other hand, is always bounded from below by the absolute value of net entry rate. Thus, industry turbulence can be seen as having two components — one resulting in changes in industry size (net entry) and another giving the amount of turbulence in excess of what can be attributed to these changes (volatility). Put differently, volatility accounts for the change in the identities of firms in excess of what can be attributed to changes in market demand conditions.

In what follows a variance-decomposition analysis is carried out for each of the variables described above. Industries vary in the extent of entry and exit. Inter-industry differences in entry and exit activity can be associated with differences in the importance sunk costs restricting entry and exit (Shapiro and Khemani, 1987; Dunne and Roberts, 1991) and differences in the underlying technology factors. Lower entry and exit activity can be associated with lower sunk costs. Industry turbulence differentials across industries become, thus, a negative function of temporally persistent inter-industry differences in both sunk costs and technology factors. The same, however, does not hold for net entry since, for example, a figure close to zero can result from either equally high entry and exit or near zero entry and exit activity. In the former case, as net entry approximates zero then turbulence tends to equal volatility. In the latter case, all net entry volatility and turbulence approximate to zero. Thus, volatility ranges between zero and the value of turbulence, all depending on the stability or growth/contraction conditions of an industry. The most volatile industries, according to this definition are those where large numbers of new firms displace large numbers of older ones without affecting the number of firms in existence (Geroski, 1995) or where the revolving door throws out in its turning the most recent entrants (Audretsch, 1995b).

Table 6.3 gives the variance decomposition[74] as it would be if there was no between-year variation for the total manufacturing to be accounted for.

Table 6.3. Entry and exit into Greek manufacturing 1982-1988: variance decomposition to account for sample variation due to industry specific effects only

	Mean	Total sample variation $\sigma^2 = \frac{1}{NT}\sum_i\sum_t(x_{it}-\bar{x})^2$	Average within-industry variation $W_n = \frac{1}{NT}\sum_i\sum_t(x_{it}-\bar{x}_i)^2$	Between-industry variation $B_n = \frac{1}{N}\sum_i(\bar{x}_i-\bar{x})^2$	B_n/σ^2	B_n/W_n
EN	11.207	129.38	24.72245	104.6561	0.8089138	4.2332***
EX	8.4857	59.093	14.65306	44.43959	0.7520324	3.0327***
ER	0.065391	0.0017342	0.0009607683	0.0007734201	0.4459839	0.8050***
XR	0.054058	0.00097256	0.0006623908	0.000310165	0.3189174	0.4682***
NER	0.011333	0.0023786	0.001783992	0.0005945982	0.2499792	0.3332***
TR	0.11945	0.0030349	0.001462326	0.001572572	0.5181630	1.0753***
VR	0.080762	0.0025449	0.001516079	0.00102883	0.4042699	0.6786***

Multiplying each of the figures of the last column by 120/19 provides the value of an F test with 19 and 120 degrees of freedom for testing the hypothesis that sectoral means are not all the same. This is exactly the same test with that obtained by carrying out one-way analysis of variance for each of the variables appeared in the first column.
*** significant at the 1% level
EN is the absolute number of entering firms
Ex is the absolute number of exiting firms
ER is the entry rate
XR is the exit rate
TR is industry turbulence
VR is the volatility rate

The fourth column is the between-industries variation in relation to total sample variation for each of the variables of interest. Around 80% of the variation of entry is accounted for by differences between industrial sectors that are time-invariant, whereas the equivalent for exit is around 75%. Entry and exit, in absolute terms, produces EN and EX that are highly positively correlated (0.71). Accounting for industry size by dividing by the stock of firms in each industry in the previous period reduces considerably not only the amount of variation accounted by inter-industry time-invariant factors for both entry (44%) and exit rates (31%), but also the positive correlation between ER and XR

[74] The decomposition exercises utilise formulations given in equation 5.2

(0.12). The net entry rate variable, on the other hand, presents the lowest across industry variation amongst all the variables analysed (24%), whereas both the turbulence rate and volatility rate present considerable important sectoral variation 51% and 40% respectively. Nevertheless, these values are smaller than those found in the Dunne and Roberts (1991) study for US manufacturing industries where the between-industry variation amounts for 69% of the total variation in the case of the volatility rate and 57% for turbulence. However, as in the case of ER and XR when compared to EN and EX, deflating volatility and turbulence by the number of firms in existence could potentially decrease the magnitude of the observed between-industry variation.

Table 6.3 tends to confirm the notion that industry size is an important determinant of entry and exit and that to the extent that the stock of firms is not independent of entry (exit), their positive correlation may result in their ratio being less variable across industries than otherwise the case (entry and exit in absolute terms). This could happen regardless of important inter-industry differences in the level of entry barriers.

Since these results of variance decomposition, presented in Table 6.3, refer to one way analysis of variance, they largely ignore the amount of sample variation accounted for by time-variant industry-invariant factors. Stating, for example, that 40% of the sample variation in the case of volatility is between-variation does not necessarily render the remaining of the variation to be entirely attributed to unsystematic (or chance) variation. Thus, in order to assess the relative importance of between-industry variation, both the extent of between-year and unsystematic variation should be examined, as in Table 6.4.

In the first three columns the total sample variation (refer to the second column of Table 6.3) is analysed assuming the absence of any sectoral variation and focusing only on the existence and the extent of temporal variation. The values presented in the third column suggest that in all but two cases the amount of between-year variation is about 5% or less of the total sample variation. The two cases that stand out are the net entry rate with around 13% of the total variation being accounted for by industry-invariant factors, and the entry rates with 11% of the total being due to temporal variation. The fourth and fifth columns give the variance and its share to the total of what could be the residual term or chance variation when both the possible sources of variation in the pooled sample have been taken into account.

Table 6.4. Entry and exit into Greek manufacturing 1982-1988: variance decomposition to account for sample variation due to time specific effects only and total unsystematic variation (error) when both industry and time effects are accounted for

	Average within-year variation $W_t = \frac{1}{NT}\sum_i\sum_t (x_{it}-\bar{x}_t)^2$	**Between-year Variation** $B_t = \frac{1}{N}\sum_i (\bar{x}_t-\bar{x})^2$	B_t/σ^2	B_t/W_t	$\sigma^2 - B_n - B_t$	$\frac{\sigma^2 - B_n - B_t}{\sigma^2}$
EN	123.2496	6.128878	0.04737168	0.0497273	18.59357	0.1437145
EX	58.09500	0.9976531	0.01688286	0.0171727	13.65541	0.2310847
ER	0.001537130	0.0001970581	0.1136313	0.1281634	0.0007637102	0.4403848
XR	0.0009342777	0.00003827811	0.03935826	0.0392802	0.0006241127	0.6417243
NER	0.002067059	0.0003115318	0.1309733	0.1507014***	0.001472460	0.6190475
TR	0.002875757	0.0001591406	0.05243690	0.0553256	0.001303185	0.4294001
VR	0.002436508	0.0001084002	0.04259493	0.0444900	0.001407678	0.5531352

Multiplying each of the figures of the fourth column by 133/6 provides the value of an F test with 6 and 133 degrees of freedom for testing the hypothesis that yearly means are not all the same. This is exactly the same test with that obtained by carrying out one-way analysis of variance for each of the variables appeared in the fourth column.
*** significant at the 1% level
EN is the absolute number of entering firms
EX is the absolute number of exiting firms
ER is the entry rate
XR is the exit rate
TR is industry turbulence
VR is the volatility rate

In the light of these results it seems that entry (EN) and exit (EX) have the smallest amount of chance variation, those with largest being the exit rate (XR) and net entry rate (NER). Thus, although net entry rates have the lowest sectoral variation and the highest temporal variation of all variables considered (see also Dunne and Roberts 1991 for similar results), their greater proportion of variation seem to stem from chance factors that cannot be attributed to industry and time-specific fixed-effects. These results contradict those of the earlier chapters using net entry data taken from a different source where net entry rates were found to exhibit significant temporal but not sectoral variation.

Overall, the results of the variance decomposition exercise suggest that factors underlying inter-sectoral differences in industry turbulence might be attributed to inter-sectoral differences in the importance of technological factors and sunk costs, and that the latter seem to be more persistent over time than differences in the amount of turnover due industry growth or contraction (net entry).

6.5. Symmetry and simultaneity in Greek manufacturing industries 1982-1988

Here an attempt is made to account for symmetry and simultaneity in entry and exit into Greek manufacturing between 1982 and 1988. In doing so, a number of industry variables are employed as regressors since the previous results revealed that the primary source of variation in entry and exit is differences in structural characteristics of industries that do not evolve that much in the short-run. It should be made clear that, although the variables employed demonstrate significant sectoral variation, this does not mean that they are one hundred percent time-invariant. That is, they do not present the same value within each sector from year to year. On the contrary, they vary within a sector as they vary across sectors over the study period. It is, however, the latter source of variation that better describes the action of these variables, the former accounting for the smallest, and often statistically insignificant, part of the systematic variation observed.

The formulations used here for entry and exit are quite similar to those in the literature but are not exactly the same. In particular entry (EN) was formulated as a function:

$$EN = f(PCM_{t-1}, SCALE, CLR, ARDT, DFS, SMFP_{t-1}, ROOM) \qquad (6.1)$$

The variable EN is the number of firms that enter. PCM is an industry's price cost margin defined as before. It is taken with a one-year lag in the entry equation and is hypothesised to have a positive influence on entry. SCALE is used to proxy the extent of economies of scale in industry. This compound variable is defined as $MEPS/CDR$ where MEPS is an industry's minimum efficient plant size and CDR is an industry's cost-disadvantage ratio. MEPS, in turn, is defined as the ratio of minimum efficient size (MES) over employment. In order to define MES an approach similar to that suggested by Pashigian (1969) was used. This is essentially the weighted measure described by formulation (4.1) in section 4.2.

The cost disadvantage ratio was defined as value-added over employment in the smallest size class over the same measure for productivity for the largest size class. CLR is a capital to labour ratio defined for each industry in each of the study years. Data on capital stock are not available from the NSSG so estimates in constant prices provided by

Georganta *et al.* (1994) were used. The capital to labour ratio is used as a proxy for capital requirements and, as in the case of the economies of scale (SCALE) proxy, is expected to exert a negative influence on entry. ARDT is the same surrogate for the product differentiation effort made in each of the 20 two-digit industries in each of the study years used in the earlier empirical chapters. The effect of this variable on entry is ambiguous. On the one hand, a high ratio is usually expected to create a disadvantage for potential entrants due to the sunk costs that they involve and/or the consumer's loyalty in favour of incumbents that they create. On the other hand, advertising intensity may be less of an entry barrier in that advertising outlays may serve as a means for informing buyers about the entry of new products (Kessides, 1986, 1991). Deflated industry sales were used to account for different industry sizes in the RHS formulation of the entry equation following the suggestions of Shapiro and Khemani (1987). Industry size is anticipated to be positively related to industry turbulence and, hence, to both entry and exit. Industry sales were deflated using wholesale price indices provided by the NSSG by industry and study year. As in Austin and Rosenbaum (1991) and Rosenbaum and Lamort (1992), account for higher entry (and exit) activity in the industry fringe (Dunne *et al.* 1988) was taken by introducing small firm presence (SMFP) as a proxy for the magnitude of fringe activity existing in each industry. SMFP was calculated as the number of firms in each sector employing capital of less than 50 million drachmas over the total number of firms (using FGI data). Following Shapiro and Khemani (1987), lagged industry growth in terms of employment was deflated by minimum efficient size to produce ROOM in the entry equation, since the entry decision depends on sufficient growth to justify additional capacity in an industry. The effect of industry growth is expected to have a positive effect on entry.

The exit equation is defined as:

$$EX = f(PCM, SCALE, CLR, ARDT, DFS, SMFP, EMPLGR) \qquad (6.2)$$

The main differences between the entry and exit formulations concern the in-phase values of both the price cost margin (PCM) and the measure of extent of small firm presence in an industry (SMFP), as well as the fact that industry growth from the preceding year, in terms of employment (EMPLGR), is not deflated by minimum efficient size and no real lag was taken.

In studies having both entry exit equations recognition has been given to the situation that exit might be more highly responsive to industry profitability and growth conditions than entry, so profits are taken with zero lags in the exit equation (Shapiro and Khemani, 1987; Rosenbaum and Lamort, 1992). This approach does not deny that exit is unlikely to be instantaneous, but rather emphasises that the exit lag should be shorter than for entry, implying that exit is a forced action whereas entry could be more well thought out. SMFP was taken in phase, merely to facilitate the identification problem in a later stage of the analysis.

Whereas the effect of industry growth on exit is expected to be negative and that of higher small firm participation positive, the effect of PCM is left as ambiguous. Industry profitability might be positively related not only to entry, but also to exit in that, although many entrants are attracted to more profitable operations, less can meet the qualifications for successful entry and survival (Dunne and Roberts, 1991).

Having defined both the entry and exit equations, the discussion now turns to specification issues. Since Orr's (1974a) seminal paper, concern has focused on the non-negative nature of entry and its consequences for the econometric study of entry. As entry and exit are non-negative, the distribution of error terms is truncated. Limiting the range of the values of the dependent variable leads to a non-zero mean of the error term and to bias and inconsistency of least squares estimators (Kmenta, 1986). In addition, OLS estimates could generate negative values for entry (exit) which are inconsistent with the observed experience. This is true regardless of the use of absolute or relative specifications of entry and exit. In the latter case, the entry (exit) variables are often, in practice, bounded from below by zero and above by one, although there is no theoretical justification for this (Khemani and Shapiro, 1986). Several ways have been suggested in the empirical literature to confront this problem. Orr (1974a, p. 62) assumed that entry can be formulated as:

$$E = \beta_0 e^{\beta_1(\pi_\rho - \pi^*)} e^{\beta_2 \dot{Q}} u_1 \qquad (6.3)$$

where π^ρ is past industry profit rate, π^* is the entry forestalling level of profits, $\dot{Q}$ is the past industry rate of growth of output and u_1 *is a log normal error term.* Taking the logarithm in both sides of the Orr formulation linearises the equation and, taking advantage of the result that $\log(u_l)$ is normally distributed, restricts the regression fitted values to non-negative values. What is unclear is how Orr employed this transformation for zero values. However, as Khemani and Shapiro (1986) suggest, adding one to all zero and non-zero observations of entry (exit) in absolute terms eliminates the zero-observations problem without eliminating the zero observations in the transformed model, since the logarithm of one is zero, so distinction can be still made between sectors having zero and non-zero entry (exit).

Another alternative solution is based on Poisson regression (Chappell *et al.* 1990), which can be applied when absolute entry (exit) is used since it accounts for a non-negative discrete dependent variable. Poisson regression was in fact implemented and results obtained (not reported here) which were quite similar to those derived from an OLS specification. The latter was preferred because it facilitates the operationalisation of a simultaneous formulation. A final alternative is the Tobit model, which accounts for both the non-negativity of the entry variable and a concentration of zero entry observations (Masson and Shaanan, 1982; Mata, 1993a). In particular, Masson and Shaanan view entry as being censored, which is the same as including exit as part of the same linear relationship as entry, but keeping it unobserved. This is not unproblematic in the context of the present research as it assumes that the values of the independent variables that correspond to zero entry could, in the absence of censorship, produce negative entry. Thus zero is a surrogate. Moreover, the estimation of the Tobit model requires the ordering of the zero and non-zero values of the dependent variable and, of course, of the corresponding values of the independent variables. Thus, it is assumed that the range of observations of the independent variables corresponding to zero entry is that which could potentially describe the unobserved negative entry values. The objections to the use of Tobit model become twofold. First, the classical Orr specification (limit profits) model allows for zero entry values as an outcome. Entry can still occur if $\pi^{p} = \pi^{*}$ (Baldwin and Gorecki, 1983) and if there are industry averages which obscure the possibility of successful displacement of less efficient incumbents by more efficient entrants, especially at the industry fringe. Second, it has become evident in applied research that, for the same range of RHS formulations, industrial sectors do experience both entry and exit (see review of comparative evidence in Cable and Schwalbach, 1991 and Siegfried and Evans, 1994 and also section 2.2.4). This point has been aptly put by

Geroski (1991a) who maintains that *"...if all entry were endogenous in the sense that entry (exit) occurred only when positive (negative) excess returns emerged in markets then one would expect to observe either entry or exit, but not both"* (ibid. p. 25). Thus, entry is not censored in that it is not just the range of the independent variable values corresponding to zero observed entry that can produce negative entry or exit. For Mata (1993a), the use of Tobit model is reserved for the presence of many zero values, whereas the logarithmic transformation is preferred when there are just a few observations at zero.

Here the logarithmic transformation is preferred for reasons explained above maintaining the view that zero entry (exit) is just another possible outcome to be accounted for by the RHS variables and should not be viewed as surrogate. The use of Tobit model may be more appropriate when the model's intention is to explore a desire to enter, but again some justification of the reasons why positive levels of this desire necessarily lead to actual entry should be provided.

Table 6.5 presents the results of the econometric estimation techniques employed. In the first two columns the results arise from OLS estimation of the entry and exit formulation described earlier. Both estimations were made in the presence of moderate collinearity. The highest condition indices (Belsley *et al.* 1980) were 18.350 in the entry equation and 15.414 for exit, which are both below the severe problem multicollinearity cut-off. When variance decomposition was carried out, the variance proportion of both PCM and PCM_{t-1} corresponding to these indices where above 0.5 meaning that the estimates of these variables might not be accurate. However, under alternative specifications these estimates were not significantly altered and retained their significance levels. The OLS results on entry and exit were also tested for group-wise heteroscedasticity, a form particularly relevant to pooled cross sections and time series (Kmenta, 1986). Testing was facilitated by means of a Lagrange multiplier test. All the partial cross-sectional variances were estimated using the pooled-OLS residuals and the divisor was T and not T-K (Greene 1993, p. 450), where T stands for the number of time series available for each cross section and K is the number of regressors (constant inclusive). For 20 degrees of freedom the values of chi square were 19.9 and 24.7 for entry and exit respectively, which are lower than the critical value of the test at the 5% percent level of significance, leading to the acceptance of the hypothesis of group-wise homoscedasticity in both the cases.

Table 6.5. Entry and exit in the Greek manufacturing industries 1982-1988: some regression results

Explanatory	OLS		2-SLS		OLS with interaction		SUR	
Variables •	EN	EX	EN	EX	EN	EX	EN	EX
PCM_{t-1}	0.47131***	–	0.046473	–	0.30960**	–	0.42368***	–
	(0.1418)		(0.5862)		(0.1336)		(0.1399)	
PCM	–	0.43498***	–	0.027235	–	0.16928	–	0.38068***
		(0.1594)		(0.2070)		(0.1507)		(0.1573)
SCALE	-17.667***	-10.074***	-6.9437	1.7081	-13.585***	-2.3962	-18.021***	-10.625***
	(3.128)	(3.486)	(14.67)	(5.332)	(2.971)	(3.410)	(3.119)	(3.477)
CLR	-0.030947**	-0.034106**	0.000332	-0.0092312	-0.01904	-0.01789	-0.031976**	-0.034419**
	(0.01519)	(0.01674)	(0.04483)	(0.01759)	(0.01409)	(0.01531)	(0.01517)	(0.01673)
ARDT	-11.045**	-16.224***	5.1264	-7.8513	-4.8893	-10.768**	-10.753**	-16.045***
	(5.252)	(5.950)	(22.27)	(6.167)	(4.954)	(5.432)	(5.250)	(5.937)
DFS	0.65628***	0.62208***	0.045631	0.12422	0.42384***	0.29766***	0.64343***	0.60586***
	(0.07109)	(0.07964)	(0.8162)	(0.1958)	(0.0791)	(0.09114)	(0.07079)	(0.07926)
$SMFP_{t-1}$	1.1860***	–	0.14900	–	0.79129***	–	1.1310***	–
	(0.1444)		(1.389)		(0.1528)		(0.1427)	
SMFP	–	0.99220***	–	0.16742	–	0.45474***	–	0.95094***
		0.1602		(0.3345)		(0.1721)		(0.1581)
ROOM	5.1130**	–	2.5820	–	4.1496*	–	4.0124*	–
	(2.519)		(4.356)		(2.313)		(2.339)	
EMPLGR	–	-0.36118	–	0.019127	–	-0.11336	–	-0.10668
		(1.136)		(1.031)		(1.022)		(1.055)
EX	–	–	0.99405	–	0.37838***	–	–	–
			(1.323)		(0.0734)			
EN	–	–	–	0.73064***	–	0.47611***	–	–
				(0.2674)		0.0835		
CONSTANT	-9.2804***	-8.8505***	0.99405	-1.8499	-5.9678***	-4.2886***	-9.0618***	-8.5881***
	(1.284)	(1.442)	(1.323)	(2.872)	(1.340)	(1.523)	(1.278)	(1.434)
$\bar{R}^2$	0.7150	0.5532	0.6331	0.6137	0.7612	0.6393	R^2 0.7284	R^2 0.5750
							System R^2 0.7465	

Significant at the 99%(***), 95%(**) and 90%(*) confidence level using two-tailed-test. • see text for discussion and description of explanatory variables
Standard errors in parentheses. Logarithms apply to PCM, PCM_{t-1}, and DFS.
EN is the absolute level of entry and EX is the absolute level of exit.

Since the test requires normality in the error term, the Jarque-Bera (1980) test for normality was implemented. The value of this test (χ^2 with 2 degrees of freedom) was 1.98 and 2.77 for entry and exit respectively, both lower than the critical value at 5%, thus accepting the assumption of normally distributed errors. It is worth noting that when the same models were estimated without logs on the dependent variables the values of the test were 41.88 and 29.87 pointing to serious deviations from normality.

The opportunity to account for the omission of certain types relevant variables is offered by pooled designs such as this. One way is to assume that in the absence of any measurement errors the effect of omitted variables is constant over time and introduce industry-specific dummies to account for time-invariant industry-fixed effects, estimating the model without a constant term (Geroski, 1991c, Yamawaki, 1991; Dunne and Roberts; 1991). Another possibility is to account for the omission of time varying industry-invariant variables (interest rates for example) by introducing time dummies, or to account for both types of omission by introducing both industry and time dummies, making the necessary modifications to avoid the dummy variable trap. In the light of the results of the variance decomposition discussed earlier, this seems at first glance the most appropriate. Therefore, both in the entry and exit equations industry-dummies were introduced and their overall significance was tested by the usual F-test between the unrestricted (dummy variables inclusive) and the restricted models. For both the entry and exit equations the results of these tests favoured the introduction of the industry-dummies. However, their introduction seriously affected the significance of the estimated coefficients of almost all variables, other than dummies. To much lesser extent, the effect of industry dummies at work on focus variables has been reported in Dunne and Roberts (1991), where the signs of both price cost margins and capital to output ratios were altered across some entry and exit formulations when industry-specific fixed effects were accounted for by using a within-industry transformation (equivalent of using industry dummy variables).

Why this happens is a difficult question. However, the results of the variance decomposition might be helpful in sketching a possible explanation. According to tables 6.3 and 6.4, it appears that for the entry variable (EN) only 14% percent of total variation is unsystematic or chance variation (error). The remainder (systematic-variation) is accounted for by 94% industry effects and 6% time effects. This indicates more or less that carrying out regression of EN on only industry dummies could account for an extremely high amount of total sample variation. Indeed the amount of total variation of the logarithm of entry accounted for by industry dummies alone reaches the impressive 86%. When exit is examined, unsystematic variation accounts for 23% of total variation of the untransformed exit. In the systematic variation, industry fixed effects contribute 98% and the remainder is due to time fixed effects. Regressing the log of exit on industry dummies alone produces the quite high explained variance of 0.66.

In the light of the above, it is evident that most of the behaviour of both the dependent variables used in this research is explained by industry effects. The within-industry transformation takes off these effects (essentially removing the between-variation part) and, seemingly, the remaining variation in the explanatory variables used does not account for much. This was then checked by regressing, one by one, all the independent variables on only industry dummies. In all but two cases, the R^2 values obtained were high and the vast majority of dummies were highly significant. The only exceptions were the variables ROOM for the entry equation and EMPLGR for exit, which both present more temporal variation than the others. Moreover, if the within-industry transformation is extended to encompass both industry and time effects, the dependent variables are left presenting only a small amount of unsystematic variation. As a conclusion, it seems that all the action is in the individual effects and the remaining variation does little to explain the behaviour of entry and exit. If this is a real explanation for the interference between the industry dummies and the structural variables, then a possible remedy would be simply to search for other variables. This outcome represents a paradox since the objective is first to explain variation of entry and exit and second, to assess the importance of structural variables, the latter not surprisingly presenting only a modest amount of time variation especially in such a short time series. Furthermore, in that all major variables traditionally used to proxy barriers to entry are quite time invariant in the short run (Geroski, 1991a) this renders other potentially successful candidates likely to suffer from the same problem. Thus, often the very fact that structural variables are quite time invariant has been blamed for low explanatory power in models using entry rates, which usually present both more temporal and unsystematic variation, or even in panel-data entry rate models with fixed effects (Geroski, 1995).

This discussion generates some hard to solve trade-offs. On the one hand, ignoring the role of omitted factors gives rise to the possibility of obtaining biased estimates. On the other, the introduction of the omitted factor effects spoils the structural variables. However, the inference on structural variables is likely to be more meaningful than inference based on fixed effects alone. Thus, as in other studies using pooled data (von der Fehr, 1991), no fixed effects are included and the risk that the estimates might be biased is acknowledged.

These pooled estimates are used, then, to make inference for the validity and the extent of the symmetry hypothesis in Greek manufacturing industries in the recent past. Inspection of the first two columns points to 'sound symmetry' as regards entry (exit) barriers. In particular, the economies of scale proxy used (SCALE) presents a strong barrier to both entry and exit. The same applies to the capital intensity barrier, proxied by the capital to labour ratio (CLR), but to a lesser degree. Product differentiation (ARDT) efforts play an important role in deterring both entry and exit, probably due to the considerable sunk costs they imply and the competitive advantages in favour of the incumbent firms they create. However, by far more interesting is that the OLS results seem to suggest that this kind of symmetry can be extended to variables other than those that traditionally describe barriers. Thus, industry profitability turns out to be positively related to both entry and exit. This confirms the finding by Dunne and Roberts (1991) for US manufacturing industries that high profits attract entry, but also high profits are associated with frequent exit. In addition, this result points to the notion that higher margins might indicate more turbulent industries. However, this calls for the understanding of the role of the two crucial factors — entry barriers and the extent of industry fringe. In the presence of both higher margins, as an indication of the possibility of profitable operations in an industry, and higher entry barriers, it transpires that not all attempts at entry end up successful, entrants meeting the requirements for entry and survival in the medium and the longer run. The existence of a larger industry fringe may indicate the possibility of serving market niches that are somewhat protected by those barriers operating in other segments of an industry. This, in turn, may encourage entrants to ignore perceptions of the overall condition of entry barriers. Nevertheless, in that the industry fringe may not attract the rivalry of larger incumbents, this might not be the case when the challenging stems from outside an industry. Fringe firms, as a result, might be subject to rivalry from potential entrants of the same kind. If the latter holds, then industry fringe can be expected to produce higher turbulence in the industry and a greater possibility of displacement.

In the present case, the extent of the presence of smaller firms (SMFP) in an industry has a strong positive effect on both entry and exit. Entry and exit are largely driven by movements among a fringe of smaller firms (Dunne *et al.* 1988; Austin and Rosenbaum, 1991; Rosenbaum and Lamort, 1992) and a considerable amount of displacement in industry can be attributed to these movements.

The result for small firm presence can be then combined with that for industry size (DFS) which is found to be positively associated to both entry and exit. The larger an industry, the larger the possibility for successful displacement (Baldwin and Gorecki, 1983; Shapiro and Khemani, 1987; Mata, 1991), and the larger the industry fringe compared to total industry size, the more probable is that much of this displacement occurs at the industry fringe.

The two variables used to assess the effect of industry growth on entry and exit are respectively those of lagged industry growth deflated by minimum efficient size (ROOM) and industry growth from the preceding year (EMPLGR). These prove to be alone in deviating from the symmetry rule. Whereas ROOM found to be positive and of moderate significance in the case of the entry equation, EMPLGR turned out to be negative and insignificant for exit. Industry growth is more effective as an incentive to enter than as an impediment to exit.

In summary then, these results tend to confirm the symmetry hypothesis for factors determining entry and exit. In addition, the sign and significance of industry size (DFS) and the industry fringe in both the equations give rise to speculations that considerable displacement might occur especially at the industry fringe. The speculations can be reinforced by the variance decomposition results where industry volatility — turbulence in excess of what is determined by demand conditions — was found to exhibit a significant amount of sectoral variation, pointing to relatively time invariant inter-industry differences in the extent of changes in the identities of operating firms.

The analysis proceeds now to examine whether on not this implied change in the identities of firms operating in industries is due to some displacement-vacuum phenomenon at work. If this is the case, then a feedback mechanism running from entry to exit, and vice versa, can be established by introducing entry and exit as RHS endogenous in the exit and entry equations respectively, and the simultaneity hypothesis can be tested.

The third and fourth columns of Table 6.5 present the results of estimating the structural equations using limited information techniques (two stages least squares — 2SLS). Dramatically, the results render almost all the variables in both the system equations insignificant, with the notable exception of the RHS entry variable in the exit equation, which appears to be positive and highly significant. This might imply that entry is an important determinant of exit, whereas the reverse is not supported. Apart from the insignificance of the entry barriers in both the equations, the considerable degree of change in signs, when compared with those of the OLS estimates, is a disturbing factor. However, this is not a new finding, since most previous studies have encountered similar problems. In Shapiro and Khemani (1987), the introduction of entry as a RHS variable in the exit equation, indeed, biased downwards the significance of almost all of the other explanatory variables employed. At the same time, the coefficient of advertising changes its sign, and the same applies to the price-cost margin variable, when both are compared to the OLS results for the exit equation without entry as a RHS variable (interaction term). In Austin and Rosenbaum (1991), when exit was introduced on the RHS of the entry equation, the minimum efficient size proxy produces the correct negative sign for the first study sub-period but is not insignificant, whereas the capital requirements proxy becomes positive and insignificant for the second sub-period. When the same study uses a simultaneous-equation framework to view the interrelation between entry and exit, an even more substantial alteration in signs occurred and detailed examples could be given. It is also worth-noting that in this study none of the coefficients are significant in the exit equation and only industry growth, exit and to some lesser extent, profits, explain entry rates.

So most studies (the present one included) suffer to some extent either from insignificance of structural variables or substantial alteration in signs as a result of formulations that employ entry as a RHS exogenous or endogenous component in the exit equation and vice versa. Yet it is the same kind of problem that led Evans and Siegfried (1992) to the surprising conclusion that entry and exit into US manufacturing industries are quite insensitive to industry conditions as rarely do any industry-variables turn out to be significant in their 2SLS results for both entry and exit.

It would not be accurate to maintain that in all studies the introduction of entry as a RHS exogenous variable in the exit equation and vice versa creates such problems. The work of Rosenbaum and Lamort (1992) is one exception but their formulations, in contrast to other studies, distinguish barriers to entry from those of exit. Thus, the introduction of RHS entry and exit as exogenous variables do not significantly alter their OLS results. Nevertheless, substantial alteration in signs also does occur in this study when entry and exit become endogenous in the exit and entry equation respectively (three stages least squares — 3SLS).

To ascertain why such an upheaval occurs in most of the entry and exit interdependence exercises is not an easy task. In the present research the examination of the symmetry hypothesis shares equal weight as that of the simultaneity hypothesis in specifying possible links between entry and exit processes. Indeed, the results obtained reveal a great deal of 'sound symmetry' in the determinants of entry and exit. Given this, the research proceeded to examine the simultaneity between entry and exit. The 2SLS procedure employed assumes, in the first place, that entry is correlated with the residual of the exit equation and vice versa, leading to biased and inconsistent estimates. For this very reason the procedure requires, at the first stage, regression of the 'endogeneity-suspect' variables on all the RHS exogenous variables in the system. The fitted values obtained from this stage, being purged of any correlation with the residuals of the relevant equations, are then employed in place of their original counterparts for the estimation to proceed to a second stage. However, these fitted values may well be correlated with other RHS variables to the extent that these fitted values represent some variable whose variation is already well accounted for by variables appearing in the RHS of the same equation. In practice, the amount of variation of fitted values accounted for by RHS side variables may well be higher than that of the original variable explained by the same variables. The reason is that the original variable differs from the fitted values by an amount that equals the residual term — the amount unexplained by all the exogenous variables in the system. It follows that the fitted values of the regression represent a variable whose variation is merely determined by the system exogenous variables. Thus, the problem of linear dependencies on the RHS might even deteriorate in the second stage of estimation, when compared to estimation with RHS interaction terms. The magnitude and the sign of the coefficients might also be affected. This crucially depends on the extent to which the exogenous variables appearing in the relevant equation contribute to the production of the fitted values at the first stage of the 2SLS procedure. If this is indeed the case, then the insignificance of RHS exogenous variables and any alteration in signs might be explained in this framework.

In the presence of 'sound symmetry', circumventing the identification problem in the mathematical sense may not necessarily ensure real identification in the sense that the real effect of all the variables in the system can be distinguished. However, since a primary objective is to infer whether or not entry and exit are simultaneous, additional testing is necessary. First, a test to examine whether or not the RHS exogenous variables can offer valid instruments for estimation of the predicted values of both entry and exit to be used in the second stage of the estimation was carried out. Testing was facilitated by Sargan's test for the validity of instruments (Stewart, 1991). The test is χ^2 with 2 degrees of freedom. The test values being 1.71 and 1.31 for entry and exit respectively are lower than the critical value at 5% and pass the Sargan's test supporting the instruments used. To explore the endogeneity issue for both entry and exit a Hausman-Wu test (Stewart, 1991) was undertaken. The values of this test (χ^2 with 1 degree of freedom) were 0.21 for testing the hypothesis of exit being exogenous in the entry equation and 0.84 for testing the exogeneity of entry when the exit structural equation is concerned. Both values are lower than the test critical value at the 5% level providing for the acceptance of the null hypothesis of the exogeneity of both entry and exit in the exit and entry structural equations respectively. This means that although entry and exit seem to be related in industries, they are not simultaneously related. Entry does not force exit and exit does not make room for entry. Being somewhat more critical, it is felt that some points related to the interpretation of the Hausman-Wu test made by Geroski (1982), and also shared in Rosenbaum (1993), should be included in the discussion. In particular Geroski maintains that this test aims, in principle, to determine whether or not the RHS 'endogeneity-suspect' variable is correlated with the residuals of the relevant equation. Rejection of the null hypothesis according to Geroski does not necessarily mean that the variable of interest is exogenous, since it can be endogenous satisfying at the same time the condition of no correlation with residual term. The adoption of this version of interpretation of the

Hausman-Wu test seems to imply that only the non-correlation with the residual terms can be asserted. This, in turn, means that if entry and exit are introduced as RHS variables in the exit and entry equations respectively, no matter if they are endogenous or exogenous, the OLS estimates obtained are consistent and the test null-hypothesis is sustained.

The estimation results when entry and exit terms were introduced as RHS exogenous variables in the exit and entry equations respectively appear in Table 6.5 columns five and six. Although the overall fit of the models was increased when compared to the OLS results without interaction terms, this was achieved at the expense of higher linear dependency between the regressors. Moreover, the introduction of interaction terms biases downwards the significance levels of regression coefficients in both the entry and exit equations, without, however, affecting their signs when compared with the OLS results. Any reduction in the significance of these coefficients should not be taken as negating the sound symmetry revealed by the OLS without interaction results. On the contrary, it may be taken as extra evidence in favour of symmetry in that there is some degree of linear dependency between exit and entry barriers.

What stands out from the interaction exercise is that both the interaction terms are positive and highly significant, rendering both entry as a significant determinant of exit and vice versa. The significance of the interaction terms perhaps is another way of demonstrating that industries that experience high entry experience also high exit. Entry and exit are two contemporaneously related processes. Or, using the terminology in Austin and Rosenbaum (1991), industries seem to 'churn'. What remains less clear, though, is whether entry and exit are also simultaneous. Even under the most rigorous interpretation of the Hausman-Wu test, the insignificance of exit in the entry equation does not support the existence of any profound mechanism simultaneously connecting entry to exit, and vice versa. If there was any such link between the two processes, then the expectation would be significant entry and exit coefficients in the simultaneous equation framework.

If entry and exit are two actions experienced by industries in time and both can be affected by exogenous market forces (shocks), then a technique that allows correlation between entry and exit in the same industries and time appears useful. The technique should allow for entry and exit, in the presence of symmetry, as being facets of the same coin rather than as being simultaneously determined. If entry and exit are significantly correlated within industries in time then this should show up when calculating contemporaneous correlation between entry and exit. Indeed, the overall correlation coefficient between the residuals of the entry and exit equations (columns one and three of Table 6.5) is 0.36 which encourages further elaboration. In particular, to test the hypothesis of the existence of non-zero within-industries correlation of entry and exit in time a Breusch-Pagan Lagrange multiplier test (Breusch and Pagan, 1980) was carried out. The test has a value of 18.67, which is well above the critical value of a χ^2 distribution for 1 degree of freedom at the 1% level, leading to the rejection of the hypothesis that there is no cross sectional dependency between entry and exit.

To account for non-zero contemporaneous correlation between entry and exit a SUR technique was also used in the last stage of the analysis. The results of this estimation appear in columns seven and eight in Table 6.5. The estimated coefficients are quite similar to those of the pooled OLS in the first two columns, and have the same signs, while the reduction in the standard errors in the majority of the estimated coefficients points to some efficiency gains.

6.6. Conclusions

The results of this research reveal that firm entry end exit are highly linked in Greek manufacturing industries between 1982 and 1988. Symmetry appears to be demonstrated and extended beyond traditional barriers to entry measures. As in other studies, entry and exit are positively correlated with each other and with price cost margins. This indicates that turbulence might be characterising more profitable industries, in that these offer both the attractions and also the impediments leading to both higher entry and exit. This result contradicts earlier findings by Anagnostaki and Louri (1995a) where average industry profits were found to be positively related to entry, but not to exit rates. However, this and other differences could, and perhaps should, be attributed to methodological differences between the two studies.

Considerable change in the identities of firms operating in the industries is implied by the coefficient of both the industry size and the extent of industry fringe proxies. In addition, there might be inter-industry differences in time invariant factors such as the technological environment and the sensitivity to sunk costs that offer grounds for considerable differences in industry turbulence and volatility rates. The latter could also serve as a proxy for the degree of change in the identities of firms, since it can be anticipated that if there is excess turbulence beyond what can be attributed to prevailing demand conditions, a higher propensity for displacement would result.

Whereas both the statistical analysis and the single equation OLS results, with and without interaction terms, imply that changes in the identities of firms should occur, the simultaneous equation estimation results do not offer sufficient grounds to justify any causal link between entry and exit. If there is a degree of change in the identities of firms within industries, this is not the result of a displacement-vacuum effect. More likely, it is the result of both entry and exit responding similarly to structural conditions within an environment of industry turbulence — natural churning. Changes in the identities of firms thus become, eventually, the result of a trial and error process where inefficient firms are forced to exit, probably due to their own poor performance, while potential entrants are ready to try their luck for successful entry and survival.

Since the residual terms in both the entry and exit equations represents omitted factors from these equations, their correlation within industries in time seems to mean that not only are entry and exit linked through the symmetry in the industry structural factors, but also through their response to factors unaccounted for in these formulations.

Overall, the conclusion to be drawn is that entry and exit are linked, industries that experience higher entry experience also higher exit, entry and exit are both affected by the same structural conditions and respond similarly to common unaccounted for factors, but whether or not entry and exit are simultaneous remains unclear. Entry and exit seem to be two facets of the same coin and the occurrence of symmetry might mask the real relationships.

Moreover, whether or not the 'forest' or the 'revolving door' metaphor applies is a question difficult to call. But, the qualified rejection of the existence of some profound feedback mechanism running from entry to exit, and vice versa, and the positive and significant effect of the industry fringe, together with the significance of entry barriers (especially that for the scale economies proxy), all support the probability that, if there is a degree of change in the identities of firms, this will be more at the industry fringe within larger industries, and in the shorter run. This pushes the revolving door a little. For a pointer to be given with less hesitation, firm level data analysis is required to reveal more about the traits of firms that enter and exit in an industry, and the possible match in their identities in both the short and longer run.

Chapter 7.

Spatial variations in new firm formation: what do we know?

7.1. Introduction

In this chapter the literature relating to entry and exit of firms in a spatial context rather than across industries is the focus of the review. This task has already been pursued in some detail by Mason (1991), Keeble *et al.* (1993), and to a lesser extent by Westhead and Moyes (1992). A somewhat earlier account of theoretical considerations and empirical evidence can be found in Keeble and Wever (1986). In the present review the bi-directional approach adopted in the second chapter is maintained. First, the effects of entry and exit on regional economies are examined to offer some justification as to why the determinants of across-space variations of entry and exit movements should be worth empirical consideration. Thus, a general discussion on the effects of the processes of interest opens this section. Issues relating to the interaction of entry and exit, diversification of industrial base, and innovation are considered next. The discussion proceeds, then, to a survey of empirical evidence on the determinants of spatial variations in entry and exit.

7.2. The importance of entry and exit of firms in a spatial context

So far the discussion has been limited to the importance of entry and exit as market regulators and a structural approach considering aspatial markets has been followed. Nevertheless, entry and exit of firms enjoys an importance not only in the case of sectors but also in the case of regions, and an attempt to appraise the latter is also worth of consideration. The single observation that the size distribution of firms is left skewed, usually there are more smaller firms than large ones in an industry, has attracted the attention of a growing literature on small firm behaviour. Small firms are numerous and collectively may account for more employment than their larger counterparts. This seems to persist in the short-run despite the existence of entry barriers. This consideration might be extended to the case where the industrial level of analysis gives way to the spatial one. The size distribution of firms might be left skewed in spatial context as well.

New firms start their lives often at a sub-optimal level. Some, in the course of their lives, grow to match the industry's optimal level. Some remain sub-optimal, whereas others contribute to exit soon after their establishment. However, the fact remains that small firms collectively continue to outnumber their larger counterparts at the same time accounting for a significant proportion of sectoral as well as of a regional employment. This feature promotes the expectation that new and often small firms might contribute considerably to employment gains. Armstrong and Taylor (1985) argue that this *"appears at first sight to present the policy maker with an exciting and potentially effective instrument for rejuvenating the depressed areas and for inducing significant improvements in the competitiveness of the industrial base of these areas"*(ibid. p. 211). Indeed, it is clear that there has been a move away in research from emphasis on industrial movement to other process of employment change such as indigenous growth and decline, new firm formation and firm deaths (Mason, 1983). This, it is argued, has been accentuated by research demonstrating that indigenous performance may be more significant than either the effect of inherited industrial structure or industrial movement in accounting for manufacturing growth and decline (Fothergill and Gudgin, 1979, 1982). As a consequence, new firm formation has been recognised as a means of developing the indigenous potential of regions and it has been advocated in place of traditional policy tools that relied primarily on attracting mobile industry to areas of high unemployment. However, restoring employment levels in depressed regions would not be an exhaustive account of the expectations associated with the entry and exit of firms at the regional level. These have been assumed to influence a region's growth if changing regional demand results in more entry than exit, and/or if the displacement taking place in a locus operates in favour of more efficient new firms in place of less efficient ones. Above all, entry and exit can potentially result in the diversification of a region's economic base in that different degrees of entry and exit are experienced across industries but within the boundaries of a particular region.

This point has been pursued by Johnson and Cathcart (1979) who distinguish two paths by which a region's industrial base can become self-adapting and diversified into more rapidly growing industries, moving towards new products and away from declining ones. The first is through diversification of existing business, and the second through new firm formation. Job creation is related to the diversification process and it might work against it if new job creation fostered by relocation of mobile industry takes place in sectors characterised by low fertility in terms of spin-off new firm formation. It has been argued that the effects of new business start-ups on local employment are quite complicated to disentangle, as this may be the result of counteracting processes. Thus, it is of great importance to examine whether new firms divert employment from other activities elsewhere in the region or whether they create new employment opportunities, exploiting new markets, without harming existing firm operations. Nevertheless, these two forces are unlikely to be mutually exclusive. The net effect on regional employment depends on whether new firms taking market share from incumbents compensate for job losses in the existing firm sector by increasing employment as they might be more efficient. In this case employment shifts within a region might not be a zero-sum game, as it would increase regional employment prospects in the long run. However, there is some evidence indicating that new firms might resist increasing employment in a period up to six years after their establishment (Storey, 1983). Most new firms expand employment very gradually depending on the type of entrepreneur. Those 'pushed' in setting up their own business by redundancy or threat of unemployment might be reluctant to expand employment in their firms beyond a manageable size (Atkin *et al.* 1983). Alternatively, new firms may safeguard the existing employment level if they take-up the slack created by closures. However, these outcomes are uncertain (Johnson and Cathcart, 1979). It would be incorrect to assume that increased new firm formation would reduce regional unemployment levels as there is no guarantee that those employed by new firms would necessarily be those previously unemployed (Atkin *et al.* 1983). In a best case scenario, new firms introducing product and process innovations that are not of immediate threat for existing firms might be seen as new employment creators. However, it is unlikely that these firms could rely on skills readily available among those unemployed, thus probably increasing the demand for locally scarce skills possessed by those currently in employment (Johnson and Cathcart, 1979). Storey (1983) calls attention to these potential skill mismatches. Survey evidence on new firms in Cleveland reveals that, whereas new firm founders have been to some extent unemployed (25%), their employees were accomplished with skills that are unlikely to be supplied by those in prolonged unemployment.

Storey (ibid.) critically moderates the over-enthusiastic reliance on new and small firms seen as having the capacity to lead economic growth, pointing attention to some interesting results of research carried out on some 1,500 new manufacturing and business firms. These results point out that although the small-firm sector is a useful provider of net new job creation, it cannot compensate for job-losses emanating from larger enterprises. It is further argued that it would be misleading to assume that stimulation of small firm sector alone would be viable when the large sector is depressed in that there is a great deal of small-firm dependency on larger firms. Most new firms mainly serve local markets (Gudgin, 1978, Johnson and Cathcart, 1979; Lloyd and Mason, 1983) and most are engaged in sub-contract work for larger companies and institutions (Gudgin, 1978). This would, in turn, suggest that the rate of new firm formation and subsequent growth of small firms will tend to be significantly influenced by the level of final and intermediate demand in the locality, which itself would be affected by larger local firms (Lloyd and Mason, 1983, 1984). These local dependencies have been conceptualised by Lloyd and Dicken (1982) as a 'crowded platform' that is served by staircases. The staircases provide the route for new firms to reach the platform and serve the departure of existing firms providing the necessary accommodating room on the platform. Exiting firms are supposed to leave either voluntarily or involuntarily as other existing local firms outperform them and/or as they are displaced by newcomers. This volatile environment on the 'crowded platform' located in space increases the competitive pressure where many of new firms die young as they face uncertain growth prospects and as increased births lead inevitably to increased deaths (Storey, 1983). Chances of success are rated considerably lower than those of failure. Empirical evidence provided by Storey (1982,1983) indicates that around 30% of manufacturing firms cease operations within 4-years after start-up. Lloyd and Mason (1984) estimate that within a ten-year span half of the stock of new firms fall into liquidation, and Gudgin (1978), Henderson (1980), O'Farrell and Crouchley (1983) all provide supportive evidence that new plants are more likely to be vulnerable to closure. However, set against the nexus of greater local dependency coupled with greater turbulence, it has also been argued that, when successful, new small firms may on aggregate have a greater impact on local economy because they are likely to have more local linkages which generate larger multiplier effects (Johnson and Cathcart, 1979). It has been proposed that *"far from being an indicator of economic weakness, a high incidence of firm exit may represent an indication of strength and dynamism in spatial economy especially when linked to a high rate of new firm formation"* (Love, 1996, p. 441). The last assertion seems to rely to a positive correlation between entry and exit to infer that this dynamic element is essentially beneficial for the local economy probably in a similar fashion to arguments presented in section 2.2.4 for an analysis at the industry level. To clarify views and to speculate on the benefits of turbulence in a spatial context, considering only the spatial dimension of data on firm entry and exit might not suffice. Say, for example, that entry and exit of sectorally independent flows of firms are found to be positively correlated over a cross section of spatial units. This would suffice to suggest that the same regions experiencing firm births also experience deaths, implying that spatial distribution of activities does not follow a well-defined pattern determined by spatial profitability differentials. If it did then the correlation should be negative. Furthermore, a positive correlation would imply that within spatial units there might be considerable change in the identities of operating firms across sectors. It may be the case that the effects of the implied turbulence on regional economies might be better evaluated if the relationships are resolved using a sectoral dimension within each spatial unit. Here it is important to understand if entry and exit coincide in the same sectors, that is if they are positively correlated across sectors within spatial-units, or negatively implying a well defined reallocation of resources towards some particular sectors and at the expense of some others. It follows that where the second case presents itself this might be indicative of diversification in progress whereas the first case should be associated with more uncertain outcomes for the regional economy. This, indeed, becomes a multi-parameter problem as it depends on quantitative terms on the cross-sectoral differentiation of net gains or losses resulting from entry and exit processes and on qualitative terms on the traits and the qualities of the 'survivors'. The latter aspect is crucially determined by the extent to which the implied within-sectors change in the identities results from an effective challenge of more efficient firms displacing less efficient incumbents, or natural churning taking place at the industry fringe of perhaps less dynamic, more traditional sectors. This may be so if under the 'recession-push' hypothesis put forward in an earlier section (2.5.3) 'pushed' entrepreneurs tend to establish firms in declining sectors during recession (Binks and Jennings, 1986b) reinforcing further decay. The latter might be possible as new entrants undercut, and threaten, the survival of existing firms. They may work longer hours for less remuneration thus suppressing labour costs in the presence of limited employment alternatives. They may also utilise cheap, second hand machinery (Atkin *et al.* 1983). Alternatively, new firms established during recession may soon contribute to exit. In addition, firm-deaths triggering the birth of some firms in the first place through job-shedding, might cause further deaths through a domino effect in an industry where released stocks of preceding marginal firm closures cannot be accommodated by existing and successive marginal firms entering (Binks and Jennings, 1986b).

On the other hand, Storey (1983) makes the critical point that as new small firms become relatively more important during recessionary periods it is important to ask whether these successful firms are later acquired by larger ones when the good times return. Schutt and Whittington (1987) claim that small firm resurgence is more apparent than real given the possibility that deliberate fragmentation policies are responsible for the emergence of many new independent firms. Westhead and Moyes (1992) turn to Storey and Johnson's (1987) results which point to increases in the number of small businesses being the outcome of large firm restructuring, involving mass redundancies and increased out-contracting of production and service processes, to find empirical evidence for this view.

7.2.1. New firm formation, employment growth and economic well being

As already trailed by the discussion above, the effects of new firm formation on regional growth have not been unanimously agreed in the empirical evidence of survey and econometric investigation research undertaken in various country contexts. Admittedly, most of earlier work has been concentrated in British and Irish regions, whereas it is only quite recently that evidence from other countries has become available.

In England early evidence provided by Johnson and Cathcart (1979) suggests that new firms made a relatively poor contribution to employment in the Northern region as they account for less than 10% of the employment created by immigrant industry. This casts some considerable doubt that new firms were the driving force towards self-sustaining growth in this region. This view is shared by Storey (1981) in findings from another north of England study in the County of Cleveland. Further in later evidence summarised by Storey (1983) it was reported that in Cleveland, Durham, Tyne and Wear new manufacturing businesses between 1965 and 1978 created slightly more than 1,000 jobs annually, whereas the same areas recorded losses of around 10,000 jobs due to larger firm closures. Gould and Keeble (1984) add more to the scepticism that surrounds the industrial restructuring and job generation contribution of new firms. It was demonstrated that in East Anglia, one of the regions exhibiting the highest new firm formation rates in Britain, manufacturing employment accounted for by new firms was in 1981 only 4.7%. On a slightly more positive note, Hart and Gudgin (1994) provide figures underlining the importance of new endogenous firms to the growth of both national and regional economies in the Republic of Ireland. It is demonstrated that new indigenous firms account for around 10% of manufacturing employment in 1990 and around 45% of all new manufacturing employment stems from new firms employing between 11 and 49 persons. However, the authors suggest that the role of small-firm sector should not be overemphasised since for many local economies economic well being would be to a great extent associated with the performance of large and often foreign-owned plants. Consequently it has been suggested that new firm formation should not be viewed as an exclusive means of generating regional economic growth and this view has been also shared by Hart and Hanvey (1995). The analysis reported in the latter study focuses on three comparative areas in the UK, Northern Ireland, Leicestershire and Wearside over the period 1986-1990. The results indicate that although new and small indigenous firms play an important role in the job generation process, the level of displacement associated with these new jobs is sufficiently high to warrant concerns about long-run sustainability of the employment created. In the Northern Ireland case it is clear that employment gains through new firm formation cannot compensate for job losses emanating from externally owned branch-plants.

On the other hand, recent evidence from Sweden (Davidsson *et al.* 1994) has been quite affirmative as to the significant role of new firm formation in generating employment. Rough, but conservative, estimates point out that more than 50% of all new jobs were created by small firms and the positive evidence becomes even more impressive when net job creation is concerned, as no less than seven out of ten new jobs were created by small firms. Empirical support has also been offered that new firm formation and especially small autonomous firms (Davidsson *et al.* 1995) have a vital role in increasing well-being, measured by various complicated wealth indices, in Swedish regions. Guesnier (1994) sketches a similar picture for France where, despite early policy persistence on appreciating the role of large national firms, the 1980s turned out to be the decade of the small and medium enterprises (SMEs). This, it is argued, owes much to the stagnation of large firms and the increasing adaptability of SMEs to markets requiring specialised, but also diversified, products not supplied by rigid mass producers. In emerging highly spatially differentiated patterns of economic growth, Guesnier (ibid.) argues that new firm formation has been playing a major role.

A regional analysis between employment change and entry in West Germany (Fritsch, 1996) reveals that positive effect of the latter on the former can be found only in the manufacturing sector. New firm start-ups in the service sector as well as when all sectors are combined seem to have a negative effect on regional employment change. In contrast, Audretsch and Fritsch (1992) provide some evidence that lower and not higher rate of start-up activity in manufacturing is associated with subsequent growth rates in employment in West Germany. Recent evidence from West German planning regions (Fritsch, 1997) suggests that a relatively weak positive effect of new firm formation on regional employment change takes place in the phase with new firm formation, but it turns out to be negative in the subsequent periods. Analysis from labour market areas in the United States (Reynolds and Maki, 1990, 1991) also confines limited positive evidence for the effect of birth rates and subsequent regional economic growth to the manufacturing sector. Reynolds *et al.* (1994b) provide some cross-country evidence that manufacturing firm birth rates have a small positive impact on subsequent economic growth and argue that high rates of new firm formation are a necessary but not sufficient condition for such development. This indeed appears to be a valid generalisation — most regions with positive indices of economic development tend to have higher start-up rates, but not all of those with high entry rates enjoy as high level of welfare (Spilling, 1996). Not unrelated are concerns expressed by Storey and Johnson (1987) that spatial differentials in new firm formation are likely to widen the gap between the prosperous and less prosperous areas in the UK as new firm formation and entrepreneurship tend to be higher in more prosperous regions (see also Whittington, 1984).

7.2.2. The interaction between firm births and deaths, turbulence and economic growth

Until recently the relationship between firm births and deaths at the regional level had not been widely explored. Some awareness of a positive relationship between the two has been evidenced in the work by Cross (1981) who found significant positive association (rank correlation) between entry and exit rates in Scotland and attributed this to size-related volatility of small firms that contribute more to entry and exit from industries. O'Farrell and Crouchley (1984) also provide evidence, confined to industry level, suggesting that entry and exit are highly positively correlated (0.67). Drawing on earlier evidence O'Farrell and Crouchley (1983) suggest that the age of plants negatively determines exits. The combined effect of entry and exit (turbulence) was further assumed to be mainly responsible for the age distribution of firms in an industry supporting the view that sectors with high entry rates would *ceteris paribus* exhibit higher exit rates because of higher proportions of small young plants which are vulnerable to closure.

A more direct account of the relationship between entry and exit of firms in a regional context is given in Moyes and Westhead (1990) where lagged firm de-registrations over thousands of production workers were found to significantly and positively account for spatial variations of new firm formation across British counties. It was suggested that the use of this variable might be 'contentious' as it is argued that high entry rates are often accompanied by, if not stimulated by, high exit rates. However, such a turbulence variable, it is also claimed, would be difficult to ignore as the demise of old firms may provide from their remains the basis for the establishment of new business (ibid. p. 128). Keeble and Walker (1994) have also tested empirically a unidirectional relationship between firm births and deaths operating the other way around. That is, spatial variations of firm exit were assumed to be determined by lagged new firm registrations. Econometric estimation indicates that higher past new firm formation has a positive and statistically significant effect on current firm deregistrations. The interpretation offered favours the view that new firms are most vulnerable and inclined to failure, implying that current deaths directly relate to the births of the most recent past.

Love (1996) criticises Keeble and Walker (1994) for using a recursive system with entry present in the exit equation but not vice versa. Undoubtedly Love's intentions to proceed with the estimation of entry and exit equations adopting a bi-directional simultaneous equation estimation framework, and filling a research gap, are well justified. However, his critique of Keeble and Walker (ibid.) for using a 'recursive' system may be unjustified in its strict econometric sense as lagged and not in-phase new firm formation was used in this study as determinants of firm deregistrations. Love distinguishes between two types of exit — voluntary and involuntary exit. The former has a similar rational to the 'income-choice' model presented in section (2.5.3), that is entrepreneurs may choose to quit their business if wage levels attainable in paid employment exceed income gained from self-employment. The latter form of exit, it is argued, might be the result of increased dependency on poor local demand conditions (see also Lane and Schary, 1991), or the result of unemployment pressured entrepreneurs having greater propensity to failure. Entry is hypothesised to 'cause' exit because new firms soon after entering contribute to exit due to their youthfulness and size. Exit is assumed to 'cause' entry because exit creates more room for entry or because exit release resources readily available for potential entrants (second hand machinery, cheaper labour etc, see also Binks and Jennings, 1986b, Storey and Jones, 1987). However, Love (1996) maintains that the potential effect of exit on entry is much less direct than of that of entry on exit as *"ultimately all deaths must come from births but deaths need not result in births"* (ibid. p. 444). Simultaneous estimation results reveal that entry is a positive and significant determinant of exit and vice versa. It is concluded that *"entry and exit of business is a 'revolving' door phenomenon; firms are born, often quickly die, this process in turn leads to entry and so on"* (ibid. p. 449). A number of additional comments may be helpful in respect of the aims, methods, results and interpretations of this study. Firstly, it is assumed that entry contributes very soon to exit and it is inferred that there is close match of identities between entering and exiting firms (revolving door), yet this is demonstrated with a simultaneous-equations framework. As the latter is based on instantaneous inter-determinacy of entry and exit, no time lag between entry and exit is allowed making the connection between the interpretation and the prior to estimation hypothesis somewhat problematic. In contrast, Keeble and Walker (1994), although condemned by Love, have been much more consistent in that the use of lagged entry in the exit equation might be more appropriate to relate identities of past entries with current exits. Secondly, Love justifies that the system is simultaneous and not recursive by testing, and statistically rejecting, the joint restrictions of zero exit coefficient in the entry equation and zero cross-equation residual correlation. Non zero values of the exit coefficient in the entry equation might not be sufficient evidence that exit is endogenous in the entry equation. Equally there is no direct evidence offered that entry is endogenous in the exit equation. Thirdly, there is considerable change in the direction, as well as in the significance, of the effect of other (exogenous) variables on entry and exit when the simultaneous estimation results are compared with those of single equation estimations (see discussion in Chapter 6 for analogous problems in corresponding industrial analyses).

Johnson and Parker (1994) argue that the effect of firm births and deaths on subsequent births and deaths in a spatial context may be quite ambiguous in direction and they distinguish between two kinds of effects that births can have on deaths and vice versa. The first type, the 'multiplier' effect — describes a situation when births cause future births but retard future deaths, and deaths cause future deaths but retard future births. The second type is referred to as a 'competition' effect and reflects the occurrence of more births causing deaths and discouraging future deaths and vice versa[75]. Econometric panel data vector autoregression estimation reveals that in the retailing sector past births reduce future births indicating a prominent 'competition' effect in the entry equation. In contrast, the multiplier effect seems to be the most important factor affecting death rates as past increases in the birth rate reduces the current death rate. Johnson and Parker (1996) extend this modelling process to examine the interdependence between entry, exit and other economic variables such as unemployment and output. Lagged births and deaths do not appear this time to affect current firm births, whereas the negative effect of two-year lagged births on deaths confirm the authors' earlier results. Unemployment is significantly reduced by firm births lagged one and two periods but also significantly induced by one-period lagged firm deaths. Interestingly, the significant effect of lagged entry on output varies in direction depending on the lag length. It is positive for a one-year lag imposed on entry but negative when a two-year lag is taken.

[75] The interested reader is referred to pages 283-284 of this research for examples of both the 'multiplier and 'competition' effects.

But a one-year lag imposed on firm deaths has a consistent negative effect on sectoral output.

Non-British empirical evidence points out that high turnover rates i.e. entry and exit rates taken together, are associated with a relative increase in economic well-being in Swedish regions (Davidsson *et al.* 1995). In contrast, the effect of firm turnover on regional employment change in West Germany (Fritsch, 1996) has been positive and significant for the service sector, but negative for manufacturing industries when taken in-phase, whereas it becomes insignificant and quite unstable in its direction for subsequent periods. In the same country context, Audretsch and Fritsch (1993) demonstrate that more stable regional economic environments have better stimulated subsequent economic growth whereas higher firm turbulence appear to be related to regional economic decline.

7.2.3. Diversification of industrial base vs. 'sectoral inertia'

The contribution of new firm formation in diversifying a region's industrial base can be assumed to operate across sectors in that resources are re-allocated towards more efficient uses and away from traditional and declining sectors. In contrast, an unemployment-push theorisation views new firm formation as emerging from deteriorating performance and closure of existing firms. At the conjunction of these theorisations a critical constraint for the diversification effect of new firm formation is the extent to which new firm founders confine themselves to the same sectors they were previously engaged in. As an additional filter, it would greatly matter if the origin and destination sectors differed considerably in their dynamism. If this were not the case then reliance on new firm formation as the main diversification force would sometimes disappoint its proponents. The benefits for the regional economy would then be dependent on the possible re-organisation of production structures within rather than between sectors, given that 'pushed' entrepreneurs prove not to be less efficient than those already established in the same industries.

Beesley (1955) assumed that origin and destination sectors were identical and this seems to echo Brock and Evans' (1989) theorisation of industry-specific human capital (see also section 2.5.3). Vivarelli (1991, p. 217) argues that *"far from the universal choice that characterises theoretical model, entrepreneurial action is relatively constrained. Instead of looking around to seek the most profitable opportunity, the* *potential entrepreneur concentrates his attention on a familiar sector."* This occurs because *"a person working in an industry is more likely to identify a market gap"* (O'Farrell and Crouchley, 1984, p. 229) and it is often quite irrespective of the degree of industry competition and growth prospects (Storey, 1982), as these industries are often those which have been most acutely affected by recession (Atkin *et al.* 1983).

Survey evidence for different spatial contexts tends to confirm that many entrepreneurs are indeed characterised by 'sectoral inertia'. Johnson and Cathcart (1979) in their study of the Northern Region find that 57% of indigenous founders of manufacturing firms started their business in the same sector in which they were formerly employed and similar evidence has been provided for Scotland (Cross, 1981)[76], Cleveland, Durham, Tyne and Wear (Storey, 1982), Nottingham (Atkin *et al.* 1983), and Merseyside, Greater Manchester and South Hampshire (Lloyd and Mason, 1984). In Vivarelli's (1991) survey in the Milan area in Italy, 68.8% of entrepreneurs declare themselves to have come from the same sector where they were working as dependent foremen, while only 24.4 % were independent professionals and 6.8% started as entrepreneurs.

Johnson and Cathcart (1979) point out that when analysing the role of new firms in diversification, using the rationale that these are the result of distinct choice between paid-employment and self employment, an explicit account of the characteristics of the origin and destination sectors is needed. Not only the attractiveness of different industries as destinations but also the relative suitability of such industries as generators of spin-offs should be understood. Industry growth might be used as an indicator of flows of new firm formation towards more dynamic industries and away from declining ones within a region. However, it argued that the effect of inter-industry growth in explaining within-region inter-industry variation of new firm formation might be difficult to disentangle when due consideration is given for 'origin' and 'destination' growth effects. The complications arise because the net effect of industry growth is the result of two conflicting forces. On the one hand, low growth might trigger higher new firm formation from an 'origin' point of view under a 'push' theorisation and the growth coefficient

[76] The degree of sectoral inertial found in Cross' survey for Scotland is somewhat lower (39%) than that reported in Storey (1982) for Cleveland (60%).

implied would be negative. On the other hand, low growth industries might be seen as unpromising 'destinations' for new firm formation implying a positive effect of industry growth in accounting for inter-industry differences in new firm formation. The results of this exercise in the Northern Region point to a positive, but insignificant, industry growth coefficient, probably due to this contradiction between 'origin' and 'destination' growth effects. The same result is also evident in the O'Farrell and Crouchley (1984) study of new firm formation in Ireland in sectoral (but not spatial) analyses where the effect of manufacturing employment growth on new firm formation was found to be both positive and significant. Fritsch (1992), analysing spatial variations in new firm formation in West Germany, directly tests the influence exerted by the percentage of the labour force employed in each sector on formation rates in the same sector. As the region's labour force in manufacturing and services were not found to be significantly related, it was inferred that many founders moved to new sectors when starting their own business.

7.2.4. New firm formation and innovation

A number of researchers have raised the issue of the role of new firms as contributors to innovation and technological change and its implications for regional economic growth and prosperity (Keeble and Wever, 1986). Rothwell (1982) and Oakey (1983) argue that many new firms are technologically advanced, launch new products, thus playing an important role in regional industrial restructuring. In contrast, Little (1977) assigns only a minor role to new firms in technological advancement. As far as the locational context of the debated role of new firms as vehicles of innovation is concerned it seems that opinions might well also not be unanimous. Whereas there is traditionally a strong association between innovation and agglomeration (Korte, 1986; de Jong and Lambooy, 1986; Malecki, 1984, 1990), some recent work in the UK seems to point to a reversal of such a link. It has been suggested that accessible rural areas exhibit considerably higher rates of successful innovations compared to their urban and more remote rural counterparts (Keeble and Tyler, 1995).

Empirical evidence on the innovative performance of new firms in a spatial context is quite limited, being primarily confined to survey results. The picture drawn has not been particularly encouraging as it has been demonstrated that the contribution by new firms in introducing innovation across various regions in the UK has been relatively small. Early evidence provided by Johnson and Cathcart (1979) for the Northern Region indicates that only nine out of seventy four firms that were established in this region between 1971 and 1973 were primarily based on an important innovation. Interestingly, immigrant founders comprised five of them. Comparative evidence from Merseyside, Greater Manchester and South Hampshire (Lloyd and Mason, 1984) provides that in the first two regions only ten firms claimed to be engaged in innovative activities whereas the corresponding number of firms in South Hampshire was still only twelve. The authors further argue that even these small figures might be exaggerated by the respondents as a *"function of some rosy-hued views about their capacity"* (ibid. p. 216). Gould and Keeble (1984), in a survey of surviving new firms in East Anglia, find that only 10% of these were high technology firms, employing some 13% of total new-firm employment and being of slightly larger employment size when compared with other new firms. Electronics firms alone accounted for 58% of the new firms total and were characterised by even larger employment size. More recent survey evidence from South Hampshire (Mason, 1989) also reports only limited support for the idea that new firms exploit new product and process opportunities as the proportion of those who claimed such motives was just 10%.

Vivarelli (1991) uses a broad definition of innovation that encompasses also the application and development of products and processes patented elsewhere, in survey covering the Milan region in Italy. Although percentages are higher than those in British regions, innovation-driven entrepreneurs still appear to be in minority as only 20.7 % of the founders interviewed claim that their entrepreneurial initiative was determined by technological opportunities. In addition only 20.3% of newly created firms appeared to be dynamically engaged in introduction of process innovation. This contrasts somewhat with Brusco's (1982) assertion that the growth of the industrial district phenomenon finds an explanation in the innovation potential and technical advancement of new Italian firms.

7.3. The empirical evidence for the determinants of new firm formation

Research on the determinants of spatial variation in new firm formation has been versatile in respect of the variables deployed as regressors in econometric models, or of relevant factors considered in statistical and survey based analyses. The plethora of economic and other variables used as determinants has often created problems of data handling in that it has often been evident that the effect of potential contributors in 'explaining' spatial patterns of new firm formation is intertwined. The solution to this problem has been the use of numerous large correlation matrices, stepwise regressions, or the application of data reduction techniques such as principal components-varimax rotation analyses (Moyes and Westhead, 1990, Westhead and Moyes, 1992). This seems to imply that spatial analysis of firm entry and exit has been necessarily quite 'loose' when compared with the relatively limited permutations of the Orr-type of entry model explored in the second chapter of the present research. This may not necessarily be unhelpful despite econometric difficulties arising from the truncation of regression equation specifications as a result of redundant information or the introduction of insignificant variables.

In a recent collective effort to make cross-national comparisons of spatial processes in new firm formation (Reynolds *et al.* 1994a) the need to narrow the spectrum of potential determinants on an operational and comparable basis was immense. As a result, six primary processes were given consideration in association with spatial aspects of firm entry and exit. These were, local demand aspects, urbanisation/agglomeration effects, the role of unemployment, personal household wealth, small firm presence and local government spending and assistance. This compilation of a more concise base of determinants of spatial variations in new firm formation has been the outcome of a quite long-term experimentation benefiting from *"the considerable volume of previous work in this field by UK academics"* (Keeble and Walker, 1994, p. 413). The effect of these processes has been considered in the survey that follows. In particular, empirical evidence regarding the role of unemployment and 'income-choice' models is reviewed first as these follow the discussion in the last section of chapter two and can potentially facilitate a bridging of industrial and regional analyses. Next, a cluster of factors is considered relating to structural aspects of regional economies, such as small plant size and the effect of the existing mix of activities. On the supply side, with respect to local entrepreneurs, the role of local occupational structures is examined next. Under the broad heading of 'other economic factors' the effect of demand side factors is treated along with access to capital issues. The latter encompass the effect of personal wealth indices, collateral availability and also some limited evidence on policy and government spending effects. A separate discussion of the urban-rural shift issue is left to the end since it offers a dimension which reflects the result of processes already discussed and also provides a framework to consider other determinants of spatial new firm formation processes drawing on competing theoretical backgrounds.

In reviewing the empirical evidence on a number of determinants of new firm formation it is often the case that the results obtained are sensitive to the new firm definition. This reflects Mason's (1983) pleading that *"it is essential to ensure that similar definitions have been used when any attempt is made to compare the results of independently-conducted surveys of new firm formation... [and]... every study of new firms should contain an explicit statement of the definitions used in order to facilitate the interpretation of its findings"* (ibid. p. 59). Therefore, in the following survey direct reference to the operational definition used is provided when empirical outcomes and cross-study contrasts are heavily conditioned by this choice.

7.3.1. The role of unemployment

The empirical evidence for the much debated (Hamilton, 1989; Storey, 1991; Audretsch and Fritsch, 1994; Davidsson *et al.* 1994; Johnson and Parker, 1996; Love, 1996) effect of unemployment on new firm formation in a spatial analytical context has been quite ambiguous. Ambiguities mainly arise due to the dual, but inherently contradictory, roles of unemployment in affecting new firm formation decisions. On the one hand, unemployment increases the supply of potential entrepreneurs as more individuals are pushed to establish their own firms being without work or facing prospects of unemployment and their decision is further facilitated by availability of resources released during recession. On the other hand, increased levels of unemployment may signal that market conditions in a region are less favourable discouraging new firm formation. Essentially the analytical problem is that unemployment picks up both supply and demand effects. Love (1996) points out that the inherited ambiguous effect of unemployment should be further differentiated from both the effects on levels of local demand and the effect of the threat of unemployment brought about by an accelerated level of unemployment.

Some early and essentially British survey evidence has offered considerable support to the 'unemployment-push' hypothesis. In Storey's (1982, see also Storey 1983) survey in Cleveland, one quarter of founders claimed that they were unemployed or likely to become unemployed immediately prior to starting new business during a period when local rates of unemployment were around 8%. Atkin *et al.* (1983) find that in Nottingham the percentage of new entrepreneurs who were 'pushed' into starting their own business, mainly because of unemployment or job insecurity, accounts for more than half of new company formations. This confirms the results provided by Fothergill and Gudgin (1982) who, using a sample of surviving companies in East Midlands, noted that economic recession expressed by rising unemployment up to 1974 was associated with increased new firm formation activity. In contrast, Gould and Keeble (1984) do not find support for the notion that recession has stimulated the surge of new firms, when the latter are measured in terms of surviving manufacturing firms in East Anglia. Mason (1989) provides some qualified support to the 'recession-push' hypothesis in what pertains to unemployment but not to other aspects of this theorisation (extensive use of widely available second hand machinery) for South Hampshire.

Non-British survey evidence provided by Vivarelli (1991) stresses the necessity of taking into account 'push' along with 'push' factors when accounting for new firm births. Whereas 0.8% of the interviewees declare themselves as being unemployed in the period before starting their business, only 78.2% of new-firm founders surveyed stated that they deliberately interrupted their previous job. This, it is argued, suggests that the threat of future unemployment might have been more effective in determining new firm formation decisions than its immediate realisation.

Econometric evidence from the UK provided by Whittington (1984) reveals a positive and significant relationship between the change in the rate of unemployment and new firm formation. Ashcroft *et al.* (1991) use the unemployment rate within an income-choice model context to proxy in an inverse manner the probability of attaining income from paid employment. Despite the hypothesised positive 'push' effect, regression analyses turn up a negative and insignificant effect of this variable in accounting for spatial variations across British counties. The same, however. is not evident for the coefficient of the annual percentage change in the unemployment rate, which has a significant direct effect. Westhead and Moyes (1992) find a positive and statistically significant effect of the unemployment rate in determining county-level variations in new firm formation in the UK between 1980 and 1988. But only limited confidence is placed on this result by the authors who point-out that the same relation was strong and negative in bivariate correlation analysis. The positive result obtained in the regression analysis might be the artifact of multicollinearity. Keeble and Walker (1994) find that unemployment enhances firm deaths when death rates are defined over labour force, but changes in the rate of unemployment do not have a major effect on new firm formation for the total economy. Nevertheless, a significant positive effect was evident when accounting for spatial variation of new firm formation in financial, professional and business services sectors. Johnson and Parker (1996) also explore the effect of unemployment on both entry and exit in retailing sectors at a county level. In the entry equation, change in the number of unemployed two-years lagged has a negative and statistically significant effect suggesting that any positive recession-push influences are dominated by negative demand pull effects whereas the same effect is positive but insignificant in the exit equation. Love (1996) finds that changes in the rate of unemployment have a positive effect on exit in both single and simultaneous equation estimation frameworks, significant in the latter case. The corresponding effect of the unemployment rate in the entry equation is positive and insignificant when the entry equation is simultaneously estimated along with exit, but, interestingly, negative and significant in single-equation estimation.

Fritsch (1992) does not find that a high unemployment rate promotes a rise in the formation of new firms in West German regions. Gerlach and Wagner (1994) in their study of regional differences in small firm entry in Lower Saxony (Germany) derive a positive but insignificant unemployment effect. On the other hand, Audretsch and Fritsch (1994) provide econometric-estimation results that are heavily sensitive to the dependent variable chosen. Thus, when new firm formation rates are defined over the existing stock of firms, the effect of both the unemployment rate and its changes are positive for all sectors. When, however, new firm formation rates are defined over labour force, the effect of unemployment becomes negative and significant suggesting that high levels of unemployment are associated with lower and not higher birth rates. In contrast, the effect of changes in the unemployment rate varies in direction as it is positive for all sectors combined and for services, but negative for manufacturing.

Davidsson *et al.* (1994) point to a positive relationship between levels of unemployment and new firm formation, but that a rise in unemployment negatively affects the propensity to set-up new firms in Sweden at it signals unfavourable regional market conditions. Reynolds' (1994) results for US labour market areas seem to signal the same direction, at least in what concerns manufacturing firm start-ups, where changes in unemployment rate exhibit a significant negative effect but the percentage of unemployed civilian workforce has a significant positive association with new firm formation. For business services and other non-manufacturing sectoral aggregates the effect of both factors is positive and significant. However, it is argued that this is more profound in metropolitan labour market areas and that more comprehensive US analyses seem to suggest that higher levels of unemployment and other symptoms of individual economic depression, when significant, actually decrease birth rates (Reynolds *et al.* 1992). In a similar fashion, Guesnier (1994) finds that higher unemployment is positively associated with higher birth rates defined over regional workforce in France, but the change in unemployment rate has a negative and significant effect on new firm formation rates defined over existing stock of firms. In contrast, Norwegian evidence (Spilling, 1996) suggests that unemployment has been found to be a factor of some significant relevance for new firm formation in only very few sectors.

Storey and Jones (1987) question whether unemployment is really the best indicator of a self-employment choice induced by bad working conditions and instead favour that gross job losses due to business closures and contractions may be a more direct indicator of a self-employment choice due to redundancy. Foti and Vivarelli (1994) adopt Storey and Jones' suggestion and find this index to be significantly associated with high rates of new firm formation across Italian provinces. Using panel data consisting of 78 Italian provinces over the 1985-1988 period, Audretsch and Vivarelli (1995) provide reassuring evidence for the direction, but not for the statistical significance, of this effect. In a more conventional fashion, Garofoli (1994) demonstrates that change in unemployment rate lagged two periods seems to have a strong negative effect in determining spatial variations in new firm formation in Italy.

7.3.2. Income choice models

Following the suggestions of Knight (1921) and cross-sectional investigations at an industry level by Creedy and Johnson (1983), a number of recent studies have applied a model that involves a comparison between earnings from paid-employment and expected income from setting up own business in determining spatial variations in new firm formation. The proportion of potential entrepreneurs who decide to form a business in an area will be determined by the expected difference between these two income states.

In a direct fashion Foti and Vivarelli (1994) find that weighted averages of current manual workers' and clerks' wages have a negative and significant effect in most alternative model formulations on new firm formation. In contrast, entrepreneurial income proxied by the difference between gross value added per employee and per capita wage has been found to be positive and significant in all alternative model formulations. Audretsch and Vivarelli (1995) substantiate the empirical validity of the 'income-choice' model as an analytical framework explaining variations in new firm formation in Italian provinces. New firm formation tends to be greater in those provinces exhibiting higher profitability but where wage rates are lower.

Love (1996) tests the implications of the 'income choice' assumptions using county level data for the UK and extends the use of the model to account for spatial variations in firm exit along with entry patterns. In the exit equation, wages have been hypothesised to have a positive effect as higher wages would increase the opportunity cost of maintaining own businesses and may contribute to an increase in voluntary exit. In contrast, the level of expected profits from setting up a business in an area should be inversely related with the occurrence of exit at the spatial level. Contrary to expectations, wages were found to be negative influence on exit in both a simultaneous and single equation estimation framework, but statistically significant in the latter. In the entry equation the level of wages has been assumed to be inversely related to the rate of new firm formation since a relatively low wage level would tend to make new firm formation a more attractive option and to lower the labour costs facing new entrants. This, indeed, has turned out to be negative and significant in single-equation estimation of the entry equation but positive in the preferred simultaneous estimation accounting for interdependence between entry and exit at the county level. The entrepreneurial income proxy (gross regional product per capita) was consistently positive but insignificant in the entry equation and negative and insignificant in exit equation under all alternative econometric model specifications.

In some other studies one of two main components that determine the transition from to self-employment has been missed out. Ashcroft *et al.* (1991) find average firm profitability in a county, that has been used as a measure of expected gross returns from firm formation decisions, to be negative but insignificant in determining new firm formation. It is argued that this might arise because this proxy measures the average profitability of all firms in the county rather than of new firms, although it is not clear why these should vary systematically across regions. In contrast, Santarelli and Piergiovanni (1995) use only the wage component and find that its effect on new firm formation in Italian provinces depends on the definition of new firm formation used. Thus, this has been found negative and significant when new firm formation rates are defined over existing firms but positive and significant when the dependent variable is defined over resident population. No explanation is, however, given for these empirical discrepancies. In a somewhat different context Gerlach and Wagner (1994) employ the regional wage level for blue-collar and salary for white-collar workers to proxy human capital, expecting a positive relationship between this proxy and new firm formation. However, it is pointed out that after controlling for inter-regional differences in skill and human capital, the higher the regional wage the lower the expected rate of new firm formation would be. This effect has been consistently negative for both the small firm entry rate and small firm entry intensity in the sub-regions of Lower Saxony but statistically significant in some of the alternative econometric model specifications. In contrast, in Fritsch (1992) salaries per employee in manufacturing have been found to stimulate new firms in manufacturing and in all other sectors concerned apart from services in West German regions. However, the assumed role of wages in new firm formation has not been outlined in an income-choice framework, and no further explanations for this positive effect have been given in this study.

Of some related interest is the survey evidence provided by Vivarelli (1991) demonstrating that aspiration to attain income, underlined by conventional and self-employment models, is confirmed to be a powerful determinant of the foundation of new firm. Around 47% of entrepreneurs interviewed indicate the desire for higher income as an inducement to start a business. However, the most powerful motive was declared by some 80% of business founders in Milan area to be the aspiration of independence. This confirms earlier survey findings from Merseyside, Greater Manchester and South Hampshire indicating independence to be the key motive for establishing own firms (Lloyd and Mason, 1984). The extent to which self-employment can be seen as a direct indicator of the 'entrepreneurial-culture' and of the success self-employment in a locality that in turn encourages others to take this path providing a role model, has been given empirical support by Westhead and Moyes (1992) and Garofoli (1992,1994). These studies find positive evidence that the extent of self-employment has been associated with increases in new firm formation activity in UK counties and Italian provinces respectively.

7.3.3. Structural approach to new firm formation

There have been three main themes discussed when the effect of the existing production structure on new firm formation is taken into consideration. The first and probably most celebrated feature of local structures, in both the theoretical and empirical literature, is that of plant size. This is assumed to be important in controlling the local supply of entrepreneurs but also the ease of entry. A second structural factor of interest concentrates on the effect of the sectoral distribution of employment within a region. The third decisive structural element in affecting new firm formation is that of specialisation *vis-à-vis* diversification of an area's industrial base as this might, to some extent, determine the quantity but also the quality of generational spin-offs taking place within a region.

7.3.3.1. Small vs. large plant size structures

As far as the relation between the extent of small plant structures locally and the supply of entrepreneurs is concerned, small firms have been seen as better incubators for potential new firm founders than large firms (Cross, 1981). The argument mainly centres on the notion that working for a small firm gives the chance for employees to familiarise themselves with the whole spectrum of operational processes (Storey, 1982). This provides them with a wide range of task experiences but also allows closer direct contact with the firm proprietor who can serve as a role model (O'Farrell and Crouchley, 1984; Lloyd and Mason, 1984, Mason, 1991). This contrasts with employment in large firms which enhance development of routinised task-specific skills (Storey, 1982), not allowing employees to develop the work experience necessary for setting their own business (Fothergill and Gudgin, 1982). From a more 'economic' view, Storey (1982, p. 94) argues that as employment in small firms is often less secure and probably less well paid than in a large firm, individuals *"are more likely to consider entrepreneurship since this is probably only marginally more risky than working for an existing small firm [and hence it is not] surprising that such individuals will be more prepared to begin in business than their more risk-averse colleagues in larger firms"* (ibid.). On the other hand, dominant small plant structures might reflect the existence of low entry barriers (Gudgin, 1978) and/or the 'youthfulness' of an industry as in new industries the barriers to entry height might not yet be very well established (Cross, 1981).

The empirical evidence supporting the idea that small firm presence is a key determinant in explaining increases in new firm formation is overwhelming. Thus, a number of British studies using survey data or relying on statistical and econometric explorations, have been unanimous in pointing to the positive and significant effect of this factor. The evidence provided has often concentrated on particular regions — Gudgin (1978) for East Midlands, Johnson and Cathcart (1979) for the Northern Region, Storey (1981) for Cleveland, Cross (1981) for Scotland, and Lloyd and Mason (1984) for Merseyside, Greater Manchester and South Hampshire. Gould and Keeble (1984) who also find positive evidence in this respect for East Anglia maintain, however, that small firm presence is of secondary and not primary importance in determining new firm formation activities. As an inverse notion, Gudgin and Fothergill (1984) use employment in large plants and provide consistent evidence supporting the idea that the higher the proportion of large-plant employment is the more depressed new firm formation becomes in both the East Midlands and North East regions. Consistently favouring the role of small-plant structures has been the evidence provided by studies extending the data coverage to encompass regions (Whittington, 1984) or counties in the UK as a whole (Moyes and Westhead, 1990; Ashcroft *et al.* 1991(GB); Westhead and Moyes, 1992). Love (1996) also using county level data empirically investigates the effect of small firm presence on both entry and exit using both single and simultaneous equations estimation. The effect of small firm presence on firm entry was positive and significant when the entry equation was estimated alone, but interestingly it became negative albeit insignificant when the preferred interdependency between entry and exit was allowed. Small firm presence had been found to be a positive influence on firm exit under alternative econometric model specifications and significant in a single equation estimation framework. Keeble and Walker (1994) also find a significant positive effect on firm death rates when the latter are defined over labour force. However, the effect of local small firm predominance on formation activity was in this study heavily dependent on the definitions of new firm formation used. Thus, the effect of interest has been strong and positive when labour force was used in the denominator, but alternatively significantly negative when business stock was used instead. Such kind of result dependency on the definition of the dependent variable used is also evidenced in the Audretsch and Fritsch (1994) study for West Germany. In particular, mean establishment size turns out to be significant, but positive, when firm birth rates were defined over existing stock of firms and negative when standardisation was facilitated by using the size of work force[77].

O'Farrell and Crouchley (1984) provide reassuring evidence suggesting that the percentage of small plants in an area account significantly for increasing new firm formation activity across space in the Republic of Ireland and more recent evidence from the same country context (Hart and Gudgin, 1994) echoes these early empirical findings. Most of all, Hart and Gudgin (ibid.) using data for net new firm formation rates (surviving firms) find that small plant structures continue to have a positive, although insignificant, effect. Keeble and Walker (1994) have also used some notion of the net entry rate that is, however, confined to positive values (growth in the number of small business) and derive a significant direct effect.

In other European countries the empirical evidence of growing research efforts to identify determinants of spatial variation in new firm formation yields results that accord those from British and Irish studies. Results from Italy (Vivarelli, 1991; Garofoli, 1992, 1994; Audretsch and Vivarelli, 1995, Santarelli and Piergiovanni, 1995), France (Guesnier, 1994), Germany (Fritsch, 1992; Gerlach and Wagner, 1994), Sweden (Davidsson *et al.* 1994) and Norway (Spilling, 1996) help to establish the positive

[77] Bearing in mind that the small firm presence proxy used by Keeble and Walker (% turnover of legal units of less than £500,000) and the mean establishment size used in Audretsch and Fritsch move as notions in exactly opposite directions, it could be argued that their results are directly analogous.

influence of small firm presence on manufacturing and sector-independent definitions of new formation as an empirical regularity. However, Aydalot (1986) provides some correlation-based evidence for France which seems to suggest that the direction of the relationship between new firm formation and the average size of a firm in a region might not be independent of the definitions of the new firm formation rates used. His analysis suggests that the relation between new firm formation rates defined over local employment and average firm size is negative (-0.76), but this turns out to be positive (0.49) when new firm formation rates are defined over the number of existing firms. However, some studies have clarified empirically that whereas small-plant structures might be conducive to firm births in manufacturing industries as they serve better as incubators for future entrepreneurs, this might not be the case when service sectors are concerned. Fritsch (1992), Keeble and Walker (1994) and Davidsson *et al.* (1994) all find evidence suggesting that in professional services sectors new firms are often started by individuals who were formerly employed in large firms[78]. Reynolds (1994) does not consider the effect of small firm presence on business service start-ups but he does provide supportive evidence that higher percentage of small firms in US labour-market areas are equally conducive to firm births in both manufacturing, industrial and wider sectoral aggregates, including business services.

Of related interest is empirical evidence that relates to the role of mobile and branch plants in affecting the local entrepreneurial generation potential. Johnson and Cathcart (1979) show that mobile plants are indeed poor incubators for founders of new business. Cross (1981) provides some rank correlation evidence that the extent domestic plant ownership is positively associated with new firm formation in Scotland. In support of the argument that entrepreneurship and external control are in fact contradictory (Sweeney, 1987), as increases in external control reduces the number of risk-taking managerial positions and consequently the potential pool of local entrepreneurs (Cross, 1981). Malecki (1990) finds that branch plants inhibit the formation of new manufacturing plants in the US. The exact opposite effect is found for the services sectors. This contrasts heavily with inference made in Del Monte and Luzenberger (1989) who evaluate the

[78] See also Bryson *et al.* (1997) for a similar view concerning the creation and growth of small business service firms in Britain.

impact of regional policy in promoting new firm formation in Southern Italy. Empirical evidence based on time series analysis of a model that seeks to explain the relationship between increases in the number of local firms and inward movements of non-local firms suggests that local firms were at most indirectly helped by the positive impact of large firms moving into Southern Italy.

7.3.3.2. The effect of 'industry-mix', specialisation and diversification

Some previous research has considered the role of industrial structure in accounting for spatial variations in new firm formation. As differentials in growth and barrier to entry levels characterise different sectors at a national level, this might in turn affect regional new firm formation levels, depending on the extent to which sectors heterogeneous in these aspects make up a region's industrial base. This task has been facilitated by the use of shift-share analysis[79] and the intention has been to investigate whether the 'industry-mix' component of industrial employment in each area accounts for a substantial proportion of regional new firm formation activity. This idea was originated by Johnson (1983) who concluded that the effect of industrial mix in accounting for this variation is minimal and far more important seems to be factors that determine the intra-industry preferences of allocation of industrial activity across space. Storey and Johnson (1987) extended Johnson's (1983) research for UK regions and despite using a slightly different method reached essentially the same conclusion for UK as whole and Scotland in particular. Beesley and Hamilton (1986) concentrate attention on Scottish regions, but they do extend the use of the shift-share analysis-based methodology to account for variation in not only firm births but also firm deaths. Their results provide supportive evidence for the notion that inter-regional differences in both new firm formation and firm mortality stem mainly from marked intra-industry variation in these processes. Ashcroft *et al.* (1991) define new firm formation rates over working population and find that in four out of the eleven British industrial structure seems to be important in accounting for new firm formation. In particular, in the East and West Midlands existing industrial structure appears to contribute to potential firm closures that outnumber

[79] A more detailed and critical account of British shift-share analysis studies is offered in the next chapter.

possible increases in the number of firms due to preferable local conditions. In contrast, in East Anglia and the South West the positive contribution of industry-mix exceeds the effects of local conditions, which are also positive.

In contrast to the British studies some research from different country contexts has offered some evidence for a more decisive role of industrial structure in affecting the amount of generational firm turnover experienced in different regions. Thus, in Fritsch (1996) a shift-share like approach has been used to account for the effect of regional industrial structure on both firm births and deaths in West Germany. The number of new firms and exits are shown to depend heavily on the regional industrial structure. Foremost, it has been demonstrated that more than 50% of spatial variation in new firm formation in West German planning regions can be attributed to local sectoral composition (Fritsch, 1997). Spilling (1996) reaches the conclusion that the existing industrial structure provides the most significant explanation of regional variations of new firm formation in Norway, implying that new businesses will tend to appear in industries already presented in an area.

The extent of local dependency on specific industrial sectors (specialisation) or on a broader spectrum of industrial activities (diversification) and its effects on an area's new firm generational activity has also been given some consideration in the literature. It has been proposed that a higher diversification of the regional industrial base is associated with higher new firm formation activity (Gudgin, 1978, Cross, 1981). The rationale offered to justify such a relationship is based on the premise that higher degrees of diversification imply a higher variety of skills available locally. Skill and diverse working experiences can in turn give way to higher entrepreneurial choice and opportunity, especially to the extent that there is some degree of transfer of individuals between not only firms but also between industries. The latter might work as a safeguard in that downturn movements in some sectors would not be as harmful to the local economy to the extent that human and other resources are diverted to more secure alternatives available. Moreover, higher degrees of diversification could ensure that emerging opportunities due to, say, increasing demand for a product, may not go without being exploited locally even if only a small number of firms in the industry producing the product are in the area. Despite the attractions of this argument, an equally well justified view hypothesises specialisation to be a positive influence on new firm formation. This counter-argument has been celebrated most, as Garofoli (1992; 1994) notes, in the Italian literature on industrial districts with diffuse economies. This particular production structure it is argued *"enables circulation of strategic information in the local productive system and the introduction of forms of co-operation and collaboration among local firms"* (Garofoli, 1992 p. 118). Some empirical evidence in favour of the diversification argument is offered by Cross (1981) for Scotland. This is based on correlation coefficients between various measures of firm births and industry dominance which indicates that industrial diversity appears to be an important influence[80]. Moyes and Westhead (1992) argue that industrial specialisation, and an existing substantial tradition in production activities, significantly impede new firm formation in the UK. Conversely Garofoli (1992; 1994) using a specialisation index obtains econometric estimates indicating that specialisation has a positive and significant effect in accounting for spatial variations in new firm formation in Italy. Malecki (1990) provides some evidence to suggest that spatial differences in agglomeration of complementary economic activities has strong positive effect on new firm formation in service sectors with particular emphasis on high-technology activities in large US metropolitan areas. Reynolds (1994) finds also a positive effect of an area's degree of job specialisation on firm birth rates.

Of some relevance to this debate is the argument and empirical evidence put forward by Beesley and Hamilton (1994) that the higher the concentration of an industrial activity in space (localisation coefficient) the lower the entry rate at a national level becomes. Again then, the British literature signifies that a concentration of specialised plants in area and the economies achieved through networking might create an *"unconventionally specified entry barrier"* (ibid. p. 234). The contrast with the Italian line of argument and evidence is sharp. Revelli and Tenga (1989) conclude that the effect of territorial specialisation of particular activities has been a positive and significant stimulant of new firm formation in Italian manufacturing.

[80] It is interesting to note that whereas this conclusion is offered by the author on page 275, the table summarising the most influential factors (p. 276) identified by this study explicitly classifies industrial specialisation not dominated by a single industry in the positive ones. This seems to imply that the theorisation for the negative role of specialisation does not hold generally but only in extreme cases.

7.3.4. The local supply of entrepreneurs: the role of occupational structures

Notions of 'unemployment-push' and small-plant size structures, along with 'sectoral-inertia' related theorisations, all carry implications for the supply side of local entrepreneurship. The nexus provided by the intermingling of these theorisations is that entrepreneurs are probably incubated in small plants[81], that unemployment and/or job insecurity drives them to establish their own business, and that there is correspondence between the sector where the incubator firm operated and the destination of new firm formation activity. The subject of the present section mainly concentrates on the skills, the positions and the tasks performed by new entrepreneurs during their incubation period. The discussion concentrates on the personal traits of new firm founders and consideration is given to local occupation structures as being determinants of both the quantity and the quality of local entrepreneurial supply.

Cross (1981) argues that the level of skills possessed by individuals in a labour market area and the associated labour market of employment are important factors in accounting for the spatial variations in the rate of new firm formation. Lloyd and Mason (1983) point out that skilled manual workers are more prone to establish their own firms than unskilled or semi-skilled workers as they have acquired the necessary problem solving skills. Cross (1981) maintains that the propensity for self-employment is higher for individuals with previous managerial experience. Gudgin *et al.* (1979) relate managerial experience to educational attainment and Storey (1982) recognises managerial experience and higher levels of education can be directly associated with higher levels of entrepreneurship. Yet these features of local labour markets when in place are associated not only with greater supply of entrepreneurs but also with certain qualitative aspects of this supply. It has been argued that these qualifications and managerial expertise create in fact more successful firms (Cooper, 1973; Gudgin *et al.* 1979;Lloyd and Mason, 1983).

Gudgin *et al.* (1979) find that firms established by graduates perform better than those which are similar in other respects but established by non-degree holders. Lloyd and Mason (1983) outline evidence which suggests that individuals with a managerial

[81] This seems to apply to new manufacturing firm founders rather than to service firm proprietors as discussed in an earlier section.

background and some degree level or other professional qualification have often started faster growing firms. Storey (1982), however, does not find unambiguous evidence to support a similar conclusion. He discovered that an association between educational qualifications and entrepreneurial success appeared to hold for manufacturing but not for various services sectors. Survey evidence provided by Cross (1981) suggests that, although prior to new firm establishment founders were likely to hold managerial positions, they started their initial working experience in manual occupations. Nevertheless, it was argued that as managerial background appears to be important it would reasonable to hypothesise that the higher the extent of non-productive manufacturing employment in an area the higher should be new firm formation activity there. Cross provides some evidence indicating that the level of administrative employment is also positively associated with new firm start-ups, whereas the level of operative employment is negatively associated. Gould and Keeble (1984) also find a strong and positive correlation in specific locations between new firm formation, adjusted for industrial structure, and the percentage of the resident male population in non-manual occupations. Westhead and Moyes (1992) extend this conclusion to Britain as a whole. They are explicit in concluding that a local tradition of self-employment and a large proportion of the workforce previously having been employed in small plants, together with managerial and professional expertise, are amongst leading factors in the promotion of new firm formation.

Several researchers have noted the not inconsiderable contribution of the services sectors in 'preparing' manufacturing entrepreneurs. Cross-sectoral fertilisation has been evident in the work of Johnson and Cathcart (1979) who found that 22% of founders of new manufacturing firms were previously employed in the services sector. Cross (1981) and Storey (1982) find the corresponding proportions being 28% and 16% respectively. Storey suggests that the movement from services to manufacturing is closely followed by its counter-movement as 16% of new services firms founders were previously employed in manufacturing. Aydalot (1986) derives a significant negative correlation (-0.76) between the proportion of regional employment in manufacturing and new firm formation rates defined over manufacturing employment in France. This leads him to infer that *"it is not the industrial workers who create the firms"* (ibid. p. 115).

Paralleling the suggestive survey and statistical analysis based evidence have been econometric results in a number of British studies which clarify the effect of local occupational structures on new firm formation. Whittington (1984) finds the proportion of manual workers to have a negative and significant effect in accounting for variations in new firm formation across UK regions. Moyes and Westhead (1990) also find a positive correlation between new firm formation and the proportion professional and managerial employees, but negative in the case of the proportion of manual employees. However, in both of these results the correlations are statistically insignificant. Ashcroft *et al.* (1991), on the other hand, find that the degree of managerial background in a county has a strong positive effect in determining spatial variations in new firm formation in Great Britain. Love (1996) associates primarily the availability of management skills in area with firm exit and hypothesises the former to be inversely related to the latter. The managerial skills proxy was found to be positive, and of moderate significance, in the exit formulation of a single-equation estimation framework but negative, and significant, for the same equation in a simultaneous-equations estimation context. Keeble and Walker (1994), using the percentage of resident economically active population in non-manual socio-economic groups to proxy occupational structures that relate to professional, managerial and non manual expertise, find a positive, and statistically significant, effect on both firm births and deaths in the UK counties.

Evidence from the Republic of Ireland (Hart and Gudgin, 1994) suggests that the proportion of managerial and professional occupations in the local population exert a positive and significant effect in accounting for spatial variations in new firm formation. In contrast, the proportion of county population gaining access to higher education was found to hold a negative and statistically significant sign. The interpretation favoured in this research is that relatively few people with higher education qualifications proceed to found new manufacturing firms. Again in contrast, Guesnier (1994) finds that, when new firm formation rates are defined over existing stock of firms, the proportion of adults with bachelor degrees, young men active in the workforce, and middle management in the workforce, all have a positive and significant effects on local firm births in France.

Consistent with expectations has been the finding of Audretsch and Fritsch (1994) for Germany that the share of unskilled of labour has a significant negative effect on new firm formation. Fritsch (1992) clarifies empirically that the share of foremen in the regional labour force had a significant positive effect on the founding rate in manufacturing and the share of qualified clerical employees the same in the service sector. Davidsson *et al.* (1994) find that the proportion of workforce in technical professions has a positive influence in determining spatial variation in new manufacturing firm formation activity in Sweden. Italian evidence has been reassuring showing that high proportions manual workers in the local labour force has a significant negative effect (Garofoli, 1992, 1994), whereas managerial background and higher education as factors increase the probability of an individual forming a new business (Vivarelli, 1991).

7.3.5. Other economic factors

Mason (1991) identifies three economic factors which contribute to spatial variations in new firm formation. These are the availability of information, the availability of factors of production, and finally, local/regional market demand. It has been argued (Sweeney, 1987) that the availability of information, although important in determining an area's entrepreneurial potential, has been somewhat overlooked. The stock of information and level of information circulation is also relevant in the present review to the urban-rural shift heading as these might be considered with factors contributing to agglomeration and urbanisation economies. Access to capital as a production factor along with the effects of local demand conditions is explicitly dealt with in what follows. Implications of the role of production prerequisites such premises have also been incorporated when contrasting urban with rural locations.

7.3.5.1. Access to Capital

Mason (1991) argues that inter-regional differences in new firm formation may be accounted for by spatial variation in access to capital that relates to sources of both institutional and personal finance. The second source of finance seems to matter much more than the former as there is some considerable amount of evidence suggesting that *"personal savings are consistently the most frequently used, and the most important single source of funding for the new business"* (Storey, 1982, p. 164). Indeed Storey's (1982) survey from Cleveland demonstrates that personal savings accounted for 52% of all financial sources mentioned. Cross (1981) provides similar evidence for Scotland

(44%)[82], and Mason (1989) find that 67% of post-1979 start-up finance in South Hampshire relates to personal savings. Reliance on institutional financial sources, such as bank loans and overdrafts, has appeared in several studies to be really quite limited. Storey (1982) reports that only 27% of surveyed new firms declare this source of finance to be the most important. Lloyd and Mason (1984) find that in the North-West conurbations only 15% of new firm founders responded that they have sought loans or overdrafts, whereas the relevant figure for South Hampshire was 42%. More recent evidence from South Hampshire (Mason, 1989) suggests that the frequency of respondents mentioning bank loans is only 32% and bank-overdrafts 29%. In contrast, O'Farrell (1986) discovers that in Ireland the proportion of new firm founders who have used bank loans as start-up capital is much higher (79%). The local availability of venture capital networks, although recognised as an important factor relating to spatial variations in new firm formation (Malecki, 1990) and regional restructuring (Florida and Kenney, 1988), has however been found mainly to refer to high levels of agglomeration in central regions (Florida and Kenney, 1988; Mason and Harrison, 1995).

Storey (1982) points out that banks are the second most important source of finance for new firm founders, after personal savings, this implies that the *"level of wealth in the local community must therefore be an important determinant of its capacity to add its stock of business"* (ibid. p. 164). Mason (1991) argues that spatial variations in home-ownership and house prices are quite important in that new firm starters can raise capital by offering their home as collateral against a bank loan. Garofoli (1992) argues that extensive regional home ownership and wealth is both a necessary condition for initiating self-employment, and also an indicator of increased propensity for attaining revenues from self-employment. This seems to carry implications for the home ownership variable. It may have both a supply-side role relating to fund-raising capacity and demand side effects signalling more wealthy markets (Ashcroft *et al.* 1991). Moreover, home-ownership may partially reflect the local occupational structure as it can be correlated across space with higher fractions of the population in professional and managerial positions (Keeble and Walker, 1994).

[82] This is elevated to around 49% if income from selling owned-property is added.

In support of the hypothesis that relates higher levels of regional home-ownership to higher levels of new firm formation activity has been considerable empirical evidence produced in series of spatial analyses in the UK (Whittington, 1984; Ashcroft *et al.* 1991). Lloyd and Mason (1983) attribute poorer new firm formation performances in Scotland and in Northern England to the relatively low levels of owner-occupation. In contrast, high house prices in South-East of England and adjacent regions, it has been argued, contribute to higher formation rates as they increase the level of personal income available. In an inverse fashion, Beesley and Hamilton (1986) find a strong negative rank correlation between firm birth rates and the percentage of local authority-owned dwellings in Scotland. Moyes and Westhead (1990) show that this finding can be extended to account for spatial variations in new firm formation at a county level in the UK as whole. Keeble and Walker (1994), to account for spatial variations of not only firm births but also deaths, have extended the use of dwelling prices as related notion. Whereas dwelling prices have a positive and statistically significant effect on firm births and on growth in the number of firms locally, their effect on firm deaths depends on the definition of death rates. Thus, this has a significant negative effect when firm-deregistration rates are defined over business stock but positive and statistically sound in the opposite case. Mixed results are also provided by Love (1996) who finds the extent of home ownership to be a negative and significant determinant of entry in a simultaneous estimation framework, but positive as hypothesised in single-equation estimation.

Elsewhere, Davidsson *et al.* (1994) fail to find any evidence suggesting that regional variations in private capital availability affect spatial variations in new firm formation in Sweden. The same, however, is not evident in France where a positive association between new firm formation rates defined over workforce and a higher percentage of dwellings as second homes was found (Guesnier, 1994). Gerlach and Wagner (1994) proxy regional differentials in wealth, using data on per capita tax, and find this indirect index of wealth to have a positive and significant effect on firm entry in Lower Saxony. Spilling (1996), utilising data on average personal property and income, only finds a negative effect on start-up rates in manufacturing in Norway. This finding has been interpreted as high start-up rates in manufacturing occur in peripheral areas where personal property tends to be lower than in central areas. A similar finding has been evident in Italy where results of both rank correlation and regression analyses indicate that, although insignificant, the direction of the relation between new firm formation and home ownership is negative (Garofoli, 1992, 1994). However, it has been argued that the Italian case is confusing because the majority of depressed areas, especially the Mezzogiorno, show high values of home ownership. Garofoli (1994) also hypothesises that geographical areas with high per capita financial assets (bank deposits) are likely to be areas where access to capital is relatively easy and new firm formation higher. Some empirical evidence relating to bivariate correlations is provided in support. Santarelli and Piergiovanni (1995) test the hypothesis that shortages in bank credit inversely affect new firm formation, and employing the utilised credit ratio as an index of credit market turbulence they find a negative and significant effect. Bartik (1989) discovers that inter-state variation in new firm formation in the US is directly determined by greater competitiveness of state financial markets and Reynolds (1994) shows that both the labour-market area median dwelling value and the percentage of owner-occupied dwellings have a positive effect on firm births variously defined in all economic sectors considered.

Recent research has revisited the issue of the effect of housing wealth on new firm formation. Black *et al.* (1996) suggest that variation in the real value of housing wealth might directly account for a significant proportion of variation in new firm formation in the UK. Robson (1996) re-examining this issue finds that, once lagged firm registration rates have been included amongst the regressors to account for time autocorrelation along with time- and region-specific effects, the relation turns out to be negative. However, there is also some evidence suggesting that access to external collateral in this form may be associated with higher rates of business survival. Johnson and Parker (1996) demonstrate that the effect of real net housing wealth, lagged two years, has a negative effect on entry — a result that is in line with Robson (1996) but in contrast with Black *et al.* (1996). In the exit equation the positive effect of real housing wealth is not consistent with Robson's proposition that the presence of such wealth may facilitate survival in the short-run.

Not unrelated to the theme of this section is the effect of regional policy measures that may alleviate some of the capital need of new firm starters, such as subsidies, grants, local development agencies etc. Some empirical evidence available suggests that policy-related effects have not been unambiguous in their role. Hart and Gudgin (1994) find a positive effect of policy-related variables that have been included as supply side indicators of availability of low-cost capital, services and advice. Davidsson *et al.* (1994) find that regional development support measures have some modest effects on firm birth rates. The same, however, has not been the case for new firm formation in Lower Saxony where there in no evidence to show that subsidies had any significant effect (Gerlach and Wagner, 1994). Keeble and Walker (1994), on the other hand, provide some empirical support for the idea that above-average local government expenditure and enterprise agency assistance helps to reduce small-firm death rates. In similar fashion, O'Farrell and Crouchley (1983) conclude that grant assistance reduces the frequency of young plant closure in Ireland.

7.3.5.2. Demand Side Factors

In earlier section of this chapter it was suggested that many new firms tend to serve local markets, at least in their first period of operation (Gudgin, 1978; Cross, 1981; Storey, 1982; Lloyd and Mason, 1984, Moyes and Westhead, 1992 amongst many others). Consequently, it has been postulated that the growth of local demand for goods and services is of great importance in promoting new firm formation activity. It also facilitates the survival and growth of new firms, as well as sustaining growth levels of existing firms (Moyes and Westhead, 1992). In particular, it has been argued that for manufacturing industries a positive relationship should be anticipated between new firm formation and the rate of change in local manufacturing employment. This is based on the assumption that the latter might be associated with the opening of new local markets and possibly with the proliferation of market niches (O'Farrell and Crouchley, 1984). As is often the case, here the demand side effects can be best thought of as intermingling with supply-side aspects. Growing manufacturing employment may also increase the pool of potential entrepreneurs (Cross, 1981) and population growth might be associated with selective in-migration that would also affect the qualities of local entrepreneurial supply (Keeble and Walker, 1994). The relation between population levels and firm births can, however, be non-linear and Malecki (1990) finds the amount of urban population in the US at which the location quotient of firm birth rate was highest to be 2.3 million.

Early evidence on the role of employment growth has been confined primarily to account for inter-industry variations in new firm formation within a region. Thus, both

Gudgin (1978) and Johnson and Cathcart (1979) do not find any significant effect for employment growth in Leicestershire and the Northern Region respectively. In contrast, O'Farrell and Crouchley (1984) explicitly use manufacturing employment growth to account for spatial variations in new firm formation in Ireland and do find evidence that it has a significant positive effect. Hart and Gudgin (1994) also show in the same context that manufacturing employment growth, serving a proxy for growth in local demand, does have a positive and significant effect on new firm formation. This, however, does not hold for net population migration.

In the Beesley and Hamilton (1986) research on spatial variations of firm births and deaths in the UK a different point of view has been taken in respect of the role of local employment growth. This is in accordance with a 'push' theorisation that associates higher new firm formation with lower employment prospects which are signalled by lower employment growth. Despite these advance expectations, a positive and significant rank correlation coefficient (0.75) between firm births and employment growth was derived. Moyes and Westhead (1990) derived a significant and positive regression coefficient for population change and found other demand-side variables, such as total employment change, and manufacturing and utilities employment change, to be positively and significantly correlated with spatial accounts of new firm formation in the UK. Similar results are found in a more recent study (Westhead and Moyes, 1992), where both population and total employment change have positive and significant effects on new firm formation. However, the use of population change was intended here to reveal more on the rurality-agglomeration dimension associated with new firm formation.

Keeble and Walker (1994) examining spatial patterns of firm births and deaths in the UK deploy the population change during the preceding five-year period and the average annual change in GDP per capita at a county level. The former was found to be positive and significant for firm births irrespective of the birth rate definition used for the total economy but more significant in determining new firm formation defined over thousands employees for the finance, professional and business services sectors. Considering the determinants of spatial differentials in the growth of number of small firms there has been some gradation in the significance of the positive effect depending on the denominator used to define growth rates, but not between manufacturing and non-manufacturing sectors where the effect is usually equally significant. The effect of GDP growth has been insignificant when new firm formation and growth rates have referred to the total economy, but significant when non-manufacturing sectors were dealt with separately by the econometric analysis. Both variables of interest had a positive and significant effect on firm deaths in non-manufacturing activities. In contrast, Johnson and Parker (1996) do not find the effect of changes in GDP figures adjusted at a county level to be of any significance in both the firm births and deaths equations. In similar fashion, Robson (1996) finds that real per capita GDP growth has a positive, but insignificant effect, on new VAT registrations.

In the same vein as Keeble and Walker (1994), Audretsch and Fritsch (1994) are able to point to a positive and significant effect of population growth on new firm formation rates in Germany, which is larger in magnitude for services. Davidsson *et al.* (1994) also find the size of the local markets to be important for start-ups in the service sector, in general, but also for manufacturing births in Sweden. Gerlach and Wagner (1994) use the rate of growth of real gross national product and find that this too has a significant positive effect in determining spatial variations in small firm entry in Lower Saxony in a model that also employs region-fixed effects.

Evidence from France (Guesnier, 1994) suggests that population growth has positive effect on new firm formation independently of the way new firm formation rates are defined. Italian evidence (Garofoli, 1992) reassures for the positive and significant effect of population growth on new firm formation. The same, however, does not apply to the rate of growth of domestic product for each province, which was not included in the RHS of any regression equation presented, implying that this was not found to be of any conventional level of statistical significance. Santarelli and Piergiovanni (1995) have been more specific using the annual rate of employment change in producer services in turn serving existing firms and find a direct effect on new producer services formation. From a somewhat different angle, Vivarelli (1991) provides survey evidence concerning the effect of demand perceptions as a motive for new entrepreneurs. This research suggests that 50.2% of those interviewed claim to have been attracted by the existence of a market niche and 44.3% from perceptions of unsatisfied demand. Bartik's study (1989) of small firm start-ups in the USA supports the view that the most important determinant of inter-state variation in firm formation over time is the gap between the size of local market demand and existing industry supply. The former was proxied by population density and the latter by manufacturing employment density. Whereas the population density was found to have a significant positive effect, industry density exerts a significant negative influence. It was estimated that a 10% increase in the ratio of population to industrial employment could potentially stimulate around a 10% to 15% increase in small firm start-ups. In the same country, Reynolds (1994) using econometric analysis to determine spatial variations across 382 labour market areas finds that both population change and real per capita income growth have a positive and significant effect in stimulating firm births across a broad spectrum of sectoral aggregates.

7.3.6. Urban-Rural Shift

Fothergill and Gudgin (1982, p. 158), referring to new firm formation patterns in the UK, point out that *"the strongest trend in industrial location during the last two decades has been the shift of manufacturing employment from cities to small towns and rural areas."* This trend seems to persist and is associated with the spatial distribution of new firm formation activity, which itself reveals the existence of an urban rural dimension. Urban industrial counties record much lower new firm formation than semi-rural counties in both central and also peripheral regions (Mason, 1991). Evidence supporting these trends has been accumulating over the years and much of the earlier evidence has come from British regions. Thus, Gudgin (1978), using data on new firm formation for local authority areas in Leicestershire, found that entry rates have a tendency to be above average in rural areas adjacent to major cities. Cross (1981) shows that in Scotland it is the smaller rather than the larger industrial areas which are gaining more new firms relative to their size. The contrast between new firm formation in urban and rural areas in East Anglia is also striking as the formation rates in rural areas are nearly three times those of large towns (Gould and Keeble, 1984).

Some comparative evidence across European Community countries has been offered by Keeble and Wever (1986) who, analysing spatial patterns of new firm formation, make a threefold generalisation in respect of regional characteristics and the corresponding intensities of new firm formation activity recorded. Evidence seems to suggest that: a) metropolitan areas surrounding large cities with diversified economic bases exhibit high new firm formation rates in both manufacturing and services; b) in contrast, high new firm formation intensities in relative terms although lower in absolute terms have been recorded in relatively unindustrialised rural regions having some tradition in small and often agriculturally related manufacturing; c) the lowest new firm formation intensities appear in older urban areas dominated by heavy and declining manufacturing industries. This does not mean that all rural areas outperform urban centres in new firm formation across Western Europe. Notable exceptions stand out in Greece, where major cities remain the main recipient of new firm formation activity (Dokopoulou, 1986), and rural areas in the south west of Ireland and Southern Italy (Mezzogiorno) lack such activity. Mason (1991) argues that a 'core-periphery' contrast in new firm formation is also evident in USA, which reflects the so-called 'frost-belt' to 'sun-belt' shift in economic activity.

Although there is no real consensus on the determinants of this kind of shift in manufacturing activity, there have been some suggestions in the literature. A considerable body of research that attempts to tackle this question has attributed higher new firm formation rates to in-migration that has been attracted as a result of quality of life considerations — amenities and better residential conditions in say rural areas. Moreover, it has been argued that this migration process is selective resulting to inflows of managerial, professional and technical workers that have a supply-side impact on the local pool of potential entrepreneurs (Mason, 1991, Robson, 1996). The Keeble and Gould (1985) and Mason (1989) studies for East Anglia and South Hampshire respectively suggest that around half of new firm founders had migrated into the area where they established their own firm at some point in their lives. Keeble *et al.* (1992) explore the link between 'counter-urbanisation' migration and new firm formation at a national level and offer evidence suggesting that around 66% of accessible rural new firm founders and some 58% of remote rural areas founders had moved there prior to undertaking of their entrepreneurial initiatives. Most of all, around 21% of remote rural founders moving for this purpose were being driven to a considerable extent by environmental and quality of life considerations[83]. Aydalot (1986) finds that the formation of new manufacturing firms in France is concentrated around areas with little manufacturing, which combine a rural environment with close proximity to a larger town,

[83] A detailed analysis of the factors underlying the urban-rural shift and also urban-rural contrasts in entrepreneurial behaviour in England can be found in Keeble and Tyler (1995).

and that there is a high correlation with spatial patterns of new firm formation and migration balance. As an exception, Greater Paris remains considerably active in new firm formation even with its negative migration balance.

In contrast to all these views on the role of migration, Illeris (1986) places particular emphasis on the cultural background of entrepreneurs and relates a potential explanation of the urban-rural shift to individual life-modes, and their propensity to become entrepreneurs. The life-mode of self-employment that is primarily characterised by the desire for independence and less by firm characteristics might be more apparent in rural areas than in metropolitan areas. In rural areas, it is argued, there are co-operation advantages relating to the social web that facilitate entrepreneurship and self-employment traditions that relate to agriculture. In contrast, in metropolitan areas the employee career life mode might dominate. This mode is mainly characterised by the aspiration of satisfactory jobs and salaries capitalising on good education. Individuals better described by the career life-mode can also establish firms but in doing so the motive relates more to the exploration of profitable opportunities utilising their own skills and experiences rather than to be independent. Illeris argues that although firms established in this fashion might be more innovative and technologically advanced, their proprietors might be prone to buyouts form larger corporations, and then move back to paid employment. Apart from the life-mode framework, the urban-rural shift in Denmark has been attributed to number of other factors. These relate to issues of finding staff, finance and premises, which might be easier in peripheral areas. The availability of premises in rural areas has concerned a number of scholars in this research field. Fothergill and Gudgin (1982) attribute much of the urban rural shift and manufacturing decline in large urban areas to limited expansion capacity of existing premises and sites facing firms in congested urban areas. O'Farrell and Crouchley (1984) emphasise the need for better understanding of the factors underlying the observed urban-rural dimension of new firm formation in Ireland, and include in these cheaper land prices and wider availability of suitable premises. Robson (1996) also recognises the possibility of higher land, office and plant floor space prices in more densely populated areas to be responsible for a negative relationship between an area's population density and new firm formation. However, the attractiveness of this argument seems greater for indigenous new firm formation decisions and probably for new branch location rather than for the relocation of existing plants as it has been argued that industrial movement is but a secondary process in respect to the urban-rural shift (Fothergill and Gudgin, 1982; Keeble and Tyler, 1995).

The significance of the urban-rural shift in new firm formation has been revisited from a technical perspective and econometric analyses drawing on alternative theoretical grounds have aggravated considerably the degree of ambiguity. Gudgin and Fothergill (1984) show that higher rural new firm formation rates are probably, at least partly, a statistical artifact caused by a failure to include at least a proportion of non-manufacturing employment in the denominator when defining new firm formation rates as in Gould and Keeble (1984). O'Farrell (1986) finds that even when the denominator used to define new firm formation rates includes some proportion of non-manufacturing employees, new firm formation rates appear to be higher in a cluster of predominantly rural areas in Ireland. However, most important seems to have been a line of argument that relates urban-rural shift with plant size structures and the well manifested role of small plants better serving as incubators of new firm founders and also reflecting overall lower entry barriers in a locality. Lloyd and Mason (1983, p. 24) argue that *"since many of the areas which have a large plant bias are in the peripheral regions of Britain and most areas with a higher share of small plants are in Midlands and South, it seems likely that inter-regional rates of new firm formation in the UK will decrease with movement north and westwards."* On the other hand, O'Farrell and Crouchley (1984) are quite explicit in assuming that population density, as a proxy of urbanisation, is inversely related to the size of plants supported by areas in Ireland. It is explained that large plants cannot satisfy their labour requirements in quantitative terms in small labour market areas. The implied bias of larger small-plant structures in favour of less urbanised areas is seen as factor partially responsible for urban-rural shifts. The proportion of a county's employment in towns of over 5,000 population was found to hold a negative and significant effect in determining spatial variations in new firm formation in Ireland and this finding re-emerged in a recent analysis in the same context by Hart and Gudgin (1994). Ashcroft *et al.* (1991) note that amongst counties in Britain with higher new firm formation rates defined over working population many can be classified as primarily rural. However, accounting for rurality by using a dichotomous variable amongst other regressors yields an insignificant, albeit positive effect. Short- and long-run effects of population density as a proxy for urbanisation on spatial variations of new firm formation and also on firm deregistrations have been accounted for in Robson (1996). Whereas there is some evidence suggesting that in the short-run the effect of population density is positive, in the long run its effect is significantly negative[84]. Speculations regarding possible underlying factors for this encompass the possibility that the size structure in more densely populated areas has been unfavourable to entrepreneurial spin-offs. Interestingly, the distinction between short and long run effects of population density on firm dissolution yields results that move in the opposite direction. The long-run effect is positive probably reflecting higher fixed-costs relating to floorspace rents in more densely populated areas.

Another strand of empirical research seeks to examine the locational preferences of new firm formation activity drawing on the inner-city incubator hypothesis (Hoover and Vernon, 1959; Vernon, 1960) and 'filtering-down' theory (Thompson, 1968). The inner city incubator hypothesis suggests that a high manufacturing birth rate takes place in the 'core' of metropolitan areas being facilitated by external economies, arising from close proximity to suppliers and customers, increased information circulation etc. The inner city location, although preferable in the early days of a new firm, might perhaps be abandoned as the firm grows and it becomes more economical to internalise services previously put out to other firms. The 'filtering-down' theory maintains that large urban areas offer an 'environment' that is more conducive to innovation possessing diversified and skilled labour markets, and information and interaction opportunities with other firms. Following a life-cycle theorisation of an industry, new more innovative firms are thought to have a higher propensity to establish in urban areas. However, as the product or the processes mature and become more standardised, firms may well tend to flee to less sophisticated and more peripheral areas[85]. Leone and Struyk (1976) find limited evidence in support of the incubator hypothesis that is confined to New York while Nicholson *et al.* (1981) demonstrate that for London the only evidence than can be used in favour of this hypothesis relates to the use of old premises by new firms. The de Jong and Lambooy (1986) research for new firm formation in the Netherlands places particular emphasis on Amsterdam and points out that the clustering of new firm within or near urban areas

[84] Short-run effects are proxied by population density growth in subsequent years, and long-run effects by population density levels.

[85] An extensive review of theoretical considerations relating to these hypotheses along with a survey of empirical evidence can be found in Nicholson *et al.* (1981).

could be attributed to the attractiveness of urban labour markets. Garofoli (1994) does not find any support for the validity of the incubator-hypothesis as a possible determinant of spatial variations in new firm formation in Italy at a provincial level. In contrast, Santarelli and Piergiovanni (1995) offer some evidence for the filtering-down theory in the producer services sector in Italy, suggesting that higher-order and more innovative producer services tend to locate within the largest urban areas. There is also some evidence from US metropolitan areas (Malecki, 1990) suggesting that geographical differences in sectoral markets and in agglomeration of complementary activities influence new firm formation, especially in high technology service sectors. On the other hand, Reynolds (1994) in analysing spatial patterns of firm births across US labour market areas, demonstrates that various proxies of urbanisation/agglomeration have a positive effect on business services start-ups[86]. The same, however, is not evident for manufacturing-firm births, indicating a shift of manufacturing away from dense high cost regions but remaining in some reasonable proximity to major metropolitan labour market areas.

Keeble and Walker (1994) maintain that population density should be interpreted as measuring the wider existence of either agglomeration economies or diseconomies which are related to costs of premises, labour and accessibility/congestion. The effect of population density on both sectorally independent and manufacturing new firm formation activity has been found positive and significant confirming that large cities still act as nurseries or incubators for enterprise. When growth in the number of small firms served as dependent variable in the econometric analysis, the effect of population density was found negative and significant. Such a reversal supports the argument that, while urban environments with their concentrated local market opportunities act as new firm incubators or nurseries, agglomeration diseconomies result in above average urban death or relocation rates, resulting in low rates of growth in numbers of small businesses. This conclusion is reinforced by the positive and significant effect of population density on firm deaths when both sector-specific and sector-independent new firm formation rates where analysed. Agglomeration diseconomies seem to have been ignored by Love (1996)

[86] Bryson *et al.* (1997) argue that South East of England and especially areas adjacent to Greater London have been the locations favoured by small business services firms in Britain.

who, focusing only on agglomeration aspects of population density, anticipates a negative relationship between the latter and firm exit at a county level the same as that witnessed in the Reynolds *et al.* (1993) research on business volatility in the USA. Despite expectations, the relationship between population density and firm exit at the county level turns out to be positive, although insignificant.

The effect of agglomeration economies proxies on new firm formation has not always been found to have a significant direct effect on new firm formation, as both the Audretsch and Vivarelli (1995) and Gerlach and Wagner (1994) studies for Italy and Lower Saxony respectively show. Conversely, Guesnier (1994) notes that in France higher new firm formation rates defined over existing number of firms are found in more urbanised departments than in rural areas, but exactly the opposite is the case when the standardisation uses thousands in the workforce. Nevertheless, in econometric analysis population density appears to be an equally significant and positive determinant of spatial variations under both alternative definitions of new firm formation rates. This was evident in the Audretsch and Fritsch (1994) research on spatial variations of firm births in Germany. Fritsch (1997) depicts that in West German planning regions over the 1986-1989 period more than half of all start-ups took place in highly congested areas and that almost 70% of all new firm start-ups were in the service sector. Nevertheless, bivariate correlation based evidence has been heavily dependent on the definition of new firm formation rates used. Thus, the relationship between formation rates and population density has been negative when the former were defined over labour force but positive when stocks of firms serve the standardisation. Adjusting formation rates for the effects of regional sectoral structures reveals a negative association between new firm formation and population density. Analysis of new firm formation patterns in Sweden (Davidsson *et al.* 1994) also reveals that the most populated market areas are among those exhibiting the highest rates of firm start-ups and that among regions recording the lowest rates appear to be those dominated by large plants. Econometric analysis further suggests that population density has a positive effect in increasing new firm formation in professional services and sectoral aggregates. Corresponding estimates for manufacturing are not available. However, the relationship between new firm formation in this sector and population density yields a negative bivariate correlation coefficient (-0.13) in the Swedish research. Spilling (1996) finds rather complicated patterns for regional variations of start-up rates in Norway in respect to the centre-periphery dimension. Although there is a tendency for major urban areas and small towns to exhibit higher start-up rates, this pattern is disturbed as some of the most peripheral areas also exhibit high start-up rates. The lowest start-up rates are recorded in smaller towns and areas with heavy industry and single sector predominance. A mixture of central-urban and peripheral areas in recording high entry rates has been found for sectoral-specific analyses with the notable exception of business services where mainly urban areas appear to be best performing incubators of new firms.

So much for the review of the forces impinging on the nature of firm entry and exit at the regional scale, attention in this thesis now proceeds the focus on these ideas as they can be applied to manufacturing in the regions of Greece.

Chapter 8.

Spatial variations in net entry rates: an application of shift-share ANOVA model †

8.1. Introduction

This research aims to examine patterns of net entry of establishments across Greek regions. Since both the nature of this dependent variable and general data availability constraints hinder a proper model-based econometric investigation of net entry rates across regions and industrial sectors, the research uses a shift-share analysis to account for these patterns.

The variant of the shift-share approach used by Johnson (1983) to account for new firm formation has been extended here to deal with net entry rates. Earlier findings of research on new firm formation in UK regions, suggesting that the main source of variation in inter-regional new firm formation stem primarily from within-sectors across space differences in formation rates, and their possible policy implications, have motivated this research. The analysis here points to the same conclusion as to what determines spatial patterns of net entry rates across Greek regions.

Shift-share analysis has been criticised on a variety of grounds, and as a result some time will be spent considering its shortcomings and the caution that should accompany its application. Conventional shift-share analysis offers little scope for statistical hypothesis testing and so the analysis here goes a step further to employ, for the first time in this area, a shift-share two-way analysis of variance (ANOVA) model. Since the application of such a model is also not beyond criticism, this research also offers some discussion of the potential advantages and disadvantages of the technique as well its appropriateness in analysing net entry rates of establishments in a spatial context. Holden *et al.* (1987) point

† This chapter draws on Fotopoulos, G., and Spence, N., *n.d.*, Spatial Variations in Net Entry Rates of Establishments in Greek Manufacturing Industries: An Application of Shift-Share ANOVA Model, *Scottish Journal of Political Economy* (submitted for publication).

out that the basic theoretical underpinnings are common to both the shift-share and shift-share ANOVA models, but that the latter might offer some major advantages owing, primarily, to the well established properties of analysis of variance. A similar view is taken here.

The estimation framework for the two-way ANOVA approach to shift-share analysis owes much to Weeden (1974) whose work has rarely been mentioned in non-UK studies. Other approaches, due to Berzeg (1978, 1984), based on a one-way layout and variants of the two-way methodology have been discussed more in the US literature. The present research presents results using both two-way and one-way ANOVA. It is demonstrated that the numerical equivalence between the estimated industry-mix effect in the one-way ANOVA model and that calculated by shift-share analysis is of limited practical use in that inference is based only on partial information.

The last task examines empirically whether or not conclusions drawn using size-independent net entry rates would hold if net entry rates defined for size-related classes were used. In other words, the hypothesis that the determinants of net entry rates in a spatial context are not independent of establishment size is examined. The results reveal that treating all establishments as being of equal size considerably obscures certain relationships and that larger firms are less amenable to local conditions when compared with their smaller counterparts.

The chapter is organised as follows. The next section discusses the use of shift-share approach in analysing new firm formation in the UK studies. Section 8.3 presents the results of a slightly modified method to account for patterns of net entry rates of manufacturing establishments across Greek regions. Criticisms of conventional shift-share analysis are discussed in the first part of the fourth section. The two-way ANOVA assumptions and notation, as well as a commentary, follow in the second part. Results of the empirical application of the methodology come next. The one way-analysis layout is analytically and critically exposed in the last part of section 8.4, together with some empirical results. Results concerning the establishment-size disaggregation exercises are provided before concluding.

8.2. Shift-share analysis and new firm formation

In the UK literature on spatial variation of new firm formation a number of papers have used shift-share analysis. The first use was by Johnson (1983) who thought that since new firm formation rates differ quite significantly across industries at the national level, spatial variation in new firm formation could be a reflection of differences in regional manufacturing structures as well as of differences in formation rates for any given industry across regions. In other words, a region can have an aggregate new firm formation rate that differs from that of the nation because it has a different mixture of industries and or because the same industries enjoy different formation rates compared to their counterparts at the national level. This is, of course, the simple premise on which conventional shift-share is based, namely to account for deviations from a hypothetical situation given by a region undergoing national formation rates unless there are some regional comparative advantage or disadvantage factors operating. Of course, as the technique does not specify these factors, it does not provide a proper theoretical approach to spatial variation of new firm formation[87].

Johnson's modification of shift-share analysis to analyse new firm formation argues that the number of new firms being generated in region r (A_r) can be decomposed as follows:

$$NS_r = \sum_{i=1}^{N}\left(\frac{E_r e_{in} f_{in}}{E_n}\right) \quad (8.1)$$

This is the number of firms that would have been formed in region r if the structure of the region's manufacturing industry was that of the country as a whole (subscript i refers to i=1,...,N industrial sectors used in the analysis).

$$S_r = \sum_{i=1}^{N}\left(e_{ir} - E_r\frac{e_{in}}{E_n}\right)f_{in} \quad (8.2)$$

Equation (8.2) demonstrates the effect of industrial structure on new firm formation in region r. This generates the number of firms that would have been formed in region r if the national formation rate of each industry had been applied to the difference between

[87] See Bishop and Simpson (1972) for a discussion of the technique in its conventional employment growth use.

the actual employment in each industry and a hypothetical amount that would be there if the region had the same manufacturing employment structure as the nation (Storey and Johnson, 1987). This is often called in the shift-share literature the composition effect, structural component or industry-mix effect.

$$F_r = \sum_{i=1}^{N} e_{ir}\left(f_{ir} - f_{in}\right) \tag{8.3}$$

Equation (8.3) allows for the effect of within-industry differences of formation rates between regions and the nation to be identified when regional formation rates are concerned. The formation or fertility component (F_r), competition effect or differential component are names that have been used to describe this quantity.

In these equations E_r is the total manufacturing employment in region r, e_{in} is national employment in industry i, e_{ir} is regional employment in industry i, f_{in} is the national new firm formation for the i-th industry and f_{ir} is its regional counterpart.

As in conventional shift-share analysis the components given in equations 8.1 to 8.3 sum to:

$$A_r \blacksquare \sum_{i=1}^{N} e_{ir}\, f_{ir} \tag{8.4}$$

It follows that, in order for equation (8.4) to provide the actual amount of new firms formed at the regional level, e_{ir} should be used in the denominator when defining f_{ir}. That is $f_{ir} = \frac{A_{ir}}{e_{ir}}$ where A_{ir} is the actual number of firms formed in industry i in region r.

However, Johnson (1983) defined formation rates in relation to thousands of male manufacturing employees. This was based on the assumption that the founders of new firms in an industry might have been previously employed in that industry and in that same region. This is somewhat problematic because, as demonstrated above, the strict application of shift-share assumes the same standardisation to define both the standard structure $e_{in}\left(\frac{E_r}{E_n}\right)$ and the specialisation $e_{ir} - e_{in}\left(\frac{E_r}{E_n}\right)$ elements.

In the studies following Johnson there has been a debate as to whether manufacturing employment or something else should really be used to define new firm formation rates in a region. Ashcroft *et al.* (1991) object to the definition of new firm formation rates using the stock of firms in each industry and region preferred by Storey and Johnson (1987). Their objection is based upon the realisation that using the stock of firms essentially restricts the birth of new firms as emerging from existing ones (see also Garofoli, 1992). They also argue that given that the existing local stock of firms reflects past new firm formation processes, then this may inflate new firm formation in regions previously suffering low new firm formation rates. Nevertheless, Storey and Johnson's calculation of shift-share components satisfies the identity (8.4) since both the structure and specialisation elements, as well as the denominator of new firm formation rates, are calculated in terms of number of firms, rather than in terms of employment. Thus, structure and specialisation is expressed in stock of firms. Although, it is true that the existing stock of firms reflects past entry processes this may not create a disadvantage for shift-share. This is because it is well known that what determines much of between-industry differences in new firm formation at the national level are differentials in structural variables such as entry barriers (see Bain 1956; Geroski, 1991 for theoretical discussion; and Geroski and Schwalbach, 1991 for empirical applications). These structural differences, in turn, may be better reflected by differences in the existing number of firms (Shapiro and Khemani, 1987)[88] rather than by nation-wide inter-industry differences in employment levels.

The counter-argument offered by Ashcroft *et al.* (1991) is that employment gives a proxy for the pool of potential entrepreneurs. Some argue that it would be even better to use working population as opposed to employees in employment (Beesley and Hamilton, 1986). This recognises that entrepreneurs come from the ranks of the unemployed as well as those in employment. Despite the appeal of this theorisation its implication for the shift-share application would be that identity (8.4) is not satisfied. This results from the use of different measures for defining formation rates (denominator) and structure/specialisation elements. The latter need to be defined using statistics available at the industry-region level. Although a proper econometric investigation of new firm formation would benefit from the Ashcroft *et al.* suggestion[89], defining formation rates in

[88] See also discussion in Chapter 6.

[89] See next chapter.

their sense might exceed the capacity of shift-share analysis as a primarily accounting device.

The most striking empirical finding shared by all UK studies using shift-share analysis is that the differential component appears to be larger in absolute values compared to the structural effect. This holds irrespective of the definition of new firm formation rate used, the definition of structure and specialisation element, the differences in spatial reference and the study period. Furthermore, this was found to be the case not only when analysing formation rates using shift-share analysis but also when the spatial variation of firm 'death rates' was the subject of the investigation (Beesley and Hamilton, 1986).

The conclusions drawn by all of the studies do not deviate from that of the first investigation, *"...that the main differences in formation rates across regions can be attributed to differences in formation rates in the same industry across regions"* (Johnson, 1983, p. 78). This conclusion seems to have potential policy implications given that the differential component has been regarded as somewhat more amenable to policy efforts than the structural, despite the point that the two components, although disentangled by the shift-share analysis, are in practice inter-related (Storey and Johnson, 1987).

This, indeed, provides the prime motive for undertaking the research in the sections to follow.

8.3. Accounting for net entry of establishments using a modified shift-share model

The modified shift share analysis presented in the previous section to describe spatial patterns of new firm formation has been further modified here. The empirical aim is to investigate whether the predominance of the differential component found in the UK studies is also evident when net entry rates of manufacturing establishments are analysed across Greek regions. Net entry is the change in the number of manufacturing establishments operating in an industry i=1,...,J in a region r=1,...,R between two points in time. Thus, this measure presents the net effect of the entry and exit processes operating both at the industry and regional level and might be a useful notion in understanding changes in regional structure and performance.

The choice of net entry, as opposed to new firm formation, was dictated by data availability. There are just no data available which detail new firms by sector and region for Greek manufacturing. Thus, the study confines itself using the change in the number of operating establishments in each of the 20 two-digit industrial sectors in each of the 13 Greek administrative regions (NUTS II – see Figure 8.1). The data used are available from the 1984 and 1988 manufacturing censuses conducted by the NSSG.

The following are defined:

N_{irt} is the number of establishments operating in industry i and region r in time t

N_{irt-1} is the number of establishments operating in industry i and region r in time t-1

$N_{it-1} = \sum_{r=1}^{R} N_{irt-1}$ is the number of establishments operating in industry i nation-wide in time t-1,

$\Delta N_r = \sum_{i=1}^{J} N_{irt} - N_{irt-1}$ is the net entry i.e. the change in the number of establishments at the regional level,

$G_{ir} = \dfrac{N_{irt} - N_{irt-1}}{N_{irt-1}}$ is the net entry i.e. growth in the number of establishments operating in industry i and region r

$G_i = \dfrac{\sum_{r=1}^{R} N_{irt} - \sum_{r=1}^{R} N_{irt-1}}{\sum_{r=1}^{R} N_{irt-1}}$ is the sectoral net entry rate at the national level,

$G_r = \dfrac{\sum_{i=1}^{J} N_{irt} - \sum_{i=1}^{J} N_{irt-1}}{\sum_{i=1}^{J} N_{irt-1}}$ is the regional net entry rate at total manufacturing level,

$W_r = \dfrac{\sum_{i=1}^{J} N_{irt-1}}{\sum_{i=1}^{J}\sum_{r=1}^{R} N_{irt-1}}$ are the regional weights that satisfy $\Sigma_r W_r = 1$.

Then the net entry counterpart of Johnson's (1983) formulation becomes:

$$NS_r = \underbrace{\sum_{i=1}^{J} N_{i\,t-1}\, W_r\, G_i}_{\text{national share component}} \tag{8.5}$$

$$S_r = \underbrace{\sum_{i=1}^{J} \left(N_{ir\,t-1} - W_r\, N_{ir\,t-1}\right) G_i}_{\text{composition effect}} \tag{8.6}$$

$$F_r = \underbrace{\sum_{i=1}^{J} N_{ir,\,t-1} \left(G_{ir} - G_i\right)}_{\text{competition effect}} \tag{8.7}$$

Summing the component (8.5) to (8.7) it follows that

$$\Delta N_r \equiv \underbrace{\sum_{i=1}^{J} N_{ir\,t-1}\, G_{ir}}_{\text{net entry}} \tag{8.8}$$

The modified shift-share presented here has been designed to account for net entry rates, defined over number of establishments in the base year. As with Storey and Johnson (1987) both the structure and specialisation elements have been defined accordingly in terms of number of establishments. The same sort of formulation could be used to account for net entry rates over industry employment if, apart from the numerators of G_i and G_{ir}, all other terms involved were re-defined in terms of employment in each industry and region.

The definition of net entry rates preferred in this research has some advantages over the one using employment in the denominator. Since net entry is the product of both entry and exit processes, firm deaths are implicit in the net entry definition, and using the stock of firms in the denominator may be more appropriate in reflecting this, as Beesley and Hamilton (1986) argue.

The results of calculation of the shift-share analysis to account for net entry of establishments at the regional level are presented in Figure 8.1 and Table 8.1. It should be noted that the results of Table 8.1 are recorded in absolute terms and those of Figure 8.1 in relative terms. The labels are expressed as percentage rates of change in relation to base date (1984) numbers of manufacturing plants in existence in each region.

Table 8.1. Results of shift-share analysis to account for net entry 1984-1988: standardisation uses stock of establishments in each industry and year in base year

NUTS II	W_r %	G_r %	ΔN_r	NS_r	S_r	F_r
East Macedonia and Thrace	4.46	2.56	165	11.29	-44.84	198.55
Central Macedonia	18.80	3.09	839	47.57	90.07	701.36
West Macedonia	4.44	1.48	95	11.22	-445.30	528.08
Thessalia	6.41	-0.86	-80	16.21	10.40	-106.61
Ipiros	2.65	-4.46	-171	6.71	-58.15	-119.56
Ionian Islands	1.64	-6.12	-145	4.15	-36.00	-113.16
Western Greece	5.18	-3.84	-287	13.09	-15.89	-284.20
Central Greece	4.51	-1.67	-109	11.40	-42.26	-78.14
Peloponnisos	4.96	-0.63	-45	12.56	-26.84	-30.72
Attiki	37.87	-0.91	-496	95.80	551.00	-1142.80
North Aegean Islands	1.97	-6.87	-196	4.99	-16.45	-184.54
South Aegean Islands	2.02	-7.62	-223	5.12	-2.46	-225.66
Crete	5.09	12.35	907	12.87	36.73	857.40

It is immediately apparent that what has characterised UK studies on new firm formation (and on firm deaths) seems also to hold for net entry in Greek manufacturing industries. In all cases the absolute and relative values of the differential component are larger than those for industrial mix. This seems to suggest that differences in net entry rates between regions mainly stem from within-industry differences in net entry rates over space. The structure of economic activity in a region, on the other hand, seems to be of less importance overall.

As far as the spatial distribution of net entry is concerned, the striking feature of Table 8.1 and Figure 8.1 is that in only four out of thirteen regions were gains in manufacturing establishments recorded. These account for 2,006 new establishments and outweigh loses of 1,752 manufacturing plants in the rest of the country. What is also interesting is that high manufacturing gains tend to occur at the edges of the Greek territory. Three regions gaining in manufacturing plants cover all of the Greek north, and the fourth region, which enjoys the highest net entry in the country, represents the island-economy that of Crete, located in the very south of the Aegean Sea. Crete presents herself with a most impressive increase of slightly more than nine hundred manufacturing establishments, which is also the highest net gain in relative terms (12.35%).

Gains in West Macedonia and East Macedonia and Thrace can be attributed to comparative advantages offered by the local conditions enabling some industries to grow faster or decline slower, rather than to specialisation in nationally faster growing or slower declining activities. However, it most certainly is the case that the performance in West Macedonia is heavily reduced by a dramatically poor mix effect, apparent in both absolute and relative terms.

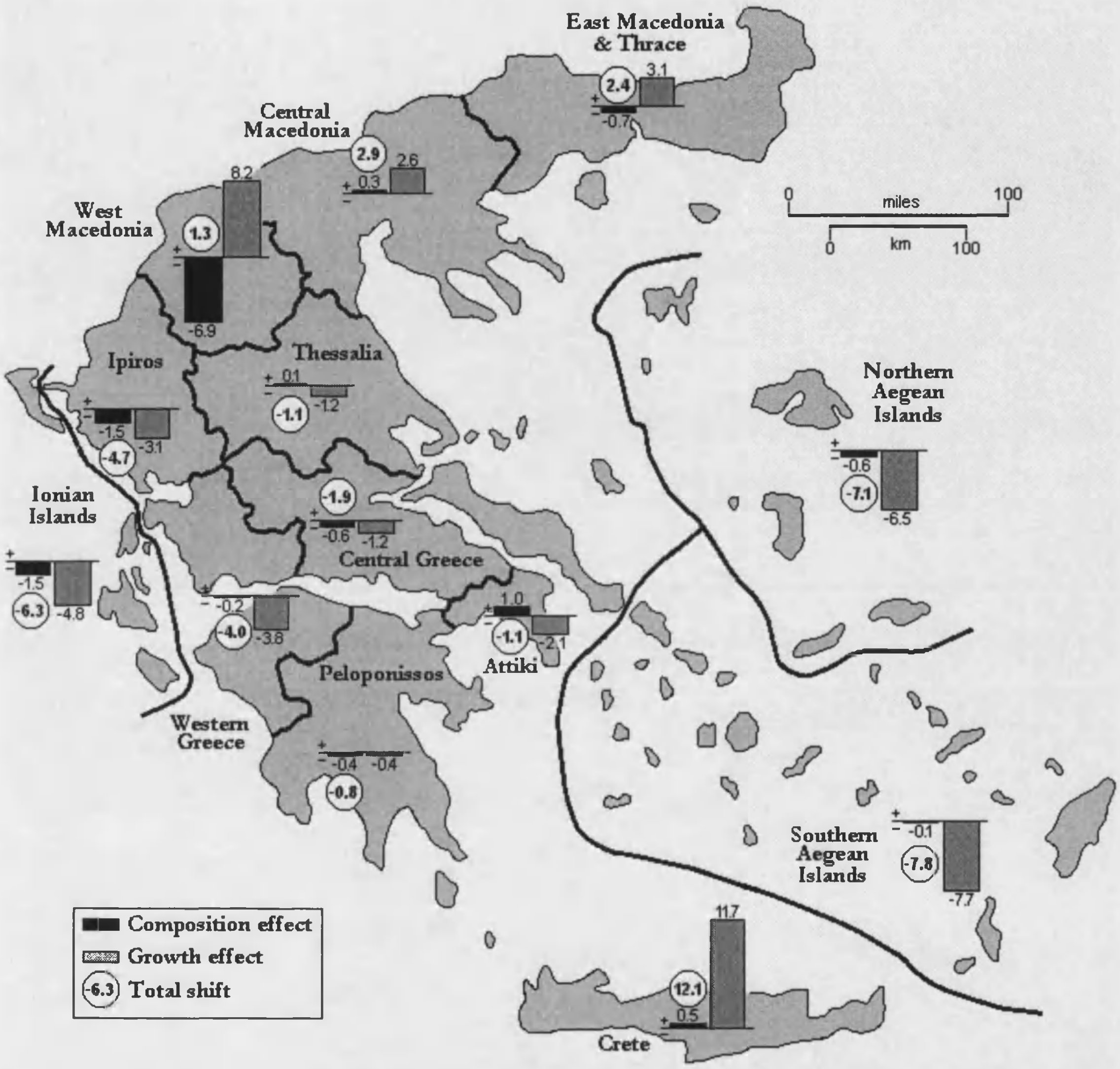

Figure 8.1. Net entry of manufacturing establishments across Greek regions 1984-1988

Central Macedonia is also of some interest as it contains the second largest urban centre in Greece – the industrial hub of Thessaloniki. This region, accounting for almost 19% of all manufacturing units in 1984, experienced the second largest increase in manufacturing gains both in absolute and relative terms (3.09%). This contrasts greatly with the case of Attiki, housing the largest Greek urban centre — Greater Athens, where around 37% percent of all manufacturing units were located in 1984 (39% in 1978).

Attiki records the heaviest loses in manufacturing industries in absolute terms. Nevertheless, in relative terms this reduction is not marked, representing less than 1% of the stock of manufacturing units in existence 1984. More interesting, in contrasting the performance of Central Macedonia and Attiki, is that whereas both of them have a positive industry-mix component the same is not true for their differential component. Local conditions in and around Thessaloniki could stimulate almost a 2% rise in manufacturing establishments in some industries, but for the region in which Athens is located conditions are such that they contribute a 2% reduction in manufacturing establishments.

Moving down the manufacturing-share hierarchy, both Thessalia and Western Greece each still account for around of 6% of all manufacturing establishments and contain long established industrial districts (Volos and Patra respectively). Both regions present net loses in manufacturing plants. The reduction is more acute for the latter (3.84%) than for the former (0.86%). What both of these areas of some considerable industrial tradition share is a negative differential component. In both areas, then, the conditions are such that they induce further decline in already declining sectors while nationally better performing industries grow at slower rates. This negative competition effect is further worsened by a negative industrial-mix effect in Western Greece, and only slightly moderated by a positive structural effect in Thessalia.

Island-economies, apart from the remarkable performance of Crete, all find themselves in 1988 suffering around 6% loses in manufacturing units. This positions them in the higher echelons of under-performing regions in these terms. The effect of both the mix and growth components is ubiquitously negative. Of course, it is true to say that these economies specialise more in tourism than in manufacturing and so the repercussions may not be great. Their individual shares in the total number of manufacturing establishments were in the region of 1.5% to 2% in 1984.

Of the remaining regions, Central Greece and Peloponnisos do have some manufacturing importance representing just under 5% of the manufacturing stock of establishments each. Central Greece being contiguous with the Greater Athens area (Attiki region) has benefited in the past from outward movement of Athenian manufacturing and being proximate to the country's largest market should, in theory, offer advantages for plants considering relocation. However, this does not appear to be the case as far as the shift-share results are concerned. Central Greece has suffered more than 1.5% decrease in manufacturing units, but, more important, both the shift effects are negative. This suggests that at this level of spatial aggregation any outward movement of manufacturing plants from Athens, or close proximity to markets, have not been able to sustain growth in the number of plants operating in this region. Of course, in using net entry this does not mean that it is necessarily the case that new firm entry (through relocation or anything else) is insignificant. In reality it should be said that the degree of deterioration suggested both by the actual change and the hypothetical effects of the mix and differential components has been only moderate. Much the same can be said for Peloponnisos.

Ipiros has been the continental region in Greece suffering the largest decrease (4.46%) in manufacturing from the number of operating plants perspective. The negative mix component suggests that this region is not specialised in nationally growing industries but, more important, the main handicap seems to be the absence of comparative advantages enabling industries in this region to grow faster or to decline slower than their national counterparts.

Overall, the results of the analysis reveal that there is a tendency for a reversal in past trends of industrial accumulation. Labrianidis and Papamichos (1990) point out that this weak tendency for changing the spatial distribution of manufacturing establishments in favour of peripheral regions has been operating since 1978. This somewhat modestly reverses patterns of continuous accumulation in Attiki up to 1978. They point to some centrifugal movement of manufacturing activity towards central Greece and Macedonia as a whole, while the rest of the country mainly reflects a pattern of decline.

This is not to say that Attiki is no longer the main industrial centre of the country. Having 37% of all manufacturing units within its borders and suffering less than 1% reduction in manufacturing plants, it certainly still is. On the other hand, the area does house around 30% of net exit (sum of negative ΔN_r values) in the country as a whole, and accounts for some 13% of plant turnover (sum of all ΔN_r irrespectively of sign). Central Macedonia and Crete, in contrast, account for more than 95% of the country's net entry and more that 65% of total plant turnover so making them the main hosts of new industrial activity. These areas both specialise in nationally fast growing industries and possess overall comparative advantages. In Attiki the magnitude of the negative differential component clearly demonstrates a distinct lack of comparative advantage for industries to grow in terms of numbers of establishments faster or to decline slower than their national counterparts. This occurs despite the overall positive significant structural effect.

The descriptive analysis offered by the shift-share analysis does not offer sufficient grounds to infer a clear-cut, urban-rural, or centre-periphery pattern, as clearly presented in the UK literature on new firm formation (Gudgin, 1978; Gould and Keeble 1984). For Greece the picture is much more complicated due to the high degree of unevenness in the distribution of both population and manufacturing activity. New industrial activity seems to be attracted towards a region that contains the second largest urban centre, on the one hand, but also towards an isolated island-economy of likely high indigenous potential on the other. This new patterning occurs at the expense of other less heavily urbanised areas that suffer reductions in the number of manufacturing establishments.

8.4. Shift-share analysis as a linear model reconsidered

8.4.1. A critique of the conventional shift-share analysis

Shift-share analysis has been attacked from various angles and its credibility even as a descriptive tool has been heavily questioned. The most fundamental objection is that it provides little or no theory of regional growth (Stilwell, 1970) and thereby its results should not be taken too seriously in regional policy formulations (Buck, 1970). Bishop and Simpson (1972) maintain that the non theoretical nature of shift-share turns out to be an important handicap only when there is a misunderstanding of its purpose which gives rise to expectations beyond the capacity of the method as essentially a standardisation technique. Fothergill and Gudgin (1979), valiant defenders of the shift-share method in response to criticisms summarised by Richardson (1978) also share this view.

A second serious point of critique about shift-share analysis, having implications for this research, is that the effect of the industry-mix component could be under some circumstances seriously underestimated when compared to differential component. An argument in favour of this criticism is that shift share ignores linkages between industries and multiplier effects at the regional level. This implies that some industries may grow faster in one region rather than in another, not because of inherited efficiency advantages, but because of better links with other industries within the same region (Mackay, 1968). This means that, to some extent, the differential component and the industry-mix effect are inseparable. Fothergill and Gudgin (1979) argue that this does not present a serious problem for analysis at the level of UK regions, as their evidence suggests that the impact of multiplier effects on the differential component is not large.

This in not, however, the only potential source of intermingling of the mix and growth components. Another possibility is that the differential component might not be independent of the specialisation of regional manufacturing. Esteban-Marquillas (1972) disentangles the effect of specialisation from the differential component using the notion of homothetic employment. That is, the employment that sector i would have in region r if the employment structure in that region were the same as that of the nation. It is maintained that using the homothetic employment, instead of the actual, when deriving the differential component leaves the latter unaffected by the effect of industry-mix. Thus, this manipulation entails to substitution of the conventional differential component by two new ones. The first refers to the 'purged' differential effect and the other to the 'allocation' effect. The latter reflects whether or not a region is specialised in sectors of faster regional growth. Specialisation is defined as the difference of the actual and homothetic employment.

Arcelus (1984) has extended the use of the homothetic employment to derive expressions that include an industry specialisation effect within each of the components of shift-share analysis. In doing so, he also manages to introduce a new element that attempts to disentangle the effect of regional growth from that of national growth on the differential component. In other words, apart from that element of the differential effect arising from regional specialisation in an industry, there should be another representing the effect of regional growth itself. This is based on the premise that *"...growing regions are expected to affect the employment levels of the industries in their midst in ways different than stagnant or backward regions do"* (Arcelus, 1984 p. 6). From a demand for the products of local manufacturing perspective this seems to account for both the demand at the national and also within-region levels. Overall, the major concern of Arcelus was to account for the effect of the overall growth, the individual industry growth, as well the individual region growth on each sector-region combination. Haynes and Machunda (1987) have commended this attempt of allocation of the effect of unique sector-region growth combinations on the shift share components as being analytically superior to traditional shift-share analysis.

Another strand of particular importance for the present research, stems out from the rather obvious realisation *"...that any standardisation procedure is a mechanical partitioning of actual performance into components, the sizes of which cannot be subjected to any tests of statistical significance"* (Brown, 1972 p. 133). The proponents of this critique suggest, as an alternative, an analysis of variance approach which makes possible the testing of the statistical significance of the derived components for each region. This is the alternative approach adopted here.

8.4.2. The two-way ANOVA shift-share model

The notation and properties of the modifications in the algebraic derivation of shift-share analysis owe much to the pioneering work of Weeden (1974). His unpublished work stimulated the use of an extended shift-share analysis presented as a linear model in earlier work by Brown (1972).

Extending the notation presented in the third section of this chapter, and working with net entry rates, the following are defined:

$$G_n = \frac{\sum_{r=1}^{R}\sum_{i=1}^{J} N_{ir,t} - \sum_{r=1}^{R}\sum_{i=1}^{J} N_{ir,t-1}}{\sum_{r=1}^{R}\sum_{j=1}^{J} N_{ir,t-1}}$$ is the national net entry rate (total manufacturing)

and some extra weights,

$$W_i = \frac{\sum_{r=1}^{R} N_{ir,t-1}}{\sum_{r=1}^{R}\sum_{i=1}^{J} N_{ir,t-1}}$$ and $\Sigma_i W_i = 1$

$$W_{ir} = \frac{N_{ir,t-1}}{\sum_{i=1}^{J} N_{ir,t-1}}$$ and $\Sigma_i W_{ir} = 1$;

$$Z_{ir} = \frac{N_{ir,t-1}}{\sum_{r=1}^{R} N_{ir,t-1}} = \frac{W_{ir} W_r}{W_i} \text{ and } \Sigma_r Z_{ir} = 1$$

then it follows that $G_r = \Sigma_i W_{ir} G_{ir}$, $G_i = \Sigma_r Z_{ir} G_{ir}$, and $G_n = \Sigma_r W_r = \Sigma_i G_i$.

Working with growth rates the shift share identity now becomes:

$$G_r - G_n = \underbrace{\sum_i (W_{ir} - W_i) G_i}_{\text{industry mix}} + \underbrace{\sum_i W_{ir} (G_{ir} - G_i)}_{\text{differenti al component}} \qquad (8.9)$$

In analysis of variance terms, Weeden (1974, p. 57) proposes that the linear model generating net entry rates (G_{ir}) is given by:

$$G_{ir} = A_i + B_r + V_{ir} \qquad (8.10)$$

where A_i and B_r are industry and regional dummies respectively, and V_{ir} is the residual term representing unsystematic variation. The latter is the amount of variation not attributed to factors that determine the average growth of each industry nationally (A_i) and factors that determine the average growth of each region at the total manufacturing level (B_r).

Provided that the residual term is normally distributed with zero mean, so that its expected value is $E(V_{ir})=0$, then it follows that the expected value of the regional growth rate is given by:

$$E(G_r) = \sum_i W_{ir} A_i + B_r \qquad (8.11)$$

the expected value of national growth is given by

$$E(G_n) = \sum_i W_i A_i + \sum_r W_r B_r \qquad (8.12)$$

and that of the their difference is

$$E(G_r - G_n) = \sum_i (W_{ir} - W_i) A_i + (B_r - \sum_r W_r B_r) \qquad (8.13)$$

The derived shift-share ANOVA expression becomes

$$g_r - g_n = \sum_i (W_{ir} - W_i) a_i + b_r - \sum_r W_r b_r \qquad (8.14)$$

where a_i and b_r are the estimated coefficients of the industry and regional effects respectively and g_r and g_n present the estimated regional and national net entry rates.

The estimators of the industry-mix and the differential components become:

$$C_{1r} = \sum_i (W_{ir} - W_i)\, a_i \qquad (8.15)$$

$$G_{2r} = b_r - \sum_r W_r b_r \qquad (8.16)$$

respectively.

Fothergill and Gudgin (1979) have criticised the proposal of Brown (1972) and Weeden (1974) for the use of the shift-share ANOVA model, as opposed to the conventional one, in employment growth applications. In particular, they argue that the analysis of variance model uses unweighted averages of growth rates over all regions for each industry and unweighted averages of growth rates for each region over all industries, whereas the shift-share analysis applies a well-defined weighting system on industry growth rates[90]. The capability of these unweighted averages to reflect the regional factors, which in turn affect all industries in a region, is strongly questioned. They argue *"that different factors affect each industry in varying degrees in a particular regions" [and that] "...There is unlikely to be any simple way to separate systematic regional factors from random ones"* (Fothergill and Gudgin, 1979, p. 317).

It is true that the models are not directly analogous. Shift-share analysis applies a weighting system on combinations of $G_i = \dfrac{\sum_{r=1} N_{irt} - \sum_{r=1} N_{irt-1}}{\sum_{r=1} N_{irt-1}}$ and $G_r = \dfrac{\sum_{i=1} N_{irt} - \sum_{i=1} N_{irt-1}}{\sum_{i=1} N_{irt-1}}$ to account for the effect of composition and growth effects in analysing differences between observed regional and national growth rates. The analysis

[90] For convenience the second right hand side term in equation 8.9 might be rearranged as $G_r - \sum_i W_{ir} G_i$.

of variance model, however, uses the effects of differences between industry $\frac{1}{R}\sum_{r}\frac{N_{ir,t}-N_{ir,t-1}}{N_{ir,t-1}}$ and also between regional means $\frac{1}{J}\sum_{i}\frac{N_{ir,t}-N_{ir,t-1}}{N_{ir,t-1}}$ in explaining variation in G_{ir}. This allows some statistical inference to be drawn on the contribution of the composition and growth effects in explaining differences between estimated regional and national growth rates. This requires that both the composition and growth effects be expressed as linear combinations of the coefficients of industry and regional effects respectively. This necessarily renders the composition and growth effects derived from the ANOVA version of shift-share analysis the result of solely systematic factors. The view that inter-industry differences and inter-regional differences in growth rates themselves are not solely determined by systematic factors seems well justified. However, neither the shift-share analysis nor the ANOVA method claims to explain why these differences occur in the first place. They both use *a priori* types of information. For the first, the starting point is the statement that industry and regional growth rates differ. The second utilises information that average industry and average regional growth rates differ, when this is true.

Fothergill and Gudgin (1979) argue that there might be factors systematically affecting the growth rate of industry i in region r which have not been included in equation (8.10). If this is the case then a necessary condition for the proper use of analysis of variance arises *"when no large systematic factors remain embedded in the random residual term"* (ibid. p. 318). This seems to express the authors' worry about possible interaction of the industry-mix and differential components in a manner that their effect is not uniform and additive. Holden *et al.* (1987) maintain that, if difficulties are found in applying the analysis of variance for these reasons, there should be even greater concern about applying the shift-share analysis in the first place, since the same requirements are involved. Analysis of variance has an advantage over the conventional shift-share methodology when it comes to the interaction of growth rates across each industry region combination (the intermingling of industry and differential components) in that it can form a testable hypothesis within the framework of shift-share ANOVA model. In other words, the existence of interaction itself could be tested perhaps via a Tukey test (Hays, 1994), even if its parameters cannot be estimated. Having only one element per region and industry combination (no replication), there is no parsimonious way to derive estimates of the interaction term. Interaction, if overall significantly present, would affect statistical inference. This is so to the extent that systematic variation would have been partitioned in industry fixed effects (differentials of industry growth averages), regional fixed effects (differentials of regional growth averages), and interaction effects due regional-industry growth differential combinations. Since the last mentioned terms are not really estimable this would suggest that, when testing for the overall significance (also individual significance) of industry or regional effects, essentially it has to be assumed that interaction is residing in the error term. This, in turn, means that if the interaction effect, an essentially systematic source of variation treated as unsystematic, occupies a large part of the error term, then the latter is overestimated and this would suggest that the hypothesis of significant fixed effects might be rejected when it is actually true. When this happens it is said that the model is not additive, the interaction effect is not an eligible proportion of the error term. If the reverse hypothesis, however, is confirmed (the interaction effect can be assumed as a negligible proportion of the error term — additivity), then whatever inference is made as to the significance of the effects is safe without any loss of generality. This situation, when justified by the Tukey-test, seems to satisfy the condition imposed by Fothergill and Gudgin (1979) for the proper use of the analysis of variance approach with shift-share objectives. There should be no large systematic factor embedded in the residual term and hence the derived components of the shift-share ANOVA model are separable.

Apart from the statistical consequences of possible intermingling of the estimated industry-mix and differential components that are avoided when the model is additive, additivity acts a safe-guard against undesired effects due to the level of spatial and industrial aggregation used. It is possible, under some circumstances, that neither the industry nor the regional effects are significant when at the same time interaction is significant rendering the model non-additive. In such situation, it follows that the levels of the one factor of the analysis (growth rates of regions) average over the levels of the other factors (industry growth rates) resulting in insignificant effects for both the factors (Scheffé, 1959). Possible statistically significant differences between regions and also between industry growth rate means are, thus, masked. This would be, to some extent, an artifact of the combination of the level of spatial and industrial aggregation used. However, hypothesis testing under a valid additivity assumption does not suggest what level of aggregation should be preferred, but says that given the choice of aggregation made the conclusions drawn are statistically secure.

Finally, Fothergill and Gudgin (1979) object the use of the analysis of variance approach to shift-share claiming that the error term in formulation (8.14) is heteroscedastic. In the present situation this might be seen in conjunction with Garofoli's (1994) valid point that using the existing number of establishments to generate new firm formation rates might result in areas with few perhaps larger establishments exhibiting artificially inflated rates. This applies to net entry rates as well. The resulting situation would be that the variance of the error term would be higher in areas with a small number of establishments in some industries, which are undergoing rapid growth or decline. The remedy would be to insert explicitly this assumption regarding the behaviour of the error term. That is, the variance of the error term is given by $Var(V_{ir}) = S^2 / W_{ir}^2$, suggesting that the estimable equation results from multiplication of both sides of equation (8.14) by W_{ir}. In addition, this transformation might be used to counter the argument of Fothergill and Gudgin that the ANOVA model uses unweighted averages (Holden *et al.* 1987).

All these lines of argument may be helpful in shaping the view that both the shift-share ANOVA model and the conventional method are by no means a substitute for a proper model explaining patterns of net entry rates across regions and industries. But as Holden *et al.* (1987, p. 1249) say *"the basic theory underpinning the use of the analysis of variance and shift-share in the analysis of regional growth is the same and, that this theory is questionable"[but analysis of variance is preferred over the shift-share because] "...It is a standard technique with known properties."* Moreover, the shift-share ANOVA model serving the same modest objectives as the conventional shift-share analysis, offers an extra advantage since the standardisation components are *"fairly accurate estimators of composition and growth, but inferior to the corresponding analysis of variance estimators given the assumptions of the analysis of variance model"* (Weeden, 1974 p. 91). Weeden maintains that although the analysis of variance estimators are unbiased and minimum variance estimators of the corresponding shift-share components, the opposite does not hold. The standardisation components are not minimum variance estimators of the ANOVA ones *"because they are based on partial information (in effect the values of W_{ir} and G_{ir} for region r only"* (ibid. p. 64).

Despite all this, the ANOVA model has not been as widely used as the standardisation method. The sole applications of the two-way layout Weeden model have been evaluations of the effects of regional policy in stimulating employment growth in UK regions (Buck and Atkins, 1976, 1983). Some alternative model-based approaches relate primarily to a one-way analysis of variance layout (Berzeg, 1978, 1984) and information-theoretic extensions of shift-share (Theil and Gosh, 1980), both of which are explored in Knudsen and Barff (1991) who provide some empirical examples. This leads Knudsen and Barff to argue that *"insufficient attention has been paid to statistical, model-based approaches to shift-share analysis" [despite that] these statistical variants mitigate some of the major reservations associated with hypothesis testing and the predictive capacity of the technique"*(ibid. p. 421). The same view is shared here. Certainly in terms of new firm formation there is scope to explore the potential of the analysis of variance approach.

It may even be argued that the application of the shift-share ANOVA model might offer a good starting point to explore patterns in the determinants of inter-regional variation in net entry rates across industries. This is because the proper econometric modelling of net entry rates across regions and industries (pooled cross section of cross section data, following the definition of G_{ir}) would essentially necessitate the use of variables defined at both the regional and industry level. These data are quite rare and certainly not publicly available for Greece.

The result might be to omit one of the data dimensions — industrial sectors. This would, in turn, mean that the effect of industry-specific regionally-invariant factors (industry-fixed) and region-specific industry-invariant factors (regional fixed-effects) cannot be assessed as they could be in the shift share ANOVA model. It would be possible to use information obtained from the shift share model in a cross sectional application having as a dependent variable the differential component or some combination of it. This is what Ashcroft *et al.* (1991) do in using, as a dependent variable, the firm formation rate that would have occurred if each region had the same industrial structure as the nation $\{(NS_r+F_r)/NS_r\}$ over the region's expected share of the overall formation rate.

What critically distinguishes this study however from the present research is that the variable considered here is net entry rate and not the new firm formation rate. The consequence is if $(NS_r+F_r)/NS_r$ was to be used in the present research it would in practice present both negative and positive signs. In the study by Ashcroft *et al.* the same variable was essentially positive, not because of F_r (which can take on both signs) but because of the enormous NS_r component that crowds out any possible reduction due to a negative F_r. The service provided by the positive dependent variable is that all theoretical assumptions, and also empirical regularities emerging from previous research, can be used to explain this, 'purged' from any industry structure, hypothetical new firm formation rate. The same is not feasible in the present research since NS_r is always smaller than the values of F_r (see Table 8.1). This would imply that $(NS_r+F_r)/NS_r$ should be theorised as the growth in the number of firms (positive or negative) that would have occurred if a region had the same industrial structure as the nation, compared with the region's expected share of the overall growth rate. Nevertheless, to the extent that this definition does not exclude negative growth (exit in excess of entry), the econometric inference would have to be based on assumptions as to whether the determinants of entry and exit at the regional level would be the same. Entry and exit of firms from industries have been hypothesised to be, to some extent, determined by the same factors. The symmetry hypothesis established by Caves and Porter (1976) theorises barriers to entry as being also barriers to exit owing primarily to the sunk (irrecoverable) nature of costs that deter entry, and, once they have been committed, deter also exit. The symmetry hypothesis was first granted empirical support by the Shapiro and Khemani (1987) study for Canadian manufacturing industries. Both Anagnostaki and Louri (1995a) and the research undertaken in Chapter 6 provide evidence for a valid symmetry hypothesis in Greek manufacturing industries. The latter study also provides empirical evidence for the validity of the symmetry hypothesis beyond the core of structural characteristics usually used to define entry (exit) barriers. The regional analysis of entry and exit is not only deprived of an equivalent to symmetry hypothesis, but, additionally, the determinants of exit are less susceptible to *a priori* theoretical expectations *"given the almost complete lack of theory relating to the location of business failures"* (Keeble and Walker, 1994 p. 423). Indeed, the theoretical justification of the exit equation has been rather weak even in studies utilising new econometric approaches (panel vector autoregression estimation) to examine the interdependence between the determinants, as well as the effects, of entry and exit at the spatial level (Johnson and Parker, 1996). It seems that apart from a negative effect of two-year lagged firm births the only significant determinant of firm deaths was real net housing wealth, and this had a positive effect. Love's (1996) study examining the simultaneity of firm entry and exit at the British county level offers a better attempt to justify, theoretically, the exit equation formulation. The empirical evidence, however, presented in a single equation estimation framework, without interaction variables (entry as independent variable in the exit equation and vice versa), points to some symmetry relating to the positive effect of small business structures locally, and the negative effect of wages and unemployment.

There appear to have been only two previous studies examining the determinants of net entry rates at the subnational level. Both refer to UK regions during the eighties (Keeble and Walker, 1994, Keeble *et al.* 1993) and have greatly benefited from the fact that net changes were always positive. Thus, both studies, using VAT registration and de-registration data, treat net entry as small firm population growth and survival. These authors recognise fully that there is still an *"absence of any separate theory of the spatial distribution of survival rates of new businesses"* (Keeble and Walker, 1994, p. 421) and these concerns suggest that unease should be accentuated when net entry takes on both negative and positive values.

8.4.3. A two-way ANOVA shift share model for Greece and its regions

In order to establish statistical tests the following theorem was applied. Suppose that the coefficient vector of estimating the equation (8.10) is the weighted least squares estimator $\hat{b}=\left(X^{*'}X^{*}\right)^{-1}X^{*'}G^{*}_{ir}$ where $G^{*}_{ir}=G_{ir}W_{ir}$ and X^{*} represents the RHS dummy variables in equation (8.14) multiplied by W_{ir}. Then, following Johnston (1973, p. 126) it follows that if vectors c_1 and c_2 are found such as $c_1'b$ gives the estimated industry-mix component (equation 8.15) and $c_2'b$ gives the estimated differential component (equation 8.16), then the variances of each component is given by $\text{var}(c_1'b)=\sigma^2 c_1'(X^{*'}X^{*})^{-1}c_1$ and

$\mathrm{var}(c_2'b) = \sigma^2 c_2'(X^{*'}X^{*})^{-1}c_2$. In these expressions σ^2 is the variance of the estimate of the weighted least squares model. A computational warning suggests that including all industry dummies and all regional dummies in RHS of equation (8.10) renders the X matrix singular. This can be avoided by dropping, say one regional dummy, without affecting the derivation of shift-share components since equation (8.16) requires that in order to derive the differential component of one region the coefficients of all others need to be taken into account. An alternative would be to put *a priori* constraints on the coefficients of the heteroscedastic model such as $\sum_i W_{ir}a_i = 0$ and $\sum_r W_{ir}b_r = 0$ which permit the inclusion of all industry and regional dummies[91].

The results of the shift-share ANOVA model assuming heteroscedastic disturbances are presented in Table 8.2.

The first and second columns of Table 8.2 present the actual difference between regional growth rates and national growth rates, and the equivalent estimated difference respectively. It is easily verified that there is unequivocal sign agreement between the two columns.

In terms of general hypothesis testing, the confirmations presented at the base suggest that both the regional and the industry fixed-effects make a statistically significant collective contribution in explaining patterns of net entry rates across industries and regions. Partial hypothesis testing provides that the same is evident if the collective effects of industry and regional effects are evaluated separately. In addition, the insignificant Tukey test for non-additivity suggests that the model is additive. This means that the conclusions drawn above for the overall significance of both industry and regional effects in their separate assessment are statistically secure. As a consequence, it may be concluded without any loss of generality that, between 1984 and 1988 for the level of industrial and spatial aggregation used, industry means and regional means of net entry rates are statistically different from each other. More important is that in accounting for these differences a statistically sound contribution to the explanation of net entry rates is made. Furthermore, the intermingling of industry and regional effects does not present

[91] See also Suits (1984) for an alternative formulation of these restrictions.

a strong problem and interaction effects, being statistically negligible, can be satisfactorily incorporated to the error term.

Table 8.2. Estimates of components in the shift-share-ANOVA model: standardisation uses stock of establishments in each region and industry
(t-ratios in parentheses)

NUTS II	Actual G_r-G_n	Estimated g_r-g_n	Composition $C1_r$	Growth $G2_r$	Difference from actual G_r-Gn
East Macedonia and Thrace	2.384	2.220	0.289 (0.397)	1.932 (0.642)	0.163
Central Macedonia	2.914	5.599	0.203 (0.440)	5.396** (2.041)	-2.685
West Macedonia	1.292	1.202	-15.703*** (-5.015)	16.905*** (2.959)	0.090
Thessalia	-1.039	-0.230	2.249*** (3.838)	-2.479 (-0.811)	-0.810
Ipiros	-4.638	-5.963	-0.657 (-1.005)	-5.306** (-1.786)	1.326
Ionian Islands	-6.291	-8.194	-1.647* (-1.461)	-6.547** (-2.305)	1.904
Western Greece	-4.014	-3.668	0.433 (1.025)	-4.101* (-1.416)	-0.346
Central Greece	-1.849	-3.011	0.813** (1.698)	-3.823* (-1.305)	1.162
Peloponnisos	-0.803	-0.871	0.979* (1.649)	-1.849 (-0.663)	0.068
Attiki	-1.082	-1.581	0.710* (1.283)	-2.291 (-1.136)	0.499
North Aegean Islands	-7.050	-6.956	1.096* (1.519)	-8.052*** (-2.787)	-0.094
South Aegean Islands	-7.799	-8.700	0.849* (1.429)	-9.550*** (-3.220)	0.901
Crete	12.172	7.532	2.568*** (3.689)	4.964** (1.654)	4.639

H1: $Br_1=Br_2=\ldots Br_{R-1}=0$ and $Ai_1=Ai_2=\ldots Ai_{J-1}=0$, $F(31,228) = 7.77$***
H2: $Br_1=Br_2=\ldots Br_{R-1}=0$ given $Ai\neq 0\ \forall\ i=1,\ldots, J-1$, $F(12,228) = 3.56$***
H3: $Ai_1=Ai_2=\ldots Ai_{J-1}=0$ given $Br\neq 0\ \forall\ r=1,\ldots, R-1$, $F(19,228) = 8.42$***
Tukey's test for residual non-additivity $F(1,227) = 0.003$
*** significant at the 1% level $|t| \geq 2.3428$, **significant at the 5% level $|t| \geq 1.6517$, *significant at 10% level $|t| \geq 1.2853$ for 228 degrees of freedom
Estimation after Weeden (1974)

The results of the estimation of the shift-share ANOVA model presented in Table 8.2 reconfirm that the coefficients of the differential component (growth) dominate in absolute value those of the industry-mix (composition) effect. It is equally interesting that this predominance is not reflected in the growth effect being more statistically significant than the industrial-mix or composition effect in all cases. Cases where the economically predominant growth effect has been estimated with less statistical accuracy, when at the same time one or both the components are of some conventionally accepted statistical significance, stand out as those of Thessalia, Central Greece, Peloponnisos, Attiki and Crete. The remaining four-region group where, in absolute terms, the economically larger coefficient of the growth component appears to be more significant than the industry-mix effect consists of Central Macedonia, Ipiros, Ionian Islands, and Western Greece.

In the model which accounts for heteroscedasticity, three out of four regions that enjoy positive net entry rates also have both components positive. The only exception refers to West Macedonia where both coefficients are highly significant but whereas the industry-mix effect suggests a reduction of around 16% in the number of operating establishments, the differential component compensates by suggesting a slightly higher increase of almost 17%. Components of change for East Macedonia and Thrace do not perform well, statistically.

Crete presents an undisputed case of a dynamic industrial area that provides not only economic impressive but also statistically significant evidence. Central Macedonia, on the other hand, owes most of its gains in manufacturing to some comparative advantage for industries to grow faster or decline slower locally when compared with performance of their counterparts at the national level. Thus, the statistical identification of the hubs of new industrial activity in Greece confirms the picture provided by the conventional shift-share analysis (Table 8.1).

The poorest environments for manufacturing growth have been those of the North and South Aegean Islands, Ionian Islands, Ipiros, and to some lesser extent, Western and Central Greece. Industry-mix has been quite favourable in statistical terms in Crete, Thessalia and Central Greece. It is also of some statistical significance in Attiki and Peloponnisos. The marginal significance of positive industry-mix effects in both the northern and southern clusters of Aegean Islands comes as a surprise when compared with results of the simple shift-share analysis presented earlier. Yet the structural component takes on a different sign (positive) in another four regions without being statistically significant.

The emerging suggestion is that accounting for unequal variances of net entry rates in areas with low manufacturing representation for sectors of rapid growth or decline significantly contributes to more precise estimations of the industry-mix effect.

The last column in Table 8.2 provides the difference between the estimated and actual differences of regional and national net entry rates. In many cases this difference is been quite substantial. However, this cannot be used to refute the fit of the model since the estimation was based on a transformed model, which means that the variation accounted for refers to a transformed dependent variable.

Weeden (1974, p. 62) suggests that the estimated values of the difference between the regional growth rates would equal the actual difference if the growth term was transferred into the error term. However, this would mean that the growth component would represent both systematic regional effects and also unsystematic variation. In addition, it would not be possible to establish any statistical tests for the growth component.

8.4.4. A one-way ANOVA shift share model for Greece and its regions

Despite Weeden's awareness, and also critique, of the possibility of deriving the basic components of shift-share from an essentially one-way analysis of variance layout, Berzeg (1978) suggests essentially this.

In particular he proposes the estimation of the following equation:

$$G_{ir} = a + b_i + e_{ir} \qquad (8.17)$$

where a is an estimate of G_n, and b_i an estimate of G_I-G_n.

This formulation suggests that inter-regional differences in growth rates are assumed to present unsystematic, as opposed to systematic, variation, and that as probabilistic events they can incorporated in the residual term (e_{ir}). Estimation of equation (8.17) requires the imposition of a linear restriction on the coefficient vector b_i, such as $\sum_i b_i = 0$, in order to avoid singularity of the RHS variable matrix to the extent that a is an estimable constant.

Berzeg points out that, under the assumption of residual constant variance, the parameters would not identify the true variables G_n, and G_I-G_n. However, he suggests that if it is assumed that $\text{Var}(e_{ir}) = S^2 / W^{*}_{ir}$ where $W^{*}_{ir} = \dfrac{N_{ir,t-1}}{\sum_{r}^{R}\sum_{i}^{J} N_{ir,t-1}}$, then OLS estimation of

equation (8.17), where both sides have been multiplied by $\sqrt{W^{*}_{ir}}$, ensures for numerical equivalence between the estimated parameters and the shift-share related components. It is useful to examine the properties of this transformation.

Without loss of generality and in order to avoid imposing restrictions, equation (8.17) could be re-parameterised and estimated as:

$$G_{ir} = A_i + e_{ir} \tag{8.18}$$

where, as before, A_i indicates industry dummies. Multiplying both sides by the suggested weight prior to estimation can retain the heteroscedasticity assumption made above. This would render the estimators of A_is numerically equivalent to G_is.

This 'desired' numerical equivalence is achieved as follows:

In matrix form the model in equation (8.18), if data are arranged first by industry and then by region, becomes:

$$\begin{bmatrix} G_{1r} \\ G_{2r} \\ . \\ . \\ . \\ G_{jr} \end{bmatrix} = \begin{bmatrix} j_{1r} & 0 & . & . & . & 0 \\ 0 & j_{2r} & . & & & 0 \\ 0 & 0 & & & & 0 \\ 0 & 0 & & . & & 0 \\ 0 & 0 & & & & 0 \\ 0 & 0 & . & . & . & j_{jr} \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \\ . \\ . \\ . \\ a_j \end{bmatrix} + \begin{bmatrix} e_{1r} \\ e_{2r} \\ . \\ . \\ . \\ e_{jr} \end{bmatrix}$$

where $j_{1r} \ldots j_{jr}$ are j (R × 1) vectors of ones and $a_1 \ldots a_j$ are the coefficients of dummy variables for i=1…J industries. The matrix notation helps to illustrate that these coefficients could be estimated by either using separate regressions on each dummy (without constant) utilising all JR observations, or using separate regressions of each of the J G_{ir}s on the respective A_i utilising only R observations. The second of these is preferred for expositional reasons. It is understood here that in the untransformed model this would result in regressions on constants rending the a_is numerically equivalent to J G_{ir} means over R observations. However, in the transformed model these regressions would imply regressing 'through the origin' on a single independent variable since

$\sqrt{W^*_{ir}}$ is not constant across regions for each industry. This implies that the parameter estimates are no longer numerically equivalent to net entry rate means for each industry across regions. If $G^*_{ir} = \sqrt{W^*_{ir}}\,G_{ir}$ and $A^*_i = \sqrt{W^*_{ir}}$ for each i = 1,.., J industry then each of the a^*_i is given by $a^*_i = \frac{\sum_R A^*_i G^*_{ir}}{\sum_R A^{*2}_i}$. It can be demonstrated that this is numerically equivalent to G_i, since

$$a^*_i = \frac{\sum_r A^*_i G^*_{ir}}{\sum_r A^{*2}_i} = \frac{\sum_r \left(\sqrt{W^*_{ir}}\right)^2 G_{ir}}{\sum_r \left(\sqrt{W^*_{ir}}\right)^2} = \frac{\sum_r \frac{N_{ir,t} - N_{ir,t-1}}{\sum_r N_{ir,t-1}}}{\sum_r \frac{N_{ir,t-1}}{\sum_r N_{ir,t-1}}} =$$

$$= \frac{\frac{1}{\sum_r N_{ir,t-1}} \sum_r N_{ir,t} - N_{ir,t-1}}{\frac{1}{\sum_r N_{ir,t-1}} \sum_r N_{ir,t-1}} = \frac{\sum_r N_{ir,t} - N_{ir,t-1}}{\sum_r N_{ir,t-1}} = G_i$$

The industry-mix component can then be derived using equation (8.15). The differential component can be derived from the residuals of the weighted version of equation (8.18). The differential component is numerically equivalent to

$$\sum_i \frac{W_{ir}}{\sqrt{W^*_{ir}}} e_{ir}$$

This is, in turn, equivalent to (ignoring summation for a while)

$$\frac{W_{ir}}{\sqrt{W^*_{ir}}}\left(G^*_{ir} - \hat{G}_{ir}\right) \tag{8.19}$$

where $\hat{G}_{ir}$ stands for the predicted values of the estimation of the transformed version of equation (8.18). Since it has been proved that a_i equals G_i for each of i=1,...,J industries, expression (8.19) can be re-written as

$$\frac{W_{ir}}{\sqrt{W^*_{ir}}}\left(\sqrt{W^*_{ir}}\,G_{ir} - \sqrt{W^*_{ir}} \bullet AG_i\right)$$

where A is a JR × J matrix of industry dummies and • stands for the Hadamard product, that is element by element of each column of A by the vector $\sqrt{W_{ir}^{*}}$ and it holds that $\sqrt{W_{ir}^{*}} \bullet A = A^{*}$ the JR × J matrix of transformed industry dummies. Therefore, it follows that

$$\frac{W_{ir}}{\sqrt{W_{ir}^{*}}} e_{ir} = W_{ir}(G_{ir} - AG_{i})$$

and since $A = I_{j} \otimes j_{r}$, and it holds that $AG_{i} = (I_{j} \otimes j_{r})G_{i} = (I_{j}G_{i}) \otimes j_{r} = G_{i} \otimes j_{r}$ where I_j is an identity matrix of order j, j_r is r×1 vector of ones, ⊗ is the Kronecker product and it is implied that G_i is a J×1 vector, then

$$\sum_{i} \frac{W_{ir}}{\sqrt{W_{ir}^{*}}} e_{ir} = \underbrace{\sum_{i} W_{ir}(G_{ir} - G_{i})}_{\text{differential component}}$$

where G_i has been elevated to JR×1 vector.

The appeal of the one-way layout shift-share ANOVA model in conjunction with the transformation proposed by Berzeg (1978) is more apparent than real. It seems that the real aim for transforming the model is more to ensure numerical equivalence with the industry-mix component rather than to purge the model of the effect of unequal residual variances. Since the model only utilises information on inter-industry differences in growth rates, it is capable of producing 'accurate', in the sense of numerical equivalency, estimates of the industry-mix ignoring inter-regional differences, even when the latter are justifiable sources of systematic variation in both an economic and statistical sense.

However, the introduction of regional specific fixed effects would alter not only the corresponding estimates of the industry dummy coefficients but also their variances. It is a paradox to transform a model for the sake of some 'cure' for heteroscedasticity, in practice aiming to obtain desirable the coefficients, and being able to do so even when the specification is wrong. It seems that there is no penalty for improper use of the one-way layout in cases where two-way would be appropriate — no penalty at least in terms of numerical equivalence with the corresponding shift-share industry mix component.

Nevertheless, Berzeg recognises that when the structural specification *"...which hypothesises regional effects to be fixed or systematic, were found empirically valid, the traditional shift-share approach would be untenable"* (Berzeg, 1978, p. 465). This implies that the one-way shift-share ANOVA model would be of some use only in the case that all the coefficients of regional dummies were zero. It may not be even suggestive of the strict testing of the hypothesis that all industry-specific effects are simultaneously zero. Unless regional effects were also used in the model serving the comparison, an F test might accept this hypothesis when it not true for marginal situations, since the error term would not have been discounted for the systematic effect of inter-regional differences in growth rates.

All this discussion indicates that the close correspondence between shift-share and analysis of variance claimed by Berzeg (1978) is at the expense of using partial information. It seems that Weeden (1974) was correct in thinking that although the shift-share components are unbiased estimators of the analysis of variance components, being based on partial information, they are not minimum variance ones.

Table 8.3 presents the estimation results of the one-way layout model utilising the transformation suggested by Berzeg (1978).

Additionally using the c'b theorem presented in section 8.4.3 tests on individual industry-mix coefficients have also been established. The hypothesis that all regional coefficients are zero can be rejected (the F-test values being 4.57 for 12 and 228 degrees of freedom is very significant at the 1% level), thus indicating that regional coefficients are not all the same. Despite the significance of regional effects, their exclusion did not affect the estimates of the industry-mix effect, since, as explained above, the latter relies only on partial information.

In light of the collective significance of inter-regional differences in growth rates, the results presented in Table 8.3 would not be reliable. However, Table 8.3 might be used to offer a picture as to what the conventional shift-share components would be. It should not be deduced that since the one-way layout ensures that estimated industry-mix component equals the actual, the model offers a perfect fit. It was demonstrated above that the difference between the actual G_r-G_n and that 'predicted' by the model, expressed in terms of the residuals of the transformed model, is $\sum_r \frac{W_{ir}}{\sqrt{W_{ir}^*}}\left(G_{ir}^* - \hat{G}_{ir}\right)$ and it equals the differential component.

Table 8.3. Estimates of the industrial mix component in the shift-share, one way ANOVA model: standardisation uses stock of firms in each region and industry (t-ratios in parentheses)

NUTS II	Actual G_r-G_n	Composition $C1_r$	Growth $G2_r$
East Macedonia and Thrace	2.384	-0.695*** (-2.354)	3.079
Central Macedonia	2.914	0.332* (1.381)	2.582
West Macedonia	1.292	-6.948*** (-2.625)	8.240
Thessalia	-1.039	0.112 (0.320)	-1.152
Ipiros	-4.638	-1.517*** (-3.632)	-3.120
Ionian Islands	-6.291	-1.518** (-1.770)	-4.772
Western Greece	-4.014	-0.213 (-0.679)	-3.801
Central Greece	-1.849	-0.649** (-1.675)	-1.200
Peloponnisos	-0.803	-0.374 (-0.763)	-0.428
Attiki	-1.082	1.007*** (3.605)	-2.089
North Aegean Islands	-7.050	-0.577 (-1.154)	-6.473
South Aegean Islands	-7.799	-0.084 (-0.214)	-7.715
Crete	12.172	0.500 (1.186)	11.672

*** significant at the 1% level |t| ≥ 2.342
** significant that the 5% level |t| ≥1.6514
* significant at the 10% level |t| ≥1.2851
for 240 degrees of freedom
Estimation after Berzeg (1978)

8.5. Net entry by establishments of varying size at the regional level

The analysis so far has treated all establishments as being of equal size. This an erroneous assumption since entry by a large firm can offset entry and also exit of many smaller and to the extent that the determinants of entry might not be independent of firm size (Acs and Audretsch, 1989b). Research undertaken in Chapter 5 provides some empirical evidence that there are distinctive differences in the determinants of net entry of establishments of varying size in the Greek manufacturing industries at the national level.

For these reasons it is interesting to define net entry for different size classes of establishments and re-apply the shift share ANOVA analysis. This aims to reveal more about what the real gain is when size is accounted for. It is helpful to understand whether the industry-mix and the differential components are different compared to when all establishments are treated in aggregate.

Establishments were classified into small-scale industry if they employed less than ten persons and large-scale industry if they employ more than ten. This cut-off employment size has also been used by the NSSG to distinguish between small and large-scale industry[92]. An alternative cut off point could have been that of twenty employees. However, when the analysis was undertaken using this cut-off point, the model for the larger group was not additive creating problems with the statistical interpretation of results.

Hence, the analysis considers net entry rates of establishments sized below and above ten employees. The heteroscedasticity assumption made in an earlier section for size-independent net entry rates is maintained in what follows.

Results of the application of the two-way shift-share ANOVA methodology for the smaller size class are presented in Table 8.4. When both the regional and industry effects are combined, this makes for a significant contribution to the explanation of net entry rates across industries and space. The same also holds when these effects are evaluated separately. This conclusion is secure enough given that the Tukey test is insignificant and indicative of the model being additive.

Overall the results presented in Table 8.4 closely resemble those for size-independent net entry rates presented in Table 8.2. This seems to indicate that the driving force of growth and change in Greek manufacturing industries, at least in numbers of establishments, is the small-firm sector. Mention is necessary of the insignificance of the positive industry-mix effect for smaller firms in the Attiki region. However, the equivalent for all firms was previously only marginally significant. The negative industry-

[92] See also Labrianidis and Papamichos (1990).

mix effect in Ipiros, on the other hand, improves to marginal significance and the negative conditions for manufacturing net entry in the Ionian Islands become even more statistically important.

Table 8.4. Estimates of components in the shift-share-ANOVA model accounting for net entry of establishments employing less than 10 employees: standardisation uses stock of establishments in each region and industry
(t-ratios in parentheses)

NUTS II	**Actual G_r-G_n**	**Estimated G_r-g_n**	**Composition $C1_r$**	**Growth $G2_r$**	**Difference from actual G_r-Gn**
East Macedonia and Thrace	1.702	1.415	0.260 (0.451)	1.155 (0.393)	0.287
Central Macedonia	2.229	4.793	0.016 (0.026)	4.777** (1.833)	-2.564
West Macedonia	2.924	2.761	-11.940*** (-3.973)	14.701*** (2.651)	0.163
Thessalia	-0.995	-0.061	2.362*** (3.902)	-2.423 (-0.810)	-0.934
Ipiros	-4.104	-5.795	-0.933* (-1.432)	-4.862** (-1.670)	1.691
Ionian Islands	-6.285	-8.194	-1.630* (-1.454)	-6.564*** (-2.354)	1.909
Western Greece	-3.658	-3.341	0.175 (0.404)	-3.516 (-1.239)	-0.317
Central Greece	-2.026	-2.915	1.017** (2.040)	-3.932* (-1.384)	0.889
Peloponnisos	-0.240	-0.170	0.895* (1.517)	-1.065 (-0.388)	-0.070
Attiki	-1.045	-1.424	0.441 (0.785)	-1.865 (-0.937)	0.379
North Aegean Islands	-7.022	-6.583	1.104* (1.561)	-7.688*** (-2.707)	-0.438
South Aegean Islands	-7.425	-8.520	0.369 (0.670)	-8.889*** (-3.057)	1.094
Crete	12.303	7.366	2.473*** (3.589)	4.893** (1.660)	4.937

H1: $Br_1=Br_2=\ldots Br_{R-1}=0$ and $Ai_1=Ai_2=\ldots Ai_{J-1}=0$, F(31,228) = 7.20***
H2: $Br_1=Br_2=\ldots Br_{R-1}=0$ given $Ai\neq 0\ \forall\ i=1,\ldots, J-1$, F(12,228) = 3.14***
H3: $Ai_1=Ai_2=\ldots Ai_{J-1}=0$ given $Br\neq 0\ \forall\ r=1,\ldots, R-1$,.F(19,228) = 8.64***
Tukey's test for residual non-additivity F(1,227) = 0.024
*** significant at the 1% level $|t| \geq 2.3428$,
**significant at the 5% level $|t| \geq 1.6517$,
*significant at 10% level $|t| \geq 1.2853$
for 227 degrees of freedom
Estimation after Weeden (1974)

The picture changes quite significantly when larger firms are considered as presented in Table 8.5.

Table 8.5. Estimates of components in the shift-share-ANOVA model accounting for net entry of establishments employing more than 10 employees: standardisation uses stock of establishments in each region and industry
(t-ratios in parentheses)

NUTS II	Actual G_r-G_n	Estimated g_r-g_n	Composition $C1_r$	Growth $G2_r$	Difference from actual G_r-Gn
East Macedonia and Thrace	12.752	19.074	-1.000 (-0.834)	20.073*** (5.648)	-6.321
Central Macedonia	4.026	5.468	1.733*** (2.900)	3.736 (1.226)	-1.443
West Macedonia	-4.304	-10.649	-16.126*** (-3.163)	5.478 (0.746)	6.344
Thessalia	2.060	2.804	-1.152** (-1.743)	3.956 (0.998)	-0.744
Ipiros	-3.558	-0.143	-0.405 (-0.328)	0.262 (0.071)	-3.415
Ionian Islands	-19.687	-16.389	-15.346*** (-7.640)	-1.043 (-0.293)	-3.298
Western Greece	-3.558	-0.209	0.914*** (1.364)	-1.123 (-0.312)	-3.349
Central Greece	0.496	1.337	-4.147*** (-4.379)	5.484* (1.390)	-0.841
Peloponnisos	0.728	0.768	-2.841*** (-2.920)	3.609 (1.080)	-0.040
Attiki	-2.576	-4.298	1.130** (1.882)	-5.429*** (-2.436)	1.723
North Aegean Islands	-9.941	-13.195	-6.473*** (-4.401)	-6.722** (-1.856)	3.254
South Aegean Islands	-3.558	0.461	-0.139 (-0.107)	0.600 (0.161)	-4.019
Crete	3.507	8.866	-1.144 (-1.234)	10.010*** (2.643)	-5.359

H1: $Br_1=Br_2=\dots Br_{R-1}=0$ and $Ai_1=Ai_2=\dots Ai_{J-1}=0$, $F(31,228) = 14.19$***
H2: $Br_1=Br_2=\dots Br_{R-1}=0$ given $Ai\neq0\ \forall\ i=1,\dots, J-1$, $F(12,228) = 5.22$***
H3: $Ai_1=Ai_2=\dots Ai_{J-1}=0$ given $Br\neq0\ \forall\ r=1,\dots, R-1$, $F(19,228) = 10.21$***
Tukey's test for residual non-additivity $F(1,227) = 0.57$
*** significant at the 1% level $|t| \geq 2.3428$, **significant at the 5% level $|t| \geq 1.6516$, *significant at 10% level $|t| \geq 1.2853$
for 228 degrees of freedom
Estimation after Weeden (1974)

A first observation of interest is that the growth component does not dominate the industry-mix effect everywhere. The structural effect is, in fact, larger in absolute terms in three regions — namely Ipiros, Ionian Islands and West Macedonia. In the last two mentioned regions the effect is both large and negative in economic terms as well as being statistically insignificant. The second observation is that the differential component is of some statistical significance in fewer cases than the industry-mix effect. It could be asserted that larger firms are less amenable to locally prevailing conditions than smaller ones. This would suggest that if the differential component has been theorised as being more susceptible to policy intervention, then policy efforts to ameliorate the growth effect would seem to have stronger repercussions for smaller rather than larger firms.

The most striking feature of Table 8.5 is, however, that the geographical distribution of net gains and loses, as well as the underlying forces, is dramatically different to the all industry situation of Table 8.2. In six out the thirteen regions gains were recorded as compared to the nation as a whole in the large-firm sector. Compared with Table 8.2 new additions include Thessalia, Central Greece and Peloponnisos. However, West Macedonia does seem to lose out in performance terms compared to when size-independent and small-industry net entry rates were considered.

In terms of the sources of change, Central Macedonia owes the estimated gains to the industry-mix effect and not to its differential component as was previously the case for all industries. This provides some evidence that Central Macedonia specialises in industries of the faster growing large firm type. The exact opposite is the case for West Macedonia where a net decrease in the number of manufacturing establishments can be attributed to an unfavourable specialisation in large firms, which is not counterbalanced as in the previous cases by a positive growth effect. The latter is now smaller than the industry-mix component and statistically insignificant.

Thessalia, on the other hand, has a positive expected difference from the national net entry rate. This is due more to a positive (but insignificant) growth effect rather than to significant negative industrial composition. This is a clear reversal of trends suggested by the size-independent analysis and that for the small-firm sector.

Both Western Greece and Attiki exhibit a positive and statistically significant composition effect but the estimated difference from national growth is negative as this positive effect is offset by the negative influence of the differential effect. In fact the differential effect is negative and very significant for Attiki, which suggests that the saturated urban environment of Greater Athens has hit harder larger firms than smaller ones (the relevant coefficient for small firms, although negative, was not of any conventionally accepted statistical significance).

Industrial mix was negative and significant in four other regions. The Ionian Islands and North Aegean Islands present severe net decreases in larger scale manufacturing. Furthermore the differential component also makes a significant contribution to the overall reduction in the second case. The other two regions of significant negative composition effect are the Peloponnisos and Central Greece. In both cases this effect has been offset by positive growth factors suggesting comparative advantages for some industries (significant only in the case of Central Greece).

Another striking feature of Table 8.5 is the impressive positive and very significant coefficient of the growth component in East Macedonia and Thrace. Neither the size-independent net entry model, nor that for small firms previously estimated, had produced any significant coefficient for this region. It seems that the main gains for East Macedonia and Thrace relate to larger establishments explained by some comparative advantage provided by this region favouring such enterprises. It would be strange if there was not a clear regional policy dimension to this feature. In contrast, the specialisation effect is modestly negative and insignificant. A similar story is also evident in Crete where, however, the differential component is again remarkable.

What has been demonstrated in this section is that treating all establishments as being of equal size considerably obscures the picture. Net entry rates and their underlying determinants in the regions of Greece are quite different for larger as opposed to smaller firms.

8.6. Conclusions

The research presented here attempts for first time an investigation of patterns of growth rates in the number of manufacturing establishments across Greek regions. In doing so both the conventional shift-share analysis and ANOVA linear-model extensions were applied. The imperfections of the shift-share ANOVA model were discussed along with some of its potential advantages over the conventional non-stochastic shift-share approach.

It cannot be refuted that the shift-share analysis, even as linear model, is no substitute for a proper econometric model investigation. Nevertheless, some potential gains in using such a methodology as a first step of an empirical enquiry have been highlighted. In particular, it was argued that it might be especially worthwhile to use the analysis of variance shift-share model in the absence of a strong theoretical background in explaining net entry of manufacturing establishment in a regional context. Certainly there would appear to be only relatively poor evidence as what determines variations in the exit of firms subnationally which, in turn, deters hypothesis testing of possible symmetrical aspects between the determinants of firm entry and exit in a regional system.

The key finding of the all the alternative analyses using size-independent net entry rates was the predominance of the differential effect over the industry-mix component. This suggests that differences in net entry rates across regions can be mainly attributed to differences in net entry rates within same industry across those regions. This accords with previous results of new-firm formation and firm-death research for UK regions.

Such a conclusion is, of course, relevant to the formulation, and perhaps the evaluation, of regional policies which are specifically designed to encourage new firm formation[93]. So what can be implied by these results about policy?

First, taking manufacturing plants irrespective of size it is clear that in all regions industrial structure, as a factor, is superseded by regional performance. This is so even if the structure is helpful or unhelpful and even if the performance is good or bad. There would appear to be little point, then, in encouraging policy specifically to diversify the structure of new firm formation in under-performing regions of decline. This is not where the problem lies for it is clear that it is the nature of the local operating environment that makes the difference. It follows, then, that a greater effort should be placed on policies which encourage entrepreneurship and business starts in such regions irrespective of what those business actually do. Such a propagation of local business initiatives is really dependent on the removal of specific regional comparative disadvantage – perhaps related to local infrastructure provision. It is, perhaps, surprising that Attiki, given its favourable mix of nationally positively performing activities represented in its net entry, is one important example of just such a region which would benefit.

Second, notwithstanding the validity of the point just made, there is one region – West Macedonia – where some help in the form of encouraging nationally better performing activities to start up and survive would be of considerable help. The industrial-mix effect in this region is the least positive by far for any of the regions

[93] It must not be forgotten that the empirical context here is that of net entry so that this statement about the nature of policy must be more accurately expressed as the encouragement of new firm formation and firm survival.

considered, even though it is fractionally outweighed by an equally high growth component. In a way this is a success story of regional net entry into sectors heavily under-performing in this respect nationally.

Third, the policy picture changes somewhat when the firm size dimension is included in the analysis. Small-scale establishments appear to be the recipients of similar forces for change as the whole group of firms taken together. Perhaps this is not surprising as there many more small firms than large. The regional growth effect is still the dominant aspect overall even if this is not quite the case everywhere. However, for large firms this generalisation does not hold in quite the same way. In some under-performing regions the industrial mix plays a dominant role – West Macedonia, the Ionian Islands and Ipiros for example. In many more others its negative character is heavily detrimental for the regional performance despite being either ameliorated or outweighed by the growth effect. So industrial structure is more important as regards net entry for large firms. This implies that policies might be envisaged to encourage diversification of net entry of nationally better performing sectors of large scale manufacturing activities in underperforming areas.

Finally, the simple notion of a particularly favourable growth effect in areas of active policy in the promotion of business starts and the prevention of business deaths might be well used as an evaluation metric. This would be especially so if there had been a marked positive temporal change in the fortunes of such a growth effect associated with a policy initiative. It is difficult not to view net entry in East Macedonia and Thrace in such an encouraging policy light.

Chapter 9.

Spatial variations in new manufacturing plant openings †

9.1. Introduction

This research presents a first systematic attempt to assess the impact of various regional characteristics in accounting for spatial variations in manufacturing plant openings in Greece. Some earlier analysis (Louri and Anagnostaki, 1995) did focus on a comparison of the performance of possible determinants of firm entry between the two very broadly defined regions of Greater Athens and the rest of Greece. This analysis was confined to the use of those variables often deployed in industrial economics to identify sources of entry barriers, as well as possible inducements to entry. In doing so, the variables were defined at the national level for each of the industries considered, rendering the explanatory variables used in the econometric entry formulation essentially non-spatial. Thus, economic space enters the discussion through the comparison of the results, which points to considerable differences in the determinants of inter-industry variation of firm entry between the metropolitan core region of Athens and the rest of Greece.

In the present research the viewpoint in attempting to establish and empirically examine hypotheses that relate to the determinants of new plant operation is explicitly spatial. The decision to open a new plant is also seen here as a locational one. Care is taken to identify the possible determinants that make local environments attractive for manufacturing plants, rather than to see whether the determinants of inter-sectoral variation of firm entry might be behaviourally distinct across space. The presentation is organised as follows. The next section considers data and measurement issues and

† Fotopoulos, G., and Spence, N., *n.d.*, Spatial Variations in New Manufacturing Plant Openings: Some Empirical Evidence from Greece, *Regional Studies* (forthcoming — refereeing final revision stage). Thanks are due to two anonymous referees.

provides descriptive statistics of new plant openings across spatial units and over time. Section 9.3 sketches the hypotheses underlying the possible determinants of new firm formation at the local level. The results of empirical estimation are presented in section 9.4 and a summary of the empirical findings and conclusions are offered last.

9.2. Data and measurement issues of new firm formation in Greek regions

Data on new plant openings in Greece are scarce and this is even more of a problem when a spatial breakdown of the information is required. The only spatial data available about new plant openings stem from a record that is kept by the Ministry of Industry that registers operation permits. These are required by law for all firms wishing to operate a plant employing established power for manufacturing activity above a threshold of 15 HP. In reality it can be assumed with some confidence that these data actually refer only to new plants in that extensions of plants previously operating below the 15 HP threshold are registered separately.

The most aggregate spatial breakdown applies at a Greater Athens and rest of Greece level disclosing detail on 20 two-digit manufacturing sectors — a dimension that has already explored by Louri and Anagnostaki (1995). The second level of spatial breakdown available refers to 10 geographical departments and aggregates information for all industrial sectors. This hinders prospects of analysis that combines both a finer spatial disaggregation and some detailed manufacturing sectoral breakdown. Geographical departments, it should be mentioned, are areas much broader than Nomos (NUTS III) and in some cases even broader than administrative regions (NUTS II). Moreover, geographical departments represent geographical entities that justify themselves within a complex socio-economic historical reasoning not unrelated to the long and often turbulent life of the nation. It is not especially clear why these data as they are published by NSSG in their Statistical Yearbooks pertain to geographical departments and not to some other spatial level, but they are the most detailed available. In exploring these published data on new plant operation this study covers a time span from 1980 to 1991.

Having data on new plant formation counts has not been sufficient in the literature to offer an unproblematic comparative base for the study of spatial variation of new firm formation. The need to account for the degree of size inequality across the spatial units where new plants locate is vital, and arguments on this issue have formed part of almost all published research in this field. There are two broad operational approaches as to what should be used as a denominator in order to produce a meaningful proxy of firm formation or entry at the spatial level. The first relates to what Audretsch and Fritsch (1994) have termed the 'ecological approach' which uses as a standardising measure the stock of already operating firms. Garofoli (1992; 1994) has been heavily critical of the use of the existing population of firms in the denominator of the spatial entry rate formulation. His objections are manifold, but the basic criticism can be considered along two lines. The first regards the implications of unaccounted-for inequality in the size distribution of firms across space. Concerns arise because of the expectation that new firms are likely to consist of a higher proportion of smaller sized firms than their existing counterparts, and this is not accounted for when the stock count is used. This, combined with an unequal size distribution of firms across space itself, could introduce bias if areas are systematically characterised by large-firm structures giving rise to artificially higher entry rates. But it is the case that the size structure of existing firms has often been assumed to be itself a part of the explanation when it comes to accounting for inter-regional variation in new firm formation (Fothergill and Gudgin, 1982; Storey, 1982; Westhead, 1989). The argument is that a small firm structure could serve as an incubator of prospective firm proprietors (Evans and Leighton, 1989; Keeble and Gould, 1985). Additionally, it could also indicate that, locally, the level of entry barriers is either low (Cross, 1981) or that alternative small firm strategies are viable (Keeble and Wever, 1986). It follows that, if the stock of existing firms is smaller largely because of fewer larger-sized local firms, then the entry rates calculated in this fashion are higher than otherwise would be the case. This itself might be a source of a paradox when some measure of size structure is employed as an independent variable baring prospects of a positive effect when small-firm structures are measured and vice versa when large firm shares or average firm size is being accounted for. The covariation becomes obscured when, for example, the share of small firms as an explanatory variable is expected to exert a positive influence on entry rates when the latter become higher because of fewer larger firms in the local stock. This outcome has been witnessed in the Audretsch and Fritsch (1994) study where the hypothesised negative effect of average firm size turns out to be positive (though insignificant) in a regression which attempts to account for regional variation of firm births in Germany — calculated the 'ecological' way.

The second line of Garofoli's criticism is that some sort of 'causality' is involved in the relationship between firm stock and firm birth *"as though existing firms automatically generate new ones"* (Garofoli, 1992, p. 104). However, a strong relationship between the existing stock and the creation of new firms might well be the case and, if doubted, could form a suitable hypothesis to be tested. Such a notion would not be independent of Krugman's realisation that *"...if there is one single area in economics in which path dependence is unmistakable, it is in economic geography — the location of production in space"* (Krugman, 1991a p. 80). This consideration places emphasis on the importance of cumulative processes in manufacturing location. In this sense, the existing stock of firms, at any point in time in a particular locus, might be seen as a reflection of this accumulation over time. Moreover in the long run, perturbation of this order itself would give rise to new points of manufacturing accumulation. Often, the role of regional policy has been nothing but a conscious effort to stimulate or to help the acceleration forces of perturbation at work. Otherwise, the acceptance of this realisation might become a self-fulfilling prophecy leading to some kind of pathetic belief as to the role of historic accident — an exogenous shock. This rationale, however, does not deny the validity of Garofoli's objection to the use of the existing stock of business as a standardisation measure. It could be argued that exactly the opposite might be the case. If, indeed, the existing stock of manufacturing firms at some point in space is a reflection of past accumulation processes, then stock itself becomes a part of the explanation. That is, if the objective is to account for variation of new firm formation across space drawing on the effect of differences in some spatial unit-specific characteristics across these units, then stock is an outcome conditioned on past values of these spatial characteristics. Using it as a standardisation measure might obscure important differences in new firm formation, reducing between spatial unit variation. This would potentially introduce some bias into the estimators of spatial characteristics deployed as possible determinants of new firm formation. This consideration has been expressed in the industrial economics field when dealing with entry rates by industrial sector (Khemani and Shapiro, 1986; see also discussion in Chapter 6) drawing on similar reasoning.

Concern, however, is amplified when it comes to spatial analysis of total manufacturing aggregates. The bottom line that it is people and not firms that create new firms has given way to what has been termed by Audretsch and Fritsch (1994) as a 'labour market approach'. Standardisation is achieved by using the labour market potential for generating new firms in the locality. This draws on the entrepreneurial choice framework put forward by Evans and Jovanovic (1989). The main attraction is that a potential entrepreneur aiming to open a business often draws on previously gained experience as an employee in the same labour market area within which the new establishment is due to become operational (Gudgin, 1978; Keeble and Wever, 1986; Fothergill and Gudgin, 1982; Lloyd and Mason, 1984). Although the spatial analysis should not rule out the possibility of labour force mobility (Keeble and Gould, 1985), working population could offer a meaningful standardisation, since it proxies the magnitude of a region's full potential. Moreover, to the extent that there are already established entrepreneurial cultural differences across space, labour mobility might have a somewhat limited role because people, before moving, might not have such a clear picture of the entrepreneurial regime and market conditions of their destination. For new firm formation in the UK it has been suggested that *"...it is a feature of the social background to new firm formation that most new businesses are located close to their founders' places of residence"* (Lloyd and Mason, 1983, p. 23).

In the empirical literature there have been two versions of the 'labour market' standardisation approach. The first takes manufacturing employment in each region as a deflator-index based on the premise that the propensity to establish a new manufacturing firm might be increased amongst people previously employed in manufacturing industries. As opposed to this rather restrictive approach, there have been studies using the working population as a more appropriate basis for comparison, giving way to considerations that it might be both plausible and possible that non-manufacturing employees, along with those in manufacturing, might populate the local pool of potential entrepreneurs (Ashcroft *et al.* 1991). Part of the discussion of the critics of the 'ecological approach', that relate to implications due to unaccounted effects of size distribution of manufacturing firms across space, might also be relevant when manufacturing employment is used in the denominator when defining spatial entry or new firm formation rates. Similar levels of manufacturing employment could be the result of either the domination of disproportionately greater small firm structures, or of fewer large firms in the locality. Using manufacturing employment in the denominator does not explicitly account for size-structure within the spatial units. As a consequence, it could smooth out across-space differences in new firm formation, this being crucially dependent on the level of spatial disaggregation. It may be assumed that the higher the level of spatial disaggregation, the more probable is greater size-heterogeneity within each spatial unit. However, the most important consequence remains that size structure might itself be an important determinant as well, and for that it should be used as such in a formulation where the dependent variable is purged of any hidden size-related effect.

On these grounds the present research adopts an operational definition that employs active population (labour force) as a standardisation to define new plant establishment rates across the geographical departments in Greece. Options are few when dealing with Greek data on this topic. The number of existing manufacturing plants by region is available only for plants employing more than 20 employees. Using these data would introduce some bias into the calculation of new plant opening rates due to inequalities of the size distribution of plants across Greek regions. Thus, the dependent variable for the analysis here has to be new-operation permits for manufacturing firms over thousands of labour force.

Table 9.1 presents some descriptive statistics for the dependent variable for each of the ten spatial units considered in this analysis over the entire study period from 1980 to 1991. The nation-wide mean formation rate is extremely small, ranging from 3.3 new plants per 10,000 labour force in the Ionian Islands to 1.4 in Macedonia. Other relatively fertile areas are, respectively, the island of Crete, Attiki — which contains the Greater Athens conurbation, followed by Thessalia and Peloponnisos — which both have long-established industrial districts. The surprising leading position of the Ionian Islands is countered somewhat by its large standard deviation (0.19), which, not coincidentally, is the highest in the country. Exactly the opposite is the case for Macedonia, which has a much less volatile variation over the study period. Its standard deviation falls to as low as 0.04 and is the lowest observed.

Table 9.1. Descriptive statistics of manufacturing plant-opening rates by geographical department in Greece over the 1980-1991 period

Geographical Departments	Mean	Minimum	Maximum	Standard Deviation
Attiki, Salamina and Egina	0.24972	0.1132	0.3853	0.0937
Rest of Central Greece and Evia	0.16310	0.0848	0.2778	0.0486
Peloponnisos	0.20048	0.1213	0.3628	0.0710
Ionian Islands	0.33185	0.0972	0.7619	0.1952
Ipiros	0.18919	0.0644	0.3457	0.0873
Thessalia	0.20989	0.1053	0.3441	0.0823
Macedonia	0.14525	0.0733	0.2146	0.0455
Thrace	0.15912	0.0688	0.2589	0.0595
Aegean Islands	0.18155	0.0799	0.3257	0.0760
Crete	0.29763	0.2017	0.5239	0.0956

Table 9.2 transposes the viewpoint to the time dimension across all areas considered and an interesting feature is that average formation rates are higher from 1985 onwards.

Table 9.2. Descriptive statistics of manufacturing plant-openings by year over Geographical Departments in Greece

	Mean	Minimum	Maximum	Standard Deviation
1980	0.23163	0.0884	0.3853	0.10279
1981	0.20960	0.1092	0.3075	0.06958
1982	0.14013	0.0676	0.2439	0.06711
1983	0.18344	0.0840	0.5239	0.12516
1984	0.19589	0.0908	0.3728	0.08088
1985	0.25527	0.1364	0.4131	0.09863
1986	0.25651	0.1764	0.3433	0.05902
1987	0.24227	0.1504	0.3457	0.07352
1988	0.20846	0.1452	0.3320	0.06248
1989	0.24911	0.0848	0.7619	0.20472
1990	0.21224	0.0688	0.5559	0.13705
1991	0.16158	0.0644	0.4189	0.10613

The rates were considerably lower between 1982 and 1984 (as well as in 1991). The surge of new plant operation after 1985 is worth consideration since it relates to the introduction of an austerity programme in that year. Facing up to lower demand, as consequence of the austerity program (see discussion in section 3.4), might well have had a discouraging effect on firm formation rates.

However, it has been argued, that decreasing labour costs, as a direct consequence of the austerity program, resulted in a reversal of decreasing trends in manufacturing profits prior to 1986-1987 (Federation of Greek Industries annual reports). Improved profitability prospects then can be thought of as offsetting the negative effect of decreasing demand on new firm formation. In addition, reductions in manufacturing employment might have also increased the number of individuals 'pushed' to undertake entrepreneurial initiatives thereby avoiding unemployment (as in Storey, 1991).

It is also worth noting that the highest standard deviation of annual average formation rates was as high as 0.20 in 1989 (against a mean of 0.24) indicating that sometimes spatial variations are marked indeed. Interestingly, the maximum value of 7.6 new plants per 10,000 of labour force for 1989 was that for the Ionian Islands which generated not only the highest mean formation rate but also the highest standard deviation of all mean over-period formation rates.

Since the analysis deals with data arranged in two dimensions — space and time — an explicit account is required to determine whether or not the regional means presented in Table 9.1 are statistically different. The same also applies to the annual over-space means presented in Table 9.2. This would be particularly helpful in establishing whether or not, unconditionally on other regressors, regional- and time-fixed effects represent significant systematic sources of variation. This exercise is undertaken in Table 9.3 presenting the results of a variance decomposition analysis of new plant establishment rates.

The overall (or grand) mean over both spatial units and time is around 0.21 — that is 2.1 new plants per 10,000 labour force. The standard deviation stands out at about half the magnitude of the overall mean — that is slightly more than one firm in every 10,000 labour force. The two forces of systematic variation, in the sense that they can be accounted for by regional specific time-invariant characteristics (between-regions) and by time-specific across-space invariant characteristics (between-year), are much smaller. It is noteworthy that the first represents some 29 percent of the total variation whereas the second accounts for just 11 percent of overall sample variability. It follows by subtraction that most (59%) of total sample variability cannot be controlled for by regional and/or time specific factors. In order to establish their statistical significance both the systematic sources of variation are then divided by the amount of unsystematic variation (residual). Correcting for degrees of freedom this yields that regional-fixed effects are a quite significant source of variation (99% confidence region) whereas time effects are only of moderate significance (90% confidence).

Table 9.3. Manufacturing opening-rates by Geographical Department in Greece, 1980-1991:variance decomposition accounting for systematic and unsystematic sources of variation

Grand Mean	0.21278	**Unsystematic variation** $\sigma^2 - B_n - B_t$	0.006867
Total sample variation $\sigma^2 = \frac{1}{NT}\sum_i \sum_t (x_{it} - \bar{x})^2$	0.01161	$\frac{\sigma^2 - B_n - B_t}{\sigma^2}$	0.59101
Between-region variation $B_n = \frac{1}{N}\sum_i (\bar{x}_i - \bar{x})^2$	0.00343	$\frac{B_n}{\sigma^2 - B_n - B_t}$	0.50006
Between-year variation $B_t = \frac{1}{T}\sum_t (\bar{x}_t - \bar{x})^2$	0.00131	$\frac{B_t}{\sigma^2 - B_n - B_t}$	0.19193
B_n / σ^2	0.29554	**Regional fixed effects** $F_{(9,99)}$	5.50076***
B_t / σ^2	0.11343	**Time fixed effects** $F_{(11,99)}$	1.72739*

*** significant at 1% *significant at 10 %

All of this points to the conclusion that although the major source of variation is due to chance, stable in time inter-regional differences are the main driving force of systematic variation as they dominate time-specific but uniform across space effects.

9.3. Some potential determinants of spatial variations in new plant opening rates

The aim of this section is to hypothesise relationships that might account for variations in new plant operation rates across ten Greek geographical departments between 1980 and 1991. The lines of enquiry in the applied literature as to what determines new firm formation differentials across space have been quite versatile and several themes are apparent. The first considers the structure of production locally.

The implications of local production structures for new firm formation are varied. One of the most celebrated features is the size structure of firms operating locally and has been extensively discussed in section 7.3.3.1. The extent of small firm presence locally is proxied here as the share of manufacturing employment for firms with less than 10 employees (SMFP) and it is expected to have a positive effect on new firm formation.

A second aspect of local industrial structure that could affect the propensity to establish new plants is the degree of specialisation of the industrial activity in an area. As it was demonstrated earlier in section 7.3.3.2 agreement as to the role of such an effect has not been unanimous. Gudgin (1978), typical proponent of the view vindicated mostly in the British literature, proposes that the higher the degree of industry diversification in a region the higher the number of new firms should be. In contrast, Garofoli (1992, 1994) points out that specialisation of an area in particular industries provides the opportunity for these industries to explore localisation economies, as it has been assessed by the Italian experience on industrial districts. This, in turn, renders the hypothesised relation between specialisation, as opposed to diversification, and new firm formation, positive. Localisation economies arise as a result of the spatial proximity of related activities and in their extreme expression as result of geographical concentration of plants in the same industry.

The beneficial effect of spatial proximity was first recognised by Marshall (1920). Krugman (1991b) elaborates on Marshall's views and offers theoretical illustration, together with some empirical evidence along with historical examples to justify three sources of increasing returns considered spatially. These involve labour market pooling, the provision of non-traded inputs specific to an industry in a greater variety and at lower costs, and increased information flows and technological spillovers. As far as the first point is concerned, it is the provision of highly specialised as opposed to diversified labour that makes for an attractive location for new plants. This local supply of highly specialised skills is hypothesised to give productivity advantages to local firms. The emphasis is now placed on labour transfers between firms in the same industry rather than across industries.

The second source of convexities (increasing returns) in production at the spatial level arises if the demand for some intermediate product is high locally, then high aggregate supply of this product does not need to coincide with a large individual capital engaged. This would allow for more smaller suppliers, fully utilising their capacity, often setting up joint facilities and sub-contracting. Given that mass production of intermediate-inputs from fewer large producers is avoided, more product-differentiation by smaller producers might be expected. Finally, if a higher speed of information circulation is achieved, given higher spatial proximity, then this helps to reduce information asymmetries and hence uncertainty.

It is clear that the argument to support a positive view on the effect of specialisation on new firm formation crucially depends on the existence of strong input-output linkages locally. This, in turn, depends on both the level of sectoral and spatial aggregation. The broader the industry definition is, the greater becomes the possibility that high levels of area-specialisation containing higher input-output ties are generated. On the other hand, the higher the level of spatial aggregation, the lower the observed specialisation level becomes, *ceteris paribus*. However, reduction in the observed level of area-specialisation need not be at the expense of underlying local links in production. Production specialisation is proxied here using the 'specialisation coefficient' index defined as:

$$SPEC = \frac{1}{2}\sum_i \left| \frac{E_{ir}}{E_r} - \frac{E_{in}}{E_n} \right|$$

where E_{ir} is the employment in industry i=1,...,20 two digit (standard industrial classification) industries and r = 1,...,10 geographical departments at some point in time. E_{in} is the employment in industry i nationally and Er and En refer to total manufacturing employment at the regional and national level respectively. The index ranges between 0 and 1 taking the value of 1 when only one sector is present in the area and 0 when the sectoral structure of an area is identical to that of the nation as a whole.

Following this reasoning, it might be argued that, whatever is the hypothesised effect of specialisation on new firm formation, a better understanding of the spatial processes in increasing local firm fertility would be offered if some measure of the extent of local production links is included. The extent of local production links for a given level of spatial aggregation might in turn be proxied by some notion of vertical integration of manufacturing production spatially. The ratio of value-added from manufacturing activity to gross production value (VERTICAL) is used here to proxy this notion. This is hypothesised to have a negative effect on new firm formation. It should be stressed that a low ratio value could be partially a reflection of the industrial-mix itself, in that it would be lower if an area is dominated by low value-added industries. Moreover, a low value of this ratio does not necessarily imply that all the intermediate inputs are purchased locally. However, it would hold that, *ceteris paribus*, the greater the need to purchase intermediate inputs, the higher is the probability that this would be achieved locally.

It was argued above that the specialisation of an area in some industries implies that these industries may enjoy localisation economies that are external to the firms but internal to these industries. It was also argued that, depending on the definition of industry used, the effects of specialisation need to be studied along with some index of local production links. It should be stressed that these are not the only sources of production convexities. External economies to both firms and industrial sectors contained within a spatial unit may also exist — agglomeration economies. They stem from a large number of economic activities being concentrated in space. This ensures a greater variety of skills available in the local labour force, greater markets for products, greater provision of services and concentration of facilities jointly serving different industries (Armstrong and Taylor, 1985; Henderson, 1986). The main difference compared to localisation economies is that the emphasis in now given in economies attained across and not within industries. Localised industries could still exist within a broader, diversified spatial-unit system without necessarily being those that characterise the system, or, put differently, without rendering the system specialised in those industries. Whereas specialisation of an area involves sectoral predominance, localisation of an industry does not directly imply area-specialisation. Agglomeration economies are proxied here by population density (inhabitants/square km). Density is expected to exert a positive influence on new firm formation. Densely populated areas tend to be those where the infrastructure of services and inputs is more developed (Audretsch and Fritsch, 1994). In a Greek context, Louri (1988) argues that urbanisation effects on manufacturing output are quite significant, estimating that in 1980 and across 43 spatial units a 10% increase in urban population in a region would increase manufacturing output by 2%.

Apart from the above notion of infrastructure in terms of services and inputs, densely populated areas are also likely to be those where real infrastructure or public capital stock levels are higher. Certain types of public capital are well known to provide critical inputs into the production process (Meade, 1952; Diamond and Spence, 1989). Aschauer (1989), notably, has demonstrated that public and private capital stocks can be seen as complementary inputs into private production. Munnell (1992), using models of business location to explore the relationship between public capital and employment growth, provides evidence for a significant positive effect of the former on the latter. Moreover, it appears that the effects of increases in public capital are more beneficial in earlier stages of development when levels of public capital stock are relatively low. This consideration seems to have important implications when sub-national units are involved and, indeed, public infrastructure differentials across space can be striking in less developed economies like Greece. In a similar vein, Mas *et al.* (1996) provides empirical evidence for the positive effect of public infrastructure in explaining productivity differentials across Spanish regions.

However, the research by Eberts (1991) is unique in considering directly the effect of public capital stock on differentials of new firm openings (across 40 US metropolitan areas between 1976-1978). His empirical evidence revealed that relative change in public capital provision had a significant positive effect when the small firm openings are considered, but this was not repeated for large firms.

In the present study the effect of public capital in new firm formation is directly accounted for by the amount of public investment per capita (GPEC). Data for public investment in infrastructure relate to the public investment programme after operational and miscellaneous expenditures have been deducted. Data on public capital stock were not unavailable to this research, but even if they were, perhaps there would have been little scope to use them given that population density is likely to be more highly correlated with stocks than with flows.

Additionally, lagged per capita spending might better capture the effect on new firm formation as it has often been a tool used to alleviate regional disparities in infrastructure providing also a signalling of ameliorating local conditions. This would have the effect of increasing expectations and optimism of potential entrepreneurs. Louri (1989), drawing on earlier results (Louri, 1985) revealing a positive effect of infrastructure provision on urbanisation economies, interprets the positive effect of urbanisation economies (proxied by population) on new manufacturing capital formation as primarily due to higher infrastructure expenditures.

In similar fashion to Audretsch and Fritsch (1994) convexities in production across space and their effect on new plant openings can also be directly accounted for by using labour productivity as an explanatory variable. The idea is that new plant openings tend to increase where productivity is high enough to ensure increased returns. The danger in using this variable is again, however, that it may create acute multicollinearity problems. These, along with estimation issues, are discussed in detail in the next section. Labour productivity is defined as value-added from manufacturing activity over employment in each of the 10 geographical departments over the relevant index defined for the nation (PROD).

The next variable employed seeks to take account of the extent that supply of skilled manufacturing labour could itself be both an attraction for new firms and also a new firm generating source (Lloyd and Mason, 1983). Skilful manufacturing employees might be the future proprietors of small firms. This variable is defined as the rate of salary earning manufacturing employees over those who are wage earners for each of the spatial units considered in the analysis (SKILL).

It has also been suggested that some proxy of wealth distribution at the spatial level may be indicative of the local availability of individual financial resources needed to establish new firms. This feature can be viewed as operating on the demand side, suggesting wealthy local markets (Ashcroft *et al.* 1991) The UK literature has extensively used house ownership as an index of regional wealth on the premise that home ownership can be used as a guarantee to lever bank loans. Such data were unavailable at the regional level for Greece and so private bank deposits per capita (WEALTH) were used to proxy differentials of individual wealth.

The last variable relates to the performance of regional economies prior to new plant openings and this is measured as the growth rate of real gross regional product (GRPGR). New firms are often small. They tend to serve local markets. Hence, it is anticipated that local differences in the level and growth of demand will be important for both new firm formation and small firm survival (Keeble *et al.* 1993, p. 28). Growth rates have been calculated over different period lengths before entry (see next section) and their effect is hypothesised to be positive.

9.4. Spatial variations in new manufacturing plant openings: estimation and results

Before beginning the econometric investigation of the above hypotheses it should be emphasised that the scope here is limited to examining whether the regional characteristics identified earlier are highly correlated with new plant openings and to assess their importance. In doing so *"the orientation is exploratory and descriptive, rather than a stringent test of structural relationships"* (Gerlach and Wagner, 1994, p. 69) given that *"there is no standard textbook model of plant openings"* (Hamermesh, 1993, p. 137).

The first problem the empirical examination of these relationships faces is multicollinearity. However, this is not something new in the spatial analysis of new firm formation. Cross (1981, p. 261) notes that *"...Almost every facet of manufacturing industry is related to every other facet, though to varying degrees [and therefore] ...the inclusion of a measure of industrial structure and one of employment type may cause problems of multicollinearity."* The present research certainly does face problems of linear dependence between explanatory variables if all variables suggested in the previous section were to be included in the same regression equation. Some effort has been made to arrange alternative model formulations ensuring that the individual effects of estimated coefficients are accurately assessed.

The correlation matrix of all potential explanatory variables revealed some interesting relationships. The highest correlation (0.88) was that between specialisation (SPEC) and the measure of small firm presence (SMFP). Small firms in aggregate are the largest employers in Greek manufacturing, and SPEC is defined in terms of employment shares. The second highest correlation was between the proxy for individual wealth by region (WEALTH) and population density (0.64). Density, in turn, was positively correlated with the proxy for manufacturing skilled labour (0.50), and negatively correlated with both specialisation (SPEC, -0.51) and small firm structures (SMFP, -0.55). The largest remaining coefficient (0.31) was that between labour productivity (PROD) and the extent of skilled manufacturing labour (SKILL).

Table 9.4 provides the results of the estimations and the arrangements of the explanatory variables in model formulations (1) and (2). Although not entirely purged of interdependencies (the determinants of the regressors correlation matrices ranges between 0.48 and 0.30, with 0 denoting absolute singularity and 1 signalling perfect orthogonality), these calibrations still allow for the individual effect of each regressor to be identified.

Table 9.4. Results of regressions accounting for new plant openings in Greek manufacturing across Geographical Departments: 1980-1991
(estimated coefficients and standard errors in parentheses)

	(1)		(2)	
Variables	**linear**	**log-linear**	**linear**	**log-linear**
PROD	0.12016*** (0.03593)	0.55816*** (0.1606)	0.10935*** (0.03670)	0.51902*** (0.1660)
SPEC	-	-	0.71163*** (0.1525)	2.6107*** (0.6899)
SMFP	2.7882*** (0.5577)	11.451*** (2.492)	-	-
VERTICAL	-0.46967*** (0.1545)	-2.1131*** (0.6904)	-0.55373*** (0.1695)	-2.3005*** 0.7668
SKILL	-	-	0.0074844*** (0.003013)	0.034106*** (0.01363)
WEALTH	-	-	0.0029141** (0.001159)	0.010642** (0.005243)
DENSITY	0.23010*** (0.04094)	1.0048*** (0.1829)	-	-
$GPEC_{(4\text{-year lag})}$	0.053466*** (0.02036)	0.20226** (0.09098)	-	-
$GRPGR_{(3\text{-year lag})}$	0.24122** (0.1391)	0.98118* (0.6215)	0.28218** (0.1422)	1.1946** (0.6432)
CONSTANT	-2.5312*** (0.5185)	-12.923*** (2.317)	-0.092345* (0.06665)	-2.5314*** (0.3016)
R^2	0.33	0.31	0.29	0.25
$F_{(6,119)}$	9.58	8.71	7.94	6.49
$F_{(9,104)}$-fixed effects		1.73		1.18

*** significant at the 1% **significant at the 5% * significant at 10%

Before proceeding with the commentary on the estimation, some points that relate to the nature of the dependent variable should be made. As evident from Table 9.1 and Table 9.2 the values of the dependent variable lie in the (0,1) interval. In the applied literature of firm entry and exit in manufacturing industries, this property of the dependent variable (the entry rate, but also the non-negativity of entry in absolute terms) has given concern (Geroski, 1983; Khemani and Shapiro, 1986; Mata, 1993). This involves the appropriateness and efficiency of OLS and has implications for hypothesis testing as the non-negativity and bounded nature of the dependent variable questions the normality assumption for the dependent variable and consequently the error term. In fact the value of OLS estimation *per se* might be questioned in this context as there is no guarantee that the predicted values would be non-negative confined in the same interval. In this event the model would predict plant closures instead of plant openings. Some remedies have been proposed to deal with these problems. Khemani and Shapiro (1986) suggest the use of the log-odds ratio, $\log\left(\frac{P}{1-P}\right)$ (where P is the plant-opening rate defined in section 9.2), in place of the original variable (P). This would allow the new-plant opening rate to be interpreted as a probability. This renders the estimable equation inherently heteroscedastic[94] and a minimum chi-square method can be used to deal with heteroscedasticity (Maddala, 1983, p. 29). However, it could be argued that the appropriate use of the log-odds ratio would permit a strict probabilistic interpretation only when the dependent variable is defined over existing plants (new plus old) and not over thousands of labour force as here. This would indeed provide an estimate of the probability of opening a new plant in a region. If the labour force denominator is to be maintained, data on self-employment should be used in the numerator of the dependent variable to ensure some probabilistic interpretation. If both the original numerator and denominator together with a probabilistic interpretation are to be maintained, on the grounds that people and not plants are those creating new plants, then, as an extra assumption, numbers of new plants in a region need to be identified with numbers of self-employed. However, this might be too much of an assumption.

The discussion above offers an argument against the use of labour force, or indeed any other variable unrelated to firm stock, for standardisation purposes when calculating new firm formation rates in a spatial context. However, the arguments in favour of the standardisation used in the present research remain attractive. This standardisation has been successfully used in other studies and, perhaps more important, the data available do not leave much choice.

Given the conceptual difficulties regarding the probabilistic interpretation of the log-odds transformation of the dependent variable, the methodology proposed by Box and Cox (1964) was adopted, as this allows the data to generate an appropriate transformation of the dependent variable. The Box-Cox procedure seeks to derive an appropriate exponential parameter λ for transforming the dependent variable so as to render the error term normally distributed and homoscedastic.

[94] Thanks are due to an anonymous referee for bringing this into attention.

Judge *et al.* (1985, pp. 839-840) describe a non-linear model of the form $y = e^{x'\beta} \cdot e^{u}$ where x is a vector of the explanatory variables in the model and u refers to a log-normally distributed and heteroscedastic error term as a special case of the Box-Cox transformation for an exponential parameter that equals zero. The properties of this model are such that taking natural logarithms on both sides of the equation renders the model linear in terms of the variables and the parameters to be estimated, that is $\ln y = x'\beta + u$. Most important is that the error term of the transformed model becomes normally distributed and homoscedastic. Orr (1974a) in his pioneering work on entry into Canadian manufacturing industries used such a model on an ad hoc basis to deal with the non-negativity of his entry variable.

Estimations of the linear specification of both model formulations (1) and (2) are given in Table 9.4. All the variables are statistically significant and have the expected signs. However, when the Jarque-Bera (1980) test for error-term normality was applied, the value of the test (χ^2 with 2 degrees of freedom) was 75.86 and 56.47 respectively pointing up serious deviations from normality. Applying the Box-Cox procedure to formulation (1) and (2) produces an exponential parameter of 0.10 and 0.11 respectively. These are both quite close to zero suggesting that a logarithmic transformation of the dependent variable might be appropriate. As empirical applications are usually confined to simple transformations the exponential parameters derived from the Box-Cox procedure might be of little practical value, and a likelihood ratio test (Judge *et al.* 1985, pp. 844-845) was used to choose between the linear and the semi-logarithmic competing simple model alternatives. The linear model is assumed to be homoscedastic with an additive and normally distributed error term. In contrast, the semi-logarithmic model is assumed to be, prior to logarithmic transformation of the dependent variable, non-linear with a multiplicative, heteroscedastic, and log-normally distributed error term. Thus, this test essentially compares each of the linear and log-linear econometric model alternatives with the Box-Cox solution. For the first formulation the linear model is rejected as the test value (39.73) is higher than a χ^2 value for one degree of freedom at the 5% level of significance. The opposite is the case for the log-linear specification of formulation (1), which is accepted (χ^2 value of 0.51 for 1 degree of freedom). The respective corresponding results (36.77 and 0.54) for the second formulation also favour the log-linear specification. The advantages of the log-linear specification for both formulations become more apparent when the Jarque-Bera test was reapplied after the transformation to suggest a normally distributed error term for the log-linear version of both model formulations (2.55 and 2.18 χ^2 for 2 degrees of freedom). In addition, no heteroscedasticity of any form[95] was detected in the error term of the log-linear version for both formulations in Table 9.4.

Despite this discussion of the merits associated with the log-linear model, Table 9.4 suggests that differences between the two specifications are modest for both formulations of the new plant-openings equations. As the log-linear specification appears to better satisfy the econometric estimation assumptions, the commentary will be based upon this specification. The linear alternatives are presented for expositional reasons and to support the argument that the results of the estimation are relatively robust. As far as the OLS results of log-linear specifications of model formulations (1) and (2) are concerned, inspection of Table 9.4 reveals that all the variables employed have the hypothesised signs. Model 1 suggests that the impact of both higher productivity and small firm structures have a significant positive effect on new plant openings. The extent of vertical integration, as an inverse notion of the potential to establish production links at some level and especially within the spatial units concerned, has a significant negative effect. These results have valuable policy implications. Regional policies might be more successful when aiming to stimulate new firm formation, or plant relocation, when they focus not only on individual firms or sectors but also production networks. Small firm presence seems to be a significant and positive effect on new firm formation, and, as argued previously, this could be a reflection of two things. The first is that small firm structures are an expression of the way local firms engage in low barriers to entry sectors. The second is that they are able to offer some kind of entrepreneurial propagation. Whether or not the first or the second or both are the underlying explanations for this result, regional policies should seriously consider that although small firms are those more prone to emerge within areas, they might well be those which have a high

[95] The transformation of explanatory variables along with that of the dependent variable was also considered. A Box-Cox procedure that also accounts for heteroscedasticity concerning the explanatory variables was adopted, as it is known that the Box-Cox transformation can be sensitive to heteroscedasticity of this form (Judge *et al.*, 1985, p. 841), but again no heteroscedasticity was detected.

propensity to disappear as well. Viability of the new, and most often small, firms would raise issues as to whether the local conditions are favourable enough to sustain the growth and survival of these firms. Thus, unless small firms are engaged in local production networks, in aggregate, their survival and growth is difficult to sustain.

The positive effect of population density on new plant opening rates suggests that a critical mass is required to stimulate the emergence of new firms. In addition, past growth of the regional economy signals that rises in the level of local demand in turn trigger the surge of new firms.

Public spending in infrastructure provision, although not enjoying much attention in the new firm formation literature, justifies the expectations made for its inclusion here. Public spending per capita, lagged up to four periods, appears to be a highly significant and positive influence. It was beyond the objectives of this research to explore the extent of public and private capital substitution or complementarity, or to what extent public spending in infrastructure enters a local production function, but these too are also fascinating questions. The present research, however, suggests that a new dimension in public spending appraisal might be introduced, that of the effect of public infrastructure on new plant openings.

The alternative specification of the new plant opening equation, formulation (2) in Table 9.4, produces OLS results that confirm those of the first model where the same regressors were used. It does, however, add some new evidence on three variables. Specialised local industrial structures support arguments that increased specialisation may give rise to new plant openings through localisation advantages of sectors where localities specialise. This result, seen in conjunction with that for vertical integration, leads to the conclusion that the positive effect of local specialisation is greater the higher are the production dependencies sustained within the spatial-units concerned. The second additional empirical suggestion offered by formulation (2) is that the mix of skill in the manufacturing labour force is more beneficial to the establishment of new plants locally the higher is the rate of skilled to unskilled labour. This suggests that regional policies should take full consideration of the suitability of local labour markets when trying to induce new firm formation or when relocation programmes are concerned. Training schemes would be beneficial in attracting plants from elsewhere or in stimulating indigenous firm creation. Finally, wealth in terms of bank savings per capita presents a positive influence on the dependent variable in accordance with expectations.

Dealing with panel data provides the chance to account for bias arising from the omission of region-specific time-invariant factors. This would help to remove a potentially serious source of spatial heterogeneity. When this was attempted in model formulation (1) the collective significance of introduced regional-fixed effects was rejected. This was on the basis of an F-test at the 5% level of statistical significance (1.73 for 9 and 104 degrees of freedom) between the restricted (without fixed-effects) and the unrestricted model (fixed-effects) based on log-linear specifications. When the same test was applied to the second formulation, the hypothesis that, collectively, regional fixed-effects are insignificant was again rejected (F-test value of 1.18 with 9 and 104 degrees of freedom). The insignificance of the fixed-effects for both formulations might be related to the nature or operational definition of some of the explanatory variables deployed. In particular, both the variables SPEC and SMFP were constructed using data from the 1978, 1984 and 1988 NSSG manufacturing censuses. Since the study period in fact spans from 1980 to 1991 these variables were allowed to take on only three different values each during the study period. Prior to 1984 the study periods took on the 1978 values, the years from 1984 to 1987 were given the 1984 values, and those from 1988 onwards had the 1988 values. Data on employment and stock of plants by region, as explained earlier, are available annually only for plants employing more than 20 employees. As before using these data would seriously bias the estimates for both SPC and SMFP due to spatial inequalities in size distribution of plants. The use of census data was justified here since the time-intervals for which the values are kept the same are not large. A variance decomposition exercise similar to that presented in Table 9.3 was undertaken to examine the main sources of variation for these variables. As expected, the main source of action in both the variables stems out from inter-regional rather than inter-temporal differences. It is, however, the degree of their time invariability that probably renders the regional-fixed effects collectively insignificant.

Not coincidentally, the formulations estimated account for only a modest fraction of the variation of the dependent variable. The reason might be that whereas the 'action' in the dependent variable is merely attributed to 'chance' variation, the explanatory variables, as described above, have often been characterised by significant over-time stability of inter-regional differences in their levels. Geroski (1995) invokes a similar reasoning to account for the low explanatory power of models that seek to explain inter-industry variation in manufacturing firms entry rates.

9.5. Summary and conclusions

The aim of this research has been to undertake a first attempt to identify potential determinants of detailed spatial variations in new manufacturing plant openings in Greece.

The analysis revealed that new plant opening rates in Greece for the study period are mostly characterised by unsystematic variation, whereas the most important source of systematic variation is that due to region-specific time-invariant factors. This suggests that there should be a proportion of inter-regional differences in new plant opening structures that is quite stable in the short run.

Variables that have been justified in a growing literature of spatial accounts of new firm formation as important determinants have been deployed in this research. The majority qualifies as statistically significant determinants of new plant openings at some conventional level of significance and fulfils prior expectations for the direction of their effect. This seems to hold across different equation formulations used to circumvent the problem of multicollinearity and under different assumptions of the error processes.

In summing up the empirical findings of this study some stand out as particularly important.

a) The degree of regional specialisation in manufacturing appears to be a significant influence. This promotes the development of qualities and skills in the locality and gives the chance for industries to explore localisation economies probably through the circulation of information, reducing uncertainty and enhancing local production links, possibly promoting co-operation.

b) Indeed local production links seem to be a key point as indicated by the negative effect of the extent of vertical integration of local manufacturing. It has been argued that some proxy of the extent of local production links should be included to better qualify inference on the effect of specialisation on new plant openings. The implication should be that production linkages are essential to both new firm emergence and for sustaining small firm survival and growth, and hence should be born in mind by those planning and implementing regional policies.

c) Strong small firm presence in the locality generates higher plant opening rates, thus confirming findings of other studies. This most celebrated feature of the determinants of spatial variations in new firm formation has in turn extensive implications for the degree of exploitation of economies attained through local production networks, alternative small firm strategies implemented, and the importance of entry barriers prevailing for local manufacturing. Policies should reinforce local production networks and they should take account of the possibility of small firms tending to populate low-entry-barrier-sectors when efforts are being made to diversify local industrial structures.

d) The supply of skilled labour locally can attract and can also generate new firm formation. Training schemes can and should be evaluated on these grounds.

e) The effect of public infrastructure spending has been overlooked in the literature, however, it can be important in stimulating new plant openings. This has been demonstrated here to be especially relevant in developing countries where inter-regional differentials in levels of infrastructure can be substantial. The effort in alleviating regional disparities in infrastructure provision could be also justifiable in its effect on making locations more attractive for business.

f) Increasing local demand and accumulated wealth are positive influences on new firm formation as per expectation.

g) Productivity differentials across space additionally tend to maintain differentials in new firm formation.

Although the explanatory variables utilised in the analysis only resemble but a fraction of those that have been included in related studies at the national scale, it hoped that they help to draw a first picture on what might be determining new manufacturing plant openings across Greek geographical departments. It is further hoped that future research might benefit from disclosure of data that would make possible the study of new plant openings in more sectoral detail and at a somewhat finer level of spatial aggregation.

Chapter 10. Conclusions

10.1. Introduction

The research undertaken within this thesis presents an attempt to build upon the earlier work of Anagnostaki and Louri (1995a,b) and Louri and Anagnostaki (1995), an initial experience of research on firm entry and exit within the Greek manufacturing context. This task has been to a great extent helped by the surge of studies in various countries that took place in the early 1990s. These studies have often offered navigational support in finding a way around in this field of research, but more importantly have offered stimulation as they have raised empirical questions that have, by large, remained untouched in the Greek context. Even when these questions were to some extent tackled there has been literally no other study to compare results with so as to initiate a process for establishing empirical regularities on firm entry and exit in Greece.

In this research there has been plenty of scope as evidence for Greek manufacturing was limited, but there has also been many 'entry-barriers' obstructing entry to this research field in this country context. These barriers to research relate mainly to data unavailability and to inadequate data quality making this kind of research particularly troublesome. Despite the fact that the NSSG conduct an annual industrial survey based on a detailed questionnaire not all the results collected are published. In addition this agency does not provide access to their records identifying new and exiting firms that modify the surveyed population of firms every year. Furthermore, when access to unpublished data is allowed, this has to comply with confidentiality rules that carry implications for the level of industrial disaggregation that can effectively be used. The data themselves are rarely available in any electronic form so their collection and entry raises in turn both a capital and a labour intensity 'barrier' to research. These facts probably help to explain the paucity of Greek evidence in this field.

However, there have also been considerable incentives to the research, beyond those determined by the paucity of Greek evidence. These incentives refer to the main 'research-niches' visited by the present research, especially in the first part of thesis, which have been under-exploited by entries in the relevant publication record. By the time the early drafts relating to chapters of this thesis were in preparation, published research on the effect of wider economic conditions on entry, the determinants of firm entry by size, and the simultaneity issue on the interaction between entry and exit, was made up of only a handful of papers on each theme.

Even now, research concentrating on these particular issues does not appear to have proliferated a great deal in the very most recent years while at the same time what research has been undertaken rarely concentrates on economies other than the most advanced.

The wider research experience of this field has been reviewed and has also much benefited from the clarity in classifying the emerging empirical facts by Geroski (1995). This, indeed, has been a reference that has turned up number of times in the present research, as it offers a comprehensive stylisation of what the empirical researcher has come to know about entry and exit of firms. It also offers some most useful insights in identifying some unresolved 'mysteries' surrounding entry and exit, and in turn, industry evolution and dynamics. For this reason, this chapter proceeds in a manner that allows Geroski's stylisation to provide a benchmark for the findings of the present research.

10.2. Summary of the major findings of the research

To a large extent this thesis has been written in the form of self-contained, empirical chapters each representing an attempt to tackle a distinct empirical question relating to the processes of firm entry and exit at both the industry and regional level. This seeks to offer a more integrated view on the possible determinants of the processes of interest, drawing from, and at the same time, attempting to augment empirical evidence, relating to two different, but undoubtedly interrelated research literatures – namely industrial and regional economics.

The first empirical question put forward in Chapter 3 regards the effect of wider-economic conditions in determining net entry patterns across Greek manufacturing industries and over the 1981-1991 period. Equally important was the need to explore possible determinants of net entry rates amongst variables defined at the industry-level and over time, as there was an absolute lack of Greek evidence in this respect. The need to consider aspects of entry and exit for establishments smaller than those usually covered by the Federation of Greek Industries records necessitated the use of net as opposed to more conceptually secure gross entry and exit measures. Net entry has been in the main abandoned in the second wave of research on firm entry and exit in the late eighties and early nineties as availability of data made possible the use of gross entry and exit characteristics. Nevertheless, net entry which represents the combined result of both entry and exit processes has been often claimed to be an interesting variable to study in its own right. Indeed, it has been extensively used when the effect of entry and exit movements on industry profit margins has arisen as the main research question in a number of studies. Nevertheless, net entry has often been associated with 'counterintuitive' results as demonstrated in various sections of the review of empirical evidence in Chapter 2. The present research has adopted the view that net entry is, indeed, a variable worth studying for its own sake. It most certainly does not need to be interpreted as gross entry, as often has been the case. This has been a common practice in studies even allowing for non-positive values of net entry as well as in those restricting attention to cases where net entry is positive. However, positive net entry values include also information about exit and thus what has been interpreted solely in terms of entry might not reflect the real extent of the entry process across industries. Thus, some effort has been undertaken to demonstrate, with the help of some arguably over abstract diagrams, that different assumptions about the mechanism behind entry and exit of firms lead to seemingly identical results when net entry is used. This consideration has been therefore used as a lens for viewing the results associated with empirical exercises which have tried to offer some insights on what actually determines net entry rates across industries over time.

10.2.1. Net entry, gross entry and exit patterns in Greek manufacturing industries

In Chapter 3 for the first time it was revealed that the variation of net entry rates into Greek manufacturing industries is dominated by 'within' rather than 'between' industry variation. That is, during the study period, year by year movements of net entry rates in each sector are not consistent enough so as to characterise sectors having above or below average net entry performance over the period. This statistical occurrence of unconditional between-industry homogeneity of net entry rates consistently re-emerged when net entry rates were analysed separately for consumer, intermediate and capital goods industries (Chapter 4), but also when net entry rates by size class of establishments were analysed in Chapter 5. In particular, the variance decomposition exercise undertaken in this chapter revealed that total variation was dominated by chance or unsystematic variation in all size classes. Of the systematic sources of variation, i.e., those that can be attributed to between-industry and between-year variation, the latter was always larger than the former and statistically significant in the two smallest and the largest employment brackets considered. Therefore with no loss of generality it can be asserted that during the study period:

- *Net entry rates into Greek manufacturing industries fluctuate a great deal in time, and this can be attributed mainly to underlying entry and exit movements in size classes pertaining to smaller firms.*

In Chapter 6 the use of gross entry and exit data made it possible to construct entry and exit rates, along with net entry rates, measures of industry turbulence and volatility, and to examine some of their statistical properties. The average entry rate was around 6 percent whereas the exit rate was around 5 percent, leaving an average net entry rate of just 1 percent, over industries and time. These averages, the close correspondence between entry and exit, and the small magnitude of net entry comply with those findings reported by Cable and Schwalbach (1991) in their international comparison of entry and exit patterns across eight countries.

Geroski (1995, p. 423) provides the following stylised fact about the research experience relating to entry patterns: *"Although there is a very large-cross section variation in entry, differences in entry between industries do not persist for very long. In fact, most of total variation in entry across industries and over time is 'within' industry variation rather than 'between' industry variation."* Does this statement accurately describe entry patterns in Greek manufacturing industries? Before sketching an answer to this question, two qualifications are needed. The first relates to the time span the evidence draws upon and the second relates to the size of entrants that the entry statistics are referring to. The first qualification is important because the evidence used to develop this stylised fact draws from a seven years period (1982-1988) which might not be long enough to evaluate the persistence of entry patterns over time. The second is that the FGI data used in Chapter 6 refer to somewhat larger firms and it was argued earlier that considerable temporal fluctuations in net entry rates should be attributed to entry and exit movements at the industry fringe. Having these qualifications in mind, the evidence presented in Chapter 6 suggests that between-industry variation is the largest source of systematic variation for both entry (44%) and exit rates (31%), whereas the time-driven variation is just 11 and 4 percent respectively. Having said that, it becomes self-evident that for both variables of interest a considerably larger amount of variation cannot be attributed to marked differences between industry and annual averages. The chance variation amounts to around 44 percent of total variance in entry rates and to an impressive 64 percent for exit rates. In contrast, net entry rates, even when defined using FGI data, institutes the only variable that presents significant time-driven variation. What seems to have greatly affected Geroski's generalisation is that, if the same rationale as in Geroski (1991a, p. 18) has been used, it was based on a one-way analysis classification. This practice essentially renders any other than between-industry variation as within industry (time) variation, without discounting the latter by the amount of unsystematic variation in the data. The analysis of Greek entry and exit patterns might be better summarised as:

- *The main source of systematic variation of entry and exit rates is between-industry variation, time driven variation is, with the exception of net entry rates, of less importance, and 'chance' variation is considerably large.*

Following the stylised fact regarding the variance properties of entry rates mentioned above, Geroski (1995, p. 430, stylised result 3) maintains that: *"Entry rates are hard to explain using conventional measures of profitability and entry barriers."* The rationale used to support this argument draws on reviews of empirical studies but it is mainly associated with the notion that entry rates fluctuate much more in time than the structural variables and industry profitability proxies deployed to explain the variation in net entry. Both structural variables and profitability proxies are arguably quite stable in time, whereas they present marked differences across industries. This rationale could be modified and extended to say that this is particularly noticeable when the analysis seeks to explain variation of net entry rates. Throughout the thesis is was demonstrated analytically that net entry rates are not only those exhibiting the largest amount of temporal variation of the variables considered, but that it is equally true that sectoral variation was absent and that the single largest amount of their variation was chance or unsystematic variation. This has manifested itself in the noticeably low explanatory power of the models aimed to explain net entry rates in the thesis. The experience gained from these empirical exercises can be encapsulated, paraphrasing Geroski, as:

- *Net entry rates are hard to explain using conventional measures of profitability and entry barriers.*

As far as entry and exit *per se* are concerned, the research practice followed in Chapter 6 was to use entry and exit in absolute rather than relative terms, including a proxy for industry size amongst the explanatory variables. This, along with the semi-logarithmic form, follows suggestions by Khemani and Shapiro (1986) who object to the use of entry (exit) rates and argue that using the stock of firms to account for differences in industry size may result in entry and exit rates being relatively stable across industries. Indeed, using absolute values proved to be helpful in that the between-industry variation accounts for 80% and 75% of the total variation of entry and exit respectively. This is substantially higher than that for the corresponding variation of entry and exit rates. The explanatory power of the models estimated was also high, accounting for 71% and 55% of the entry and exit variation respectively. The suggestions of Khemani and Shapiro, then, are particularly helpful in overcoming the problem pointed out by Geroski; at least, this is what the research experience from Greek manufacturing industries suggests.

It is interesting, however, to note that whereas net entry rates, providing information for the extent of gains or loses in manufacturing units across industries, fluctuate considerably in time, the opposite seems to be the case for turbulence (firm turnover) rates. Turbulence rates provide useful information about the degree of 'trial and error' activity in markets. In other words, instead of a simple focus just on the survivors of the entry and exit process, turbulence provides some indication about the number of participants in these processes. Turbulence rates in Greek manufacturing industries are characterised by higher between-industry variation (51%) than even entry and exit rates, whereas temporal variation is a negligible fraction (1%) of total variation. This seems to suggest that there are marked differences between sectors in the sum, but not in the difference, of entry and exit experienced. The implication that immediately follows is that higher entry and exit rates, but not higher net entry rates, might be associated with lower sunk costs (Dunne and Roberts, 1991). If the higher amount of temporal variation in net entry rates is to be attributed to changes in market size, then industry volatility is the amount of industry turbulence in excess of industry growth and contraction. Volatility rates for Greek manufacturing industries calculated over the 1982-1988 period present considerable sectoral variation (40% of total), whereas as for the industry turbulence the amount of temporal variation is minimal (1%). This seems to substantiate the conjecture that:

- *There is a considerable amount of industry turbulence in excess of market changes, which might be attributed to hard-to-quantify inter-industry differences in sunk costs and technology.*

As far as there is considerable between-industry variation in both turbulence and volatility rates in Greek manufacturing industries, this would suggest that there is some consistency over time in the sectors experiencing persistently more (less) entry and exit. This, in turn, would imply that entry and exit might be positively correlated (Caves and Porter, 1976). Geroski (1995, p. 423, stylised fact 3) provides the following empirical generalisation: *"Entry and exit rates are highly positively correlated, and net entry rates and penetration are modest fractions of gross entry rates and penetration."* This empirical regularity has, as discussed in sections 2.2.4 and 6.2, some implications for a possibly positive relationship between industry profitability and firm exit but also for the idea that entrants displace some incumbents. The correlation coefficient between entry and exit in absolute terms reported here is 0.71, and 0.12 between entry and exit rates, and industry profits were found to have a significant positive effect on both entry and exit. These findings made the interdependence between entry and exit the focal point of the research undertaken in Chapter 6. When entry and exit are estimated within a simultaneous equation framework, the empirical evidence does not offer sufficient grounds to support the notion that entry and exit are simultaneously linked. Instead, it seems that these are two contemporaneously related processes, which respond in like fashion to the structural characteristics found in particular industries. Their linked response is also extended to factors unaccounted for by the individual entry and exit formulations, and this expresses itself in significant contemporaneous correlation between the entry and exit equation residuals. The change in the identities of firms operating, implied by the positive correlation between entry and exit, may then be attributed to 'natural churning' rather than to an explicit feedback mechanism running from entry to exit and vice versa. This evidence from Greek manufacturing industries may be summarised as follows:

- *Industries that exhibit high entry also exhibit high exit, the implied change in identities of operating firms can be appropriately attributed to 'natural churning', as to as whether or not entry and exit are simultaneous this remains unclear.*

10.2.2. The effect of business conditions

As temporal variation has been demonstrated to be the sole important source of systematic variation in net entry rates in Greek manufacturing industries, the effect of wider-economic conditions on net entry rates was considered in the research undertaken through out chapters three to five.

The major empirical finding of Chapter 3 shows that sluggish macroeconomic-conditions in Greece are found to be positively associated with higher net entry rates. This seems to offer some support to what Highfield and Smiley (1987) have termed an 'opportunistic scenario' or as several researchers in the field of economic geography have preferred to call it a 'recession-push' hypothesis. Lower growth rates in real GDP, lower manufacturing employment, and higher cost of capital have been associated with higher net entry rates. Logically it is possible to associate this relationship with increased firm turnover at the lower end of the firm size distribution as prospects of unemployment increase the pool of entrepreneurs pushed to establish their own firms. In addition, this could find a part of its explanation in an increasing number of firm closures due to lower demand generating an increased supply of second hand machinery, thus moderating an important entry barrier. Furthermore, reductions in labour unit costs that followed the introduction of the austerity program in 1985 have resulted in a reversal of downward trends in manufacturing profits that characterised the pre-1985 period. This, in turn, might have created better prospects for potential entrants. The empirical findings in Chapter 4, where the manufacturing industries have been grouped to clusters of consumer, intermediate and capital goods producers, offer reassuring evidence that the relationship between wider economic conditions first identified in Chapter 3 also holds for these three industry groups. In Chapter 9 dealing with some industry-independent statistics on new plant opening rates across Greek regions over time also helps to shape a similar view. If, however, higher overall net entry rates during economic downturns reflect a great deal of movement in the small firm sector, then this would pose further empirical questions. These relate to whether or not small firms' response to such conditions is superior (in the sense of survival) to that of their larger counterparts and/or whether higher net entry rates should be, to some extent, attributed to larger firm fragmentation strategies as a response to decreasing demand prospects.

The research undertaken in Chapter 5 is primarily a test of the hypothesis that the determinants of net entry are not independent of firm size. This has been particularly helpful in clarifying the underlying relationships in this respect. In particular, net entry rates of all size classes, apart from firms employing more than a hundred persons, exhibit a remarkable counter-cyclical pattern. This suggests that small firms tend to perform better during economic downturns. This has been especially true for the smallest size class considered by the analysis (10-19 employees). However, the second highest counter-cyclical response of net entry rates has been recorded in the second largest size class (50-99 employees), which contrasts remarkably with the marked pro-cyclical movement of net entry for larger firms, leaving implications for the possibility of intra-industry inter-size class mobility. Using net entry rates makes it difficult to disentangle within-industry movements from those originating or terminating outside an industry. Some econometric testing makes it possible to evaluate the hypothesis of inter-size class residual correlations of net entry rates within the same sector over time. The results of these tests demonstrate that correlations are in fact statistically significant signifying that there are omitted factors that affect net entry rates across size classes in a related manner. This, taken together with the significant correlations of net entry rates of different size classes *per se,* justifies the conclusion that inter-size class mobility within sectors is a legitimate factor in explaining part of the surge of new firms in smaller size classes during recession years. However, the extent of increasing net entry rates of firms in smaller size classes appears to be substantially higher than that which could be generated by a kind of 'trickle-down' effect initiated by decreases in the largest size class during economic downturns. The research experience relating to the effect of wider-economic conditions on net entry rates in Greek manufacturing industries can be summarised as follows:

- *There is some evidence for counter-cyclical patterns in net entry rates especially in the post-1985 period. However, this generalisation does not hold for larger firms where net entry rates tend to move pro-cyclically.*

10.2.3. Barriers to entry (exit), mobility barriers and the symmetry hypothesis

Along with the empirical question regarding the effect of wider economic conditions on firm entry and exit the need to explore the effect of barriers to entry in explaining entry and exit patterns of firms into Greek manufacturing industries has arisen. This empirical investigation has been undertaken at four analytical levels corresponding to the number of the empirical chapters in the first part of the thesis. They draw on two distinct data sets. The first, which excludes some information on smaller production units, is provided by the NSSG but allows only for net entry definitions, and the second relates to somewhat larger firms provided by the FGI which allows both gross entry and exit of firms to be discerned.

Thus, the research aim in Chapter 3 seeks to examine the effect of various barrier to entry variable proxies in determining net entry patterns for the whole of the 2-digit industries in the Greek manufacturing. The research then goes a step further in Chapter 4 in examining patterns of net entry rates in manufacturing industries, the latter being classified into three groups. This has been mainly driven by findings of previous research in US manufacturing industries where the determinants of profitability have been found to differ among industrial groupings. However, an equally interesting motive of some particular interest for the Greek case has been that of the absence of significant between-industry variation in net entry rates when all industrial sectors were considered. This, combined with the fact that the amount of variance accounted for by the econometric formulations is rather low, although not unusually so, implies that there are factors unaccounted for by these formulations that could potentially generate a higher explanatory capability. More important, these unaccounted for factors may be inter-linked across sectors that share similar structural characteristics, leading to the formulation of a twofold hypothesis that asserts that the determinants of net entry rates differ between industry groups but they are correlated across sectors within these groups. The empirical analysis indicates that these hypotheses can be sustained.

- *There are significant differences in the determinants of net entry rates across industry groups, but strong within-group correlation across sectors.*

The meaning of entry barriers in Chapter 5 changes somewhat. The main empirical hypothesis has been that the determinants of net entry are not independent of the establishments' size. However, it is difficult to distinguish between movements of firms in and out of an industry, from those from one size class to another within an industry when using net entry rates. Barriers to entry have also served as barriers to mobility within an industry. The underlying assumption has been that size is itself an important trait to distinguish segments within an industry. Overall, the results obtained in this chapter indicate that:

- *The determinants of net entry rates are not independent of establishment size.*

There is a trajectory in the responses of different size classes to stimuli defined at the industry level and some limited evidence demonstrates that small firms are different in that they manage to overcome entry barriers, perhaps adopting different survival strategies. Large firms appear to be aware of market conditions and are in an advantageous position to overcome many of the problems imposed by entry barriers. Size classes in the middle of the size class distribution offer a rather mixed result due to size-related advantages and disadvantages.

The role of entry-barrier proxies deployed in Chapter 6 has been considerably freed from those conceptual difficulties associated with the use of net entry based measures in earlier chapters, as gross entry and exit data were utilised (at the expense of being able to consider larger firms). The hypothesis to be tackled explicitly in this chapter was that of symmetry, which is the extent to which entry-barrier variables also present considerable barriers to exit. The empirical outcome of testing this hypothesis support the view that:

- *There is a sound symmetry in the determinants of both entry and exit.*

The remainder of this section reviews the empirical findings about entry-barrier proxies as they emerged from this four-level analysis and which finally help to justify the conclusion highlighted above. Each determinant will be considered in turn.

- *Economies of scale*: Some considerable experimentation in the definition of the economies of scale proxy was undertaken in chapters 4 to 6. Economies of scale has been a difficult notion to quantify due to data imperfections. A number of alternatives that have been used previously in the literature have been, to some extent, revised in Chapter 4. The effect of the economies of scale proxy used in Chapter 3 was found to be a positive and significant determinant of net entry rates into Greek manufacturing industries over the study period. The explanation provided was that this positive sign may be attributed to a situation where economies of scale present a barrier to both entry and exit, but that they mean more when accounting for exit. This empirical finding along with this provisional interpretation re-emerged in Chapter 4, using an alternative definition of the corresponding proxy, this time for capital goods industries. However, there was a reversal of sign in both the consumer and intermediate goods sectors where economies of scale was found to exert a significant negative influence on net entry rates. A provisional interpretation favouring the symmetrical behaviour of this proxy was also given, but this time, economies of scale were thought to present a higher entry than exit barrier. Using gross entry and exit in Chapter 6 helps to clarify the fact that economies of scale in the Greek manufacturing industries are indeed symmetrical in that they deter both entry and exit. This implies that there should be considerable differences across sectors in technology and also other underlying factors that give way to sunk costs. In Chapter 5 no direct economies of scale proxy was used. Instead, an index of relative efficiency for each size class, when compared to all others, was utilised. This was found to be negative and moderately significant for the small firms size class and positive but statistically insignificant for all other classes. For the smallest of the firms considered this seems to imply that although relatively better efficiency terms might have been a positive signal to small entrants few of them can be eventually accommodated and survive in more turbulent industry segments.

- *Product differentiation*: The surrogate of product differentiation efforts (ARDT) used throughout has been found to be negatively associated with net entry rates (Chapter

3) offering grounds for the provisional support of the symmetry hypothesis. Moreover, it was found to be particularly significant, as expected, when net entry in the consumer and intermediate goods sectors was considered but not for capital goods industries (Chapter 4). When net entry by size class is considered ARDT was found not to be significant, although negative, in determining patterns relating to small firms (Chapter 5). It becomes, however, of some qualified statistical importance for medium sized firms (30-49 employees) aiming to serve broader markets than the market niches served by smaller firms. Testing the symmetry hypothesis in Chapter 6 renders ARDT a significant barrier to both entry and exit justifying earlier provisional interpretations when dealing with net entry rates.

- *Capital intensity:* Data imperfections have been particularly acute when it comes to defining this variable in a Greek context, as the NSSG does not provide any data on capital stocks. Thus, the present research has had to rely on some notions that relate to the degree of mechanisation to indirectly proxy the variable of interest, or to rely at a later stage (Chapter 6) on estimates of capital stocks provided by earlier research on Greek manufacturing. Capital intensity proxies were found to, only modestly, affect net entry rates (Chapter 3), but they appear to have a significant negative effect where the consumer-industries goods are concerned (Chapter 4). Capital intensity appears to be unimportant in determining net entry patterns of smaller firms (Chapter 5), but it does inversely affect net entry rates of medium sized establishments (50-99 employees). Indeed, using an alternative capital intensity definition (capital-to-labour ratio) with gross entry and exit data for somewhat larger firms (Chapter 6), it was demonstrated that capital intensity is of some statistical significance in deterring both entry and exit.

10.2.4. Other determinants

Apart from results about the core barriers-to-entry proxies summarised above, and those concerning other traditional incentives to entry summarised in the section to follow, a number of other variables have been also deployed to account for variation of net entry rates, gross entry and exit. The first set of these variables classified here under the rubric 'other determinants' relates to the effect of industry trade conditions on net entry rates. Namely, the effect of import penetration (IMP) and export orientation (EXP) were considered in chapters 3 and 4. The major empirical findings relating to these trade-variables are as follows:

- *Import penetration:* The effect of this variable found to positively, but modestly, affect net entry rates when all 2-digit of Greek manufacturing industries were considered in Chapter 3. The positive sign that this variable holds reflects a situation where both the underlying entry and exit flows are negatively associated with higher import penetration, but entry is more elastic in its response. In the Greek context, this empirical outcome has emerged in an earlier study using gross entry and exit (Anagnostaki and Louri, 1995a). This infers that manufacturing firms in Greek industries are less discouraged to enter than they are forced to exit under international competition. Results derived in Chapter 4 suggest that this might be particularly true for net entry patterns in the consumer goods industries.

- *Export orientation:* The effect of this variable, representing an opportunity at the sectoral level to satisfy demand beyond given domestic limits, was found to be particularly weak, but negative, in affecting net entry patterns into Greek manufacturing industries (Chapter 3). However, this negative relationship turns out to be statistically significant when net entry rates in consumer goods industries are analysed. An explanation put forward in conjunction with the results by Anagnostaki and Louri (1995a) is that both entry and exit should be positively determined by higher export opportunities especially in the traditional sectors of Greek manufacturing (see Chapter 4). This is essentially because a large number of firms attracted by these opportunities failed to satisfy the requirements of successful entry and survival, therefore soon contributing to exit.

In Chapter 5 labour costs were considered amongst the explanatory variables used to account for net entry rates by size class following an assumption that smaller firms might be more efficient in finding cheaper ways of labour remuneration.

- *Labour costs:* Net entry rates of smaller firms (those employing less that 30 persons) have been positively affected by higher labour costs, and for those employing between 20 to 29 employees this effect is statistically significant. A reversal in the direction of the effect of labour costs on net entry rates takes place for the larger size classes considered and it becomes statistical significant for firms employing between 30 to 49 persons. These results may offer some qualified support for the view that smaller firms find alternative ways of lowering labour remuneration, or alternatively that larger firms may provide higher compensation for labour inputs utilised.

The extent of small firm presence into an industry (SMFP) was deployed in Chapter 6 to proxy the extent of fringe activity in an industry based on the presumption that entry and exit are largely driven by movements among a fringe of small firms. The empirical results obtained justify that SMFP has a significant direct effect on both entry and exit.

- *Entry and exit are both higher in industries with larger small firm structures.*

An industry size proxy was used in Chapter 5 to account for different sectoral size as the size-class specific net entry rates were defined over the number of firms in the same class on not in the industry. Industry size found to have a negative and significant effect on the net entry rates of all size classes included in the size brackets of 10 to 49 employees. This has been interpreted as reflecting a situation where both small firm entry and exit are positively related to larger industry size but exit is more elastic than entry in its response. The reliance on a symmetry hypothesis to explain this finding when using size-dependent definitions of net entry rates was vindicated when an alternative industry-size proxy was used as an explanatory variable to account for variations in gross entry and exit flows in Chapter 6. This helps to make the point that:

- *Entry and exit of firms, and especially of smaller ones, are both higher in larger industries.*

The combination of the empirical findings in this research relating to small firm presence and industry size helps to infer that:

- *Higher entry and exit flows, and hence higher industry turbulence, is experienced in larger industries, and when the fringe of smaller firms is large within these industries.*

10.2.5. Incentives to entry

As in the vast majority of studies reviewed in Chapter 2 and within the limits of the Orr-type of empirical entry formulation, industry profitability as indication of expected post entry profits was used in this research as a major incentive to entry. In addition, an industry growth proxy has been used to reflect the extent to which entry barriers are moderated in expanding industries, providing an additional incentive for entry. Major findings relating to these variables have been as follows:

- *Industry growth:* Industry growth, expressed in employment terms, has been found to have a direct effect on net entry rates, whereas its statistical significance was not independent of alternative formulations of the net entry equations estimated (Chapter 3). However, this direct effect turns out to be of particular statistical significance for net entry in the consumer goods industries (Chapter 4) and of some importance for only the smallest firms considered (10-19, employees) in Chapter 5. Interestingly, the effect of industry growth on net entry rates in the capital goods industries turned out to be negative and statistically significant. This case may reflect a situation where the prospects associated with industry growth might be better exploited by expansion of incumbent firms rather by an addition of new players in the markets. The results of gross entry and exit exercises undertaken in Chapter 6 reveal that whereas industry growth discounted by an industry minimum efficient plant size (ROOM) has a significant and positive effect on entry, employment growth seems to inversely affect, but insignificantly, firm exit.

- *Industry profitability:* Industry price cost margin (PCM) was found to be a negative and significant determinant of net entry rates (Chapter 3). The negativity of this variable has been uncovered in other studies (see Chapter 2) and it has been interpreted as reflecting a situation where both the underlying entry and exit flows have been positively associated with higher margins. Such an interpretation implies that the symmetry hypothesis could be extended to encompass also, in this case, industry profitability. Results presented in Chapter 4 confirmed the negative effect of PCM in all industry groups considered, but also highlighted a statistically significant effect in the consumer and intermediate goods sectors. The effect of PCM was also found to be negative in determining net entry rates of different size classes (Chapter 5), with the notable exception of the size bracket relating to firms employing 50 to 99 persons. Interestingly, the negative effect of PCM has also been found to be of some modest statistical significance in the smallest and largest size classes considered. Results obtained when using gross entry and exit data (Chapter 6) vindicate the symmetry in the behaviour of PCM, implied in earlier chapters.

10.2.6. Major findings of spatial analyses

The spatial analysis of entry was conducted at two levels. The first relates to net entry rates across industrial sectors and Greek administrative regions (NUTS II) and the second to aggregates of new manufacturing plant-openings recorded over geographical departments.

As far the results of the first analytical level are concerned, using a modified and extended version of a two way ANOVA-shift-share model the major finding echoes that of earlier studies on new firm formation in UK regions. This can be summarised as:

- *The main source of variations of net entry rates across regions stem from variation in net entry rates in same industry across regions.*

This is due primarily to the predominance of the shift-share competition effect in absolute values over the industry-mix effect. The second major finding relates to the identification of the main regional sources of net entry.

- *Central Macedonia and Crete are main hosts of new industrial activity.*

Greater Athens is the largest urban and industrial hub in Greece and is located in the Attiki region. It suffers a large negative competition effect, which clearly points to extensive agglomeration diseconomies in place. However, the actual reduction in manufacturing units in the 1984-1988 period is less than 1%, which signifies that the manufacturing decentralisation process has been slow. This result, combined with increases in manufacturing units in the region surrounding the second largest urban and manufacturing centre — Thessaloniki — and also spectacular increases in manufacturing activity in the island economy of Crete, together with declines in less urbanised continental regions, suggest that:

- *An urban-rural shift in manufacturing activity in Greece is not clear-cut, at least at this time.*

A spatial variant of the hypothesis that the determinants of net entry rates are not independent, first put forward in a non-spatial context in Chapter 5, was examined by means of a two way ANOVA-shift-share model in Chapter 8. The results of this analysis demonstrate that for larger firms, those employing more than 10 persons, the competition effect does not dominate the industry-mix component everywhere, as it was the case in both size-independent and small-establishment related results. Moreover, it appears to be significant in fewer cases than the industry-mix effect. This is helpful in suggesting that:

- *Net entry rates of larger firms are less affected by prevailing local conditions, than those of smaller firms.*

- *Industrial structure is more important to spatial variations in net entry of larger firms.*

These results, taken together with those suggestion that the geographical distribution of net gains and losses is, especially for large firms, dramatically different from that of size-independent results, help to sustain the hypothesis that:

- *The determinants of spatial variation of net entry rates are not independent of establishment size.*

As a methodological issue emerging form the analysis in Chapter 8, the one-way ANOVA shift-share model suggested by Berzeg (1978) might be refuted on the grounds that it uses only partial information. It ignores inter-regional differences in the net entry rates as a systematic source of variation, when deriving the industry-mix component to ensure its numerical equivalency with the one of the conventional method.

At the second level of spatial analysis, a number of variables were used to proxy notions that have been found in previous research in different country contexts (reviewed in Chapter 7) to play an important role in determining spatial variation in new firm formation rates.

The empirical findings in Chapter 9 highlight the importance of small-plant structures in enhancing new plant openings across regions, probably offering an appropriate environment for preparing potential new entrepreneurs but also as an indication of low entry barriers locally. This result accords those of other studies but also adds a spatial dimension to conclusions drawn from analysis conducted at the industry level in Chapter 6. The extent of regional specialisation in manufacturing industries was also found to have a positive effect on new plant opening rates. Here the underlying forces concern exploitation of localisation economies and supply of specialised human resources locally. The local supply of skilled labour proved to have a direct effect on new plant opening rates. On the other hand, a higher vertical integration of manufacturing units operating locally appeared to significantly hinder new plant openings as it diminishes the extent of local production links, suggesting a more qualified view of the role of regional specialisation. Specialisation might be more beneficial to new plant generation process locally as far as it is not attributed to large manufacturing units. Overall, it may be argued that the results obtained for these four variables seem to suggest a nexus that could be expressed by the following line of argument.

- *New plant opening rates tend to be higher in more specialised regions, and in regions with extensive local production links associated with higher small firm presence and enhancing the supply of skilled labour.*

A relatively novel potential determinant of variation in the variable of interest introduced in this research relates to the effect of public infrastructure. This was found to be a significant and positive determinant of new plant opening rates across Greek geographical departments and over time. This result, when combined with that obtained in Chapter 8 suggesting for the importance of the competition effect and consequently of local conditions, might be used to form a proposition asserting:

- *Public infrastructure provision has an important role to play in shaping local conditions that facilitate the locational decisions of new industrial activities.*

In the same vein as other studies reviewed in Chapter 7, a number of other variables were deployed to account for variations in plant opening rates and were found to have a statistically significant direct effect. Thus, the positive effect of population density suggests that a critical mass might be needed to stimulate the emergence of new firms. This, combined with the patterns of net entry rates discussed in Chapter 8 and the uneven distribution of population and hence of major markets across Greek space, helps to explain why an urban-rural shift is not clear cut in Greece. Increasing demand and accumulated wealth were also found to be a positive influence on new plant openings. The same is very much so for productivity differentials across space, which tend to maintain differentials in new firm formation, at least in the short run.

10.3. Limitations and implications relating to the research findings

There can be no doubt that a major limitation in conducting the research undertaken in this thesis has been the reliance on net entry rates. The problems associated with this have been manifold. First, net entry is neither entry nor exit but the combined effect of these two processes. Accounting for variation in this variable is difficult and some reliance on a provisional acceptance of the symmetry hypothesis is unavoidable. Second, variation of this variable has been known to be more time driven than in alternative measures often employed in the literature, but it has been quite idiosyncratic in the Greek case as between-industry variation was statistically absent. It immediately follows that it is difficult to match, on the one hand, the quite rigid structural variables with highly fluctuating in time net entry rates, on the other. Research aims to capture as much of the time variation as possible by the use of appropriate explanatory variables, and then to concentrate effort around the large component of variation that is due to chance, i.e. the error term. Structural variables are not excluded from playing a role in helping-explain some proportion of the unconditional-analysis error term when regression analysis is performed. However, this is not what they are designed to do and the prospects of success are unpromising. Third, using net entry rates by size class makes it difficult to disentangle entry and exit in an industry from movements within an industry. Here, the way out is again some reliance on the provisional acceptance of the symmetry hypothesis, on the *ad-hoc,* rather than properly tested, acceptance of the hypothesis that barriers to entry are also mobility barriers (Caves and Porter, 1977). However, the second practice cannot be unrelated to the realisation that the statistical occurrence of high entry rates in the presence of high entry barriers would become less puzzling if entry barriers are primarily thought of as barriers to mobility and eventually to survival (Geroski, 1995).

The implications arising from the difficulties relating to the use of net entry rates, but also their patterns as summarised in section 10.2.1, make hazardous any policy generalisations. The absence of sectoral variation in net entry rates means that it is difficult to reject or justify industrial policy measures designed to assist specific industrial sectors. In particular, a development law was introduced in 1982 (N1262/82) aimed to assist sectors 30-37 (SIC) — manufactures of rubber and plastics, chemical industries, petroleum and coal refining, non-metallic minerals, basic metal products, metal products, machinery and electrical appliances and electronics. The aim was to help the restructuring of Greek manufacturing sectors away from 'traditional' industries (see Chapter 4) by providing higher subsidies and direct investment grants to firms entering these sectors, thus lowering any capital-requirements related entry-barriers. The annual ranking of industrial sectors in respect of their net entry performance presented in Table 3.4 and the commentary in section 3.2 was particularly helpful in demonstrating that the position each sector occupies changes considerably from year to year. Thus, to say that assisted sectors do not perform consistently well in terms of net entry rates would not be enough to refute whatever sectoral policies have been promoted. The latter have aimed to stimulate new firm formation but they might have done very little to ensure survival. Net entry, it has been argued, gives some information about the 'survivors' of the entry and exit process, but has little if anything to say for the extent of entry and exit in the first place. Anagnostaki and Louri (1995b), using a dummy variable to distinguish assisted sectors from those not favoured by policy, and entry data as those used in Chapter 6, found that sectoral policy was effective promoting entry in terms of numbers of firms. However, as the same was not significant in determining the entrants' total assets share, it was inferred that the effect of policy in assisting restructuring must have been minimal. This conclusion seems to relate increases in the number of firms in assisted sectors with not analogous increases in average entrants' size. Combining the net entry rates statistics with the Anagnostaki and Louri (1995b) conjecture, it follows that higher turbulence, that is also higher exit rates, in the small firm sector of these industries could be responsible for the inconsistent evolution of their net entry patterns in time. Indeed, as a series of findings summarised in this chapter indicate, a considerable amount of turbulence takes place in Greek manufacturing industries and especially in the lower end of their size distribution. It could be then argued that higher turbulence in the small firm sector should call for caution in formulating sectoral policies. Small firms are more likely to be of collective rather than individual importance, and the very fact that the skewed size distribution of firms remains quite stable in time in most industries does not necessarily imply that the same firms are involved. The policy suggestion which follows is that, unless industrial policies find their own way in identifying 'winners' out of the selection process that entry and exit in industries implies, policies such as direct subsidies or grants to small firms or new firms might not be unproblematic. Instead, it would probably be more useful devising a general framework that could be collectively beneficial to small and new firms in aggregate.

It is indeed difficult to figure out exactly what such policies should be. However, some results from the spatial analyses could be used to generate some tentative proposals in this context. In Chapter 8 it was suggested that smaller firms are more dependent on local conditions than larger ones in that small firm net entry rates were more significantly affected by the competition effect in a shift-share based analytical context. In Chapter 9 higher spending on the public infrastructure provision was found to be beneficial to new manufacturing plant openings. Combining these two results makes it possible to argue that improved public infrastructure needs to be considered within a policy framework favouring the small firm sector in a broader context.

As for the counter-cyclical behaviour of net entry rates that has become apparent in the post 1985 period, this supports those who favoured the austerity programme introduced in that year by demonstrating that decreasing demand prospects have not deterred entry of firms in Greek manufacturing. It might also be argued that efforts to stabilise and reform the economy have created better longer-run prospects for some potential entrants which counterbalanced rather bleak demand prospects in the short-run. It remains, however, an important limitation that longer backward time series were not available to this research as the NSSG had problems with conducting the annual industrial surveys in two periods prior to 1980. As a consequence this research was deprived of including more phases of the economic cycle that would have made inference about the determinants of cyclical net entry rates patterns more robust. What could have been attempted, however, within the present research, was to examine the structural stability of model coefficients in the period before and after 1985. This might have been useful in more properly identifying the two probably distinct economic cycles in the Greek economy. Nevertheless, in doing so, the considerable contribution to increasing observed variation in net entry rates, due to the inclusion of the recessionary post-1985 years in a single study period, would have been missed.

Apart from cross-sectoral restructuring that was the objective of industrial policy in Greece during the 80's, the discussion in section 2.2.4 and also Chapter 6 has also indicated that the interaction between entry and exit in industries has considerable implications for within-industry restructuring and evolution. The analysis in Chapter 6 demonstrates that there should be considerable change in the identities of firms operating in an industry over time. It was also inferred that this is more likely to happen at the industry fringe rather than at some higher level of industry's firm size distribution. But the analysis failed to conclude whether entry and exit are part of feedback mechanism running from one to another. Failure to identify whether such a mechanism is present was partially attributed to the degree of symmetry in the determinants of entry and exit. This seems to make it difficult to infer that considerable restructuring actually occurs within industries in the short-run as this would require effective displacement taking place in industries, implying that there should be some stronger indication that entry and exit are co-determined than that provided by the analysis. It was then argued that the evidence provided tends to favour the 'revolving-door' metaphor where a great deal of today's exits relate to yesterdays' entries. This calls for further analysis to be carried out as the real impact of the interaction between entry and exit on industrial restructuring and evolution is something difficult to assess, unless some qualitative aspects of entry and exit are developed. This would require the utilisation of as much information at the micro-level (the firm) as possible. Treating all entrants and exiting firms as being equal in every aspect is bound to obscure relationships involved considerably. This has been discussed, and witnessed, in Chapter 5 where it was argued that research on the determinants of small firm entry has revealed more about what does not explain small firm entry patterns than what does. It follows that in order to assess the impact of entry and exit in industries, research should use information beyond entry and exit counts alone. This would require a different type of research and this needs to be discussed in the following section.

In a spatial context the results provided by the present research offer some tentative generalisations that carry some policy implications. Thus, apart from the role of public infrastructure, one research finding that needs some attention is the significance of the industry specialisation effect, attributed to extensive local production links in association with higher small firm participation, on new plant-openings (Chapter 9). This seems to suggest that production links altogether rather than individual firms should be the concern of policies aiming to reform regional industrial structures. In addition, as the local supply of skilled labour seems to affect the new firm generational capacity of regions, training schemes and the development of vocational educational institutions offering programmes that best reflect the needs of the local labour demand may be considered as particularly helpful.

The econometric evaluation of the effect of the regional dimension in the bundle of policy measures of the development law (N1262/82), mentioned earlier, was beyond the scope of this research as data availability constraints makes it difficult to accurately attempt to do so. An extensive discussion of the problems encountered in assessing the effectiveness of N1262/82 in both a spatial and sectoral context can be found in Georgiou (1991). It might be argued, however, that the positive and significant effect of the competition shift-share component (Chapter 8) on larger plant net entry rates in East Macedonia and Thrace are related to policy efforts to attract manufacturing to this borderland region. Of some policy relevance also, to some extent, are the results for other northern regions of Greece and to some lesser extent for Crete.

Overall, perhaps more policy relevant suggestions would emerge from an analytical framework that considered not only the determinants but also the effects of entry and exit processes in affecting markets and local economies. This has been beyond the scope of the present research. However, as was emphasised earlier in the thesis, knowing more about what determines entry and exit helps to better understand their effect, and the more known about their effects the more is needed to understand better the determinants. Thus, the research effort here has been to add some pieces to the puzzle concerning entry, exit, their effects and their determinants, working mainly from the determinants' side. Sometimes this approach offers some often apparently 'puzzling' results, but these too help the overall objective which was to stimulate further research in this field and country context.

10.4. Extensions and suggestions for further research

Some possible extensions of the present research directly follow directly from the discussion of its limitations outlined in the previous section. It has already been said that longer time series would be needed to draw more secure conclusions about the effect of wider economic conditions on net entry rates. This implies that the research undertaken in chapters 3 to 5 needs to be repeated and perhaps replicated in the future in order to include more information about economic cycles.

However, a crucial point concerns the lack of data on gross entry and exit by size. These data, if they were available, would be extremely useful in helping to repeat the empirical exercise in Chapter 5 for entry and exit separately. Above all, they would also be extremely useful in repeating the exercise undertaken in Chapter 6 concerning the possible interaction between entry and exit. This would facilitate the explicit testing of the hypothesis that the interaction between entry and exit might be a 'revolving-door' phenomenon at the lower end of an industry size distribution of firms where industries 'churn', but some real causality might be involved in the entry and exit interaction, towards the higher end of this distribution. Put differently, it would be helpful to establish whether or not the 'conical revolving door' metaphor put forward by Audretsch (1995b) and discussed in section 6.2 is a valid analytical hypothesis.

Despite this extension, which with appropriate data would have been dealt within the present research, the research avenue to understand more about entry and exit process perhaps should move more towards studies of post-entry performance and survival of new firms. This would be interesting in policy terms, as it would allow examination of the survival and growth prospects of firms in favoured industrial policy sectors. Such an empirical enquiry perhaps could be something of a policy-on policy-off exercise assessing the policy effect, but also comparing these results with post-entry performances of firms in less favoured industrial sectors.

Moreover, such a course of research would be also helpful in testing another important hypothesis. It has been argued that prospects of survival and growth of firms established by individuals who were 'pushed' into doing so by economic recession and diminishing employment alternatives might be lower when compared with those established by real profit seekers (Atkin *et al.* 1983; Binks and Jennings, 1986b; see also discussion in sections 2.5.3 and 7.2). In addition, some 'recession-push' theorisation was favoured to explain in part the net entry patterns for Greek manufacturing industries analysed in chapters 3 to 5. Thus, it would be extremely interesting to analyse post-entry performance of firms established in recessionary years with those established during an economy's upturns using microlevel data. The use of micro-level data in industrial analysis has been signalled as being most beneficial by several authors (Amato and Wilder, 1990; Cable and Schwalbach, 1991). In particular, Cable and Schwalbach (1991) who maintain that the use of such data can satisfy the need to reveal any systematic differences between entrants and incumbents. If, for example, potential entrants perceive themselves as different to the incumbent firms then what should attract entry is the firm-specific post-entry profit expectation. Indeed, firm-specific factors such as an 'I can do better' attitude could shape and generate some optimism of entering industries that on average might not be as profitable as others, or where market prospects might seem to be saturated enough by industry supply. But also the empirical finding in Chapter 6, substantiated in some other studies, that higher profit margins positively and statistically affect exit, challenges conventional wisdom that relates exit with unprofitable industries. It seems now that it is, most probably, firm unprofitability, and not industry unprofitability, that has the most immediate effect in determining firm exit. It follows that the analysis of entry and exit would most benefited from a combination of firm-level and industry-level data, probably with the further addition of a time-dimension. This would provide an opportunity to study patterns of less and more qualified entrepreneurs, of profitable and unprofitable firms, within profitable and less profitable industries. Alternatively, as Cable and Schwalbach (1991) suggest, one way to enrich the entry equation specifications is by introducing variables approximating any average tendency of entrants to differ from existing firms.

The analytical framework that has come into research fashion during the last ten years is that of panel data making it possible to analyse patterns of interest in two dimensions. Elevating the analysis into three dimensions, that is firm, industry and time would be technically troublesome, but it might be analytically worthwhile.

At the spatial level the future of analysing entry and exit of manufacturing firms in Greek regions is not particularly promising due primarily to data limitation problems. However, some suggestions, despite the discouraging levels of present data availability might be useful for others having access to better data sets perhaps in different contexts. As was found for both spatial patterns of net entry rates in Greece and new firm formation in the UK, spatial variation primarily stems from variation within-industry across-regions. As a consequence a helpful analytical dimension would be to examine the location-specific decisions and failure patterns of particular industries across regions. Additionally, it would be equally important to compare post-entry performance of firms in the same sector in different locations, matching firms in any other aspect apart from location (matched pairs analysis), or better by comparing the hazard of closure faced by firms belonging to same sector across regions. If this hazard were indeed spatially differentiated, the next step would be to examine why this is the case. In other words it would be interesting to analyse why the conditional probability of a firm to fail (exit) after having survived up to a certain time (proportional hazard) is different in various locations, given firm-specific, sector-specific, and host environment-specific traits.

Further research, especially in Greece, should also undertake to examine, apart from the determinants of entry and exit and post-entry performance patterns of new and small firms, also the effects of entry and exit on market structure and performance, and their effect on regional economies. Put differently, greater effort towards the research themes providing the focus for first sections of Chapter 2 and Chapter 7 concerning the effect of entry and exit on market structure and performance, on the diversification of regional industrial base, on economic well being and employment performance, is urgently required. Once again, data availability constraints and also some idiosyncratic patterns of Greek data themselves would to some extent obstruct a proper investigation of these research questions. For example, there is a considerable lack of data in Greece concerning innovation in general and innovation of small and new firms in particular. In addition, an exercise concerning the effect of entry and exit on industry profits would be severely obstructed by the fact that the appropriate variable to use in this context — net entry — is dominated by temporal variation, whereas inter-industry differentials in profit margins are quite stable in the short-run. However, more stable in time, net entry data provided on a larger-firm basis by FGI might well be useful for this empirical task.

It is then painfully apparent within the pages of this thesis that the availability of relevant data in Greece is not the most conducive to problem-free research. Furthermore, prospects for the future remain similarly bleak. However, some progress will be made if the FGI disclose entry and exit data by some size-related stratification, and when the NSSG and the corresponding Greek Inland Revenue office finally find a solution to unify economic activities coding. The latter that would make firm-level VAT records data available to the researchers. But these are opportunities, which might arise in the future. The philosophy of the research conducted in the present thesis was to make the best use of what was available. Always this has made for extreme difficulties in the analysis. On many occasions this has meant that conclusions have been less that clear cut. But it is hoped that each piece of analysis, which has been attempted, has made a small contribution to knowledge in this important and worthwhile field of research.

References

Acs, Z.J. and Audretsch, D.B., 1987. Innovation, Market Structure and Firm Size. *Review of Economics and Statistics,* 69 (4), 567-575.

Acs, Z.J. and Audretsch, D.B., 1989a. Small-Firm Entry in U.S. Manufacturing. *Economica,* 56 (2), 255-266.

Acs, Z.J. and Audretsch, D.B., 1989b. Births and Firm Size. *Southern Economic Journal,* 56 (2), 467-475.

Acs, Z.J. and Audretsch, D.B., 1990. *Innovation and Small Firms.* Cambridge, MA: MIT Press.

Acs, Z.J. and Audretsch, D.B., 1993. *Small Firm and Entrepreneurship: An East-West Perspective.* Cambridge: Cambridge University Press.

Acs, Z.J. Audretsch, D.B., 1988. Innovation in Large and Small Firms: An Empirical Analysis. *American Economic Review,* 78 (4), 678-690.

Acs, Z.J., Audretsch, D.B. and Carlsson, B., 1990. Flexibility, Plant Size and Industrial Restructuring. *In:* Acs, Z.J. and Audretsch, D.B., eds. *The Economics of Small Firms: A European Challenge.* Dordrecht: Kluwer Academic Publishers, 1990, 141-154.

Allen, G.C., 1970. *The Structure of Industry in Britain.* London: Longman.

Amato, L. and Wilder, R.P., 1990. Firm and Industry Effects in Industrial Organisation. *Southern Economic Journal,* 57, 93-105.

Anagnostaki, V. and Louri, H., 1995a. Entry and Exit from Greek Manufacturing Industry: A Test of the Symmetry Hypothesis. *International Review of Applied Economics,* 9 (1), 86-95.

Anagnostaki, V. and Louri, H., 1995b. Manufacturing Entry in Greece, 1982-1988: Did Sectoral Policy Work? *Journal of Economic Studies,* 22 (6), 60-68.

Arcelus, F., 1984. An Extension of Shift-Share Analysis. *Growth and Change,* 15, 3-8.

Arellano, M. and Bond, S., 1991. Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *Review of Economic Studies,* 58 (2), 277-297.

Armstrong, H. and Taylor, J., 1985. *Regional Economics and Policy.* London: Philip Allan.

Aschauer, D.A., 1989. Does public capital crowd out private capital? *Journal of Monetary Economics,* 24 (2), 171-188.

Ashcroft, B., Love, J.H. and Malloy, E., 1991. New Firm Formation in the British Counties with Spatial Reference to Scotland. *Regional Studies,* 25 (5), 395-409.

Atkin, T., Binks, M. and Vale, P., 1983. New Firms and Employment Creation. *SSRC Newsletter,* 49, 22-23.

Audretsch, D.B. and Acs, Z.J., 1990. The Entrepreneurial Regime, Learning, and Industry Turbulence. *Small Business Economics,* 2, 119-128.

Audretsch, D.B. and Acs, Z.J., 1991. Innovation as a Means of Entry: an Overview. *In:* Geroski, P.A. and Schwalbach, J., eds. *Entry and Market Contestability: An International Comparison.* Oxford UK and Cambridge USA: Blackwell, 1991, 222-243.

Audretsch, D.B. and Acs, Z.J., 1994. New-Firm Startups, Technology and Macroeconomic Fluctuations. *Small Business Economics,* 6 (6), 439-449.

Audretsch, D.B. and Fritsch, M., 1992. *Market Dynamics and Regional Development in the Federal Republic of Germany.* Berlin: Discussion Paper FS IV 92-96, Wissenschaftszentrum.

Audretsch, D.B. and Fritsch, M., 1993. *Births, Deaths and Turbulence and the Link with Economic Growth in the Federal Republic of Germany.* European Community: Final report to DG XXIII.

Audretsch, D.B. and Fritsch, M., 1994. The Geography of Firm Births in Germany. *Regional Studies,* 28 (4), 359-365.

Audretsch, D.B. and Mahmood, T., 1993. Entry, Growth and Survival: The New Learning on Firm Selection and Evolution. *Empirica,* 20 (1), 25-33.

Audretsch, D.B. and Vivarelli, M., 1995. New-Firm Formation in Italy: A First Report. *Economics Letters,* 48, 77-81.

Audretsch, D.B., 1991. New-Firm Survival and the Technological Regime. *Review of Economics and Statistics,* 73 (3), 441-450.

Audretsch, D.B., 1994. Business Survival and the Decision to Exit. *Journal of the Economics of Business,* 1 (1), 125-137.

Audretsch, D.B., 1995a. The Propensity of Exit and Innovation. *Review of Industrial Organization,* 10, 589-604.

Audretsch, D.B., 1995b. *Innovation and Industry Evolution.* Cambridge MA, London England: The MIT Press.

Austin, J.S. and Rosenbaum, D.I., 1991. The Determinants of Entry and Exit Rates into U.S. Manufacturing Industries. *Review of Industrial Organisation,* 5 (2), 211-221.

Aydalot, P., 1986. The Location of New Firm Creation: The French Case. *In:* Keeble, D. and Wever, E., eds. *New Firms and Regional Development in Europe.* London: Croom Helm, 1986, 105-123.

Baden-Fuller, C.W.F., 1989. Exit From Declining Industries and the Case of Steel Castings. *The Economic Journal,* 99 (4), 949-961.

Bain, J.S., 1956. *Barriers to New Competition.* Cambridge MA: Harvard University Press.

Bain, J.S., 1968. *Industrial Organisation.* 2nd. New York: John Wiley.

Bain, J.S., 1971. Barriers to Entry, Concentration and Profit Rates. *In:* Archibald G.C., ed. *The Theory of the Firm.* Harmondsworth, Middlesex, England: Penguin Modern Economics Readings, 1971, 157-190.

Baldwin, J. and Gorecki, P., 1986. *The Dynamics of Firm Turnover.* Ottawa: mimeo Economic Council of Canada.

Baldwin, J.R. and Gorecki, P.K., 1983. *Entry and Exit to the Canadian Manufacturing Sector 1970-1979.* Ottawa, Canada: Discussion Paper No.225, Economic Council of Canada.

Baldwin, J.R. and Gorecki, P.K., 1991. Entry, Exit, and Productivity Growth. *In:* Geroski, P.A. and Schwalbach, J., eds. *Entry and Market Contestability.* Oxford UK and Cambridge USA: Blackwell, 1991, 244-256.

Baltagi, B.H., 1986. Pooling Under Mis-specification: Some Monte Carlo Evidence on the Kmenta and the Error Components Techniques. *Econometric Theory,* 2, 429-440.

Baltagi, B.H., 1995. *Econometric Analysis of Panel Data.* New York: Wiley.

Bartik, T.J., 1989. Small Business Start-ups in the United States: Estimates of the Effects of Characteristics of States. *Southern Economic Journal,* 55, 1004-1018.

Baumol, W.J., 1982. Contestable Markets: An Uprising in the Theory of Industry Structure. *The American Economic Review,* 72 (1), 1-15.

Baumol, W.J., Panzar, J.C. and Willig, R.D., 1983. Contestable Markets: An Uprising in the Theory of Industry Structure: Reply. *The American Economic Review,* 73 (3), 491-496.

Beck, N. and Katz, J.N., 1995. What To Do (And Not To Do) with Time-Series Cross-section Data. *American Political Science Review,* 89 (3), 634-647.

Beesley, M., 1955. The Birth and Death of Industrial Establishments: the Experience of West Midlands Conurbation. *Journal of Industrial Economics,* 4, 45-61.

Beesley, M.E. and Hamilton, R.T., 1984. Small Firms' Seedbed Role and the Concept of Turbulence. *Journal of Industrial Economics,* 33 (2), 217-231.

Beesley, M.E. and Hamilton, R.T., 1986. Births and Deaths of Manufacturing Firms in the Scottish Regions. *Regional Studies,* 20 (4), 281-288.

Beesley, M.E. and Hamilton, R.T., 1994. Entry Propensity, the Supply of Entrants and the Spatial Distribution of Business Units. *Regional Studies,* 28 (3), 233-239.

Belsley, D.A., Kuh, E. and Welsch, R.E., 1980. *Regression Diagnostics: Identifying Influential Data and Sources of Collinearity.* New York: John Wiley & Sons.

Berzeg, K., 1978. The Empirical Content of Shift-Share Analysis. *Journal of Regional Science,* 18 (3), 463-469.

Berzeg, K., 1984. A Note on Statistical Approaches to Shift-Share Analysis. *Journal of Regional Science,* 24 (2), 277-285.

Bhargava, A., Franzini, L. and Narendranathan, W., 1982. Serial Correlation and Fixed Effects Model. *Review of Economic Studies,* 49 (4), 533-549.

Biggadike, E., 1976. *Entry, Strategy and Performance.* Boston: Division of Research, Graduate School of Business Administration, Harvard University.

Binks, M. and Jennings, A., 1986a. New Firms as a Source of Industrial Regeneration. *In:* Scott, M., Gibb, A., Lewis, J. and Faulkner, T., eds. *Small Firms Growth and Development.* Aldershot, England: Gower, 1986, 3-12.

Binks, M. and Jennings, A., 1986b. Small Firms as a Source of Economic Rejuvenation. *In:* Curran, J., Stanworth J. and Watkins D., eds. *The Survival of the Small Firm, Vol. 1.* Aldershot, England: Gower, 1986, 19-37.

Birch, D.L., 1981. Who Creates Jobs? *The Public Interest,* 65, 3-14.

Bishop, K.C. and Simpson, C.E., 1972. Components of Change Analysis: Problems of Alternative Approaches to Industrial Structure. *Regional Studies,* 6, 59-68.

Black, J., De Meza, D. and Jeffreys, D., 1996. House Prices, The Supply of Collateral and the Enterprise Economy. *Economic Journal,* 106, 60-75.

Blau, D.M., 1987. A Time Series Analysis of Self Employment in the United States. *Journal of Political Economy,* 95 (3), 445-467.

Box, G.E.P. and Cox, D.R., 1964. An Analysis of Transformations. *Journal of the Royal Statistical Society Series B,* 26, 211-243.

Bradburd, R. and Caves, R.E., 1982. A Closer Look at the Effect of Market Growth and Industries Profits. *Review of Economics and Statistics,* 64 (4), 635-645.

Breusch, T.S. and Pagan, A.R., 1980. The Lagrange Multiplier Test and its Applications to Model Specification in Econometrics. *Review of Economic Studies,* 47 (1), 239-253.

Brock, W.A. and Evans, D.S., 1989. *The Economics of Small Businesses: Their Role and Regulation in the U.S. Economy.* New York, London: Holmes and Meier.

Brown, A.J., 1972. *The Framework of Regional Economics in the UK.* London: Cambridge University Press.

Brown, C. and Medoff, J., 1989. The Employer Size Wage Effect. *Journal of Political Economy,* 97 (4), 1027-1059.

Brown, C., Hamilton, J. and Medoff, J., 1990. *Employers Large and Small.* Cambridge MA: Harvard University Press.

Brusco, S., 1982. The Emilian Model: Productive Decentralisation and Social Integration. *Cambridge Journal of Economics,* 6, 167-184.

Bryson, J.R., Keeble, D. and Wood P., 1997. The Creation and Growth of Small Business Service Firms in Post-industrial Britain. *Small Business Economics,* 9, 345-360.

Buck, T. and Atkins, M., 1983. Regional Policies in Retrospect: An Application of Analysis of Variance. *Regional Studies,* 17 (3), 181-189.

Buck, T.W. and Atkins, M.H., 1976. The Impact of British Regional Policies on Employment Growth. *Oxford Economic Papers,* 28 (1), 118-132.

Buck, T.W., 1970. Shift and Share Analysis-A Guide to Regional Policy? *Regional Studies,* 4, 445-450.

Burke, A.E., 1996. Economic Integration and New Firm Formation: Britain's Impact on Irish Enterprise. *Review of Industrial Organisation,* 11 (2), 183-200.

Buse, A., 1973. Goodness of Fit in Generalised Least Squares Estimation. *The American Statistician,* 27, 106-108.

Cable, J. and Schwalbach, J., 1991. International Comparisons of Entry and Exit. *In:* Geroski, P.A. and Schwalbach, J., eds. *Entry and Market Contestability.* Oxford UK and Cambridge USA: Blackwell, 1991, 257-281.

Cairns, R.D., 1994. Asymmetry of Information and Contestability Theory. *Review of Industrial Organization,* 9 (1), 99-107.

Carlsson, B., 1989. Flexibility and the Theory of the Firm. *International Journal of Industrial Organization,* 7, 179-203.

Carree, M. and Thurik, R., 1994. The Dynamics of Entry, Exit and Profitability: An Error Correction Approach for the Retail Industry. *Small Business Economics,* 6, 107-116.

Carree, M. and Thurik, R., 1996. Entry and Exit in Retailing: Incentives, Barriers, Displacement and Replacement. *Review of Industrial Organization,* 11 (2), 155-172.

Caves, R.E. and Porter, M.E., 1976. Barriers to Exit. *In:* Masson, R.T. and Qualls, P.D., eds. *Essays on Industrial Organisation in Honour of Joe S. Bain.* Cambridge, MA: Ballinger, 1976, 39-69.

Caves, R.E. and Porter, M.E., 1977. From Entry to Mobility Barriers: Conjectural Decisions and Contrived Deterrence to New Competition. *Quarterly Journal of Economics,* 91 (2), 241-261.

Caves, R.E. and Pugel, T.A., 1980. *Intra-industry Differences in Conduct and Performance: Viable Strategies in U.S. Manufacturing Industries.* New York: New York University Press.

Caves, R.E., Khalilzadeh-Shirazi, J. and Porter, M.E., 1975. Scale Economies in Statistical Analyses of Market Power. *The Review of Economics and Statistics,* 57 (2), 133-140.

Chappell, W.F., Kimenyi, M.S. and Mayer, W.J., 1990. A Poisson Probability Model of Entry and Market Structure with an Application to US Industries during 1972-1977. *Southern Economic Journal,* 56 (4), 918-927.

Clark, J.M., 1940. Towards a concept of workable competition. *American Economic Review,* 30, 241-256.

Clarke, R., 1986. *Industrial Economics.* Oxford UK & Cambridge USA: Blackwell.

Comanor, W.S. and Wilson, T.A., 1967. Advertising Market Structure and Performance. *The Review of Economics and Statistics,* 49 (4), 423-440.

Cooper, A.C., 1973. Technical Entrepreneurship: What Do We Know? *R. and D. Management,* 3 (2), 50-65.

Creedy, J. and Johnson, P.S., 1983. Firm Formation in Manufacturing Industry. *Applied Economics,* 15 (2), 177-185.

Cross, M., 1981. *New Firm Formation and Regional Development.* Farnborough, Hants: Gower.

Davidsson P., Lindmark, L. and Olofsson, C., 1994. New Firm Formation and Regional Development in Sweden. *Regional Studies,* 28 (4), 395-410.

Davidsson P., Lindmark, L. and Olofsson, C., 1995. Small Firms, Business Dynamics and Differential Development of Economic Well-being. *Small Business Economics,* 7, 301-315.

Davies, S. and Lyons, B., 1991. Introduction. *In:* Davies, S., Lyons, B., Dixon, H. and Geroski, P.A., eds. *Economics of Industrial Organisation.* London, New York: Longman, 1991, 1-25.

Davies, S., 1980. Minimum Efficient Size and Seller Concentration: An Empirical Problem. *Journal of Industrial Economics,* 28 (3), 287-301.

De Jong, M. and Lambooy, J., 1986. Urban Dynamics and New Firm: The Position of Amsterdam in the Northern Rimicity. *In:* Keeble, D. and Wever, E., eds. *New Firms and Regional Development in Europe.* London: Croom Helm, 1986, 203-223.

Del Monte, A. and De Luzenberger, R., 1989. The Effect of Regional Policy on New Firm Formation in Southern Italy. *Regional Studies,* 23 (3), 219-230.

Desmetz, H., 1982. Barriers to Entry. *American Economic Review,* 72, 47-57.

Diamond, D. and Spence N., 1989. *Infrastructure and Industrial Costs in British Industry.* London: HMSO.

Dokopoulou, E., 1986. Small Manufacturing Firms and Regional Development in Greece: Patterns and Changes. *In:* Keeble, D. and Wever, E., eds. *New Firms and Regional Development in Europe.* London: Croom Helm, 1986, 299-317.

Domowitz, I., Hubbard, R.G. and Petersen, B.C., 1986. Business Cycles and the Relationship between Concentration and Price-Cost Margins. *Rand Journal of Economics,* 17 (1), 1-17.

Domowitz, I., Hubbard, R.G. and Petersen, B.C., 1988. Market Structure and Cyclical Fluctuations in US Manufacturing. *Review of Economics and Statistics,* 70 (1), 55-66.

Dosi, G., 1988. Sources Procedures, and Microeconomic Effects of Innovation. *Journal of Economic Literature,* 26 (3), 1120-1171.

Droucopoulos, V. and Thomadakis, S., 1993. The Share of Small and Medium-Sized Enterprise in Greek Manufacturing. *Small Business Economics,* 5 (3), 187-196.

Duetsch, L.L., 1975. Structure, Performance, and the Net Rate of Entry into Manufacturing Industries. *Southern Economic Journal,* 41, 450-456.

Duetsch, L.L., 1984. Entry and the Extent of Multiplant Operations. *The Journal of Industrial Economics,* 32 (4), 477-487.

Dunne, T. and Roberts, M.J., 1991. Variation in Producer Turnover Across US Manufacturing Industries. *In:* Geroski, P.A. and Schwalbach, J., eds. *Entry and Market Contestability: An International Comparison.* Oxford UK and Cambridge USA: Blackwell, 1991, 187-203.

Dunne, T., Roberts, M.J. and Samuelson, L., 1988. Patterns of Firm Entry and Exit in U.S. Manufacturing Industries. *Rand Journal of Economics,* 19 (4), 495-515.

Eaton, B.C. and Lipsey, R.G., 1980. Exit Barriers are Entry Barriers: The Durability of Capital as a Barrier to Entry. *Bell Journal of Economics,* 11 (2), 721-729.

Eberts, R.W., 1991. Some Empirical Evidence of the Linkage between Public Infrastructure and Local Economic Development. *In:* H. W. Herzog and A. M. Schlottmann, eds. *Industry Location and Public Policy.* Knoxville: University of Tennessee Press, 1991, 83-96.

Esteban-Marquillas, J.M., 1972. A Reinterpretation of Shift-Share Analysis. *Regional and Urban economics,* 2 (3), 249-255.

Evans, D., 1987. The Relationship between Firm Growth, Size and Age: Estimates for the US Manufacturing Sector. *Journal of Industrial Economics,* 35, 567-582.

Evans, D.S. and Jovanovic, B., 1989. An estimated model of entrepreneurial choice under liquidity constraints. *Journal of Political Economy,* 97 (4), 808-827.

Evans, D.S. and Leighton, L.S., 1989. Some Empirical Aspects of Entrepreneurship. *The American Economic Review,* 79 (3), 519-535.

Evans, D.S. and Leighton, L.S., 1990. Small Business Formation by Unemployed and Employed Workers. *Small Business Economics,* 2 (4), 319-330.

Evans, L.B. and Siegfried, J.J., 1992. Entry and Exit in United States Manufacturing Industries from 1977 to 1982. *In:* Audretsch, D.B. and Siegfried, J.J., eds. *Empirical Studies in Industrial Organisation: Essays in Honour of Leonard W. Weiss.* Netherlands: Kluwer Academic Publishers, 1992, 253-273.

Florida, R.L. and Kenney, M., 1988. Venture Capital, High Technology and Regional Development. *Regional Studies,* 22 (1), 33-48.

Fomby, T.B., Hill, R.C. and Johnson, S.R., 1984. *Advanced Econometric Methods.* New York: Springer.

Fothergill, S. and Gudgin, G., 1979. In Defence of Shift-Share. *Urban Studies,* 16 (3), 309-319.

Fothergill, S. and Gudgin, G., 1982. *Urban and Regional Employment Change in the UK.* London: Heinemann.

Foti, A. and Vivarelli, M., 1994. An Econometric Test of the Self-employment Model: The Case of Italy. *Small Business Economics,* 6, 81-93.

Fritsch, M., 1992. Regional Differences in New Firm Formation: Evidence from West Germany. *Regional Studies,* 23 (6), 233-241.

Fritsch, M., 1996. Turbulence and Growth in West Germany: A comparison of Evidence by Regions and Industries. *Review of Industrial Organisation,* 11 (2), 231-251.

Fritsch, M., 1997. New Firm and Regional Employment Change. *Small Business Economics,* 9, 437-448.

Fuss, M.A. and Gupta, V.K., 1981. A Cost Function Approach to the Estimation of Minimum Efficient Scale, Returns to Scale and Suboptimal Capacity. *European Economic Review,* 15, 123-135.

Garofoli, G., 1992. New Firm Formation and Local Development the Italian Experience. *Entrepreneurship and Regional Development,* 4, 101-125.

Garofoli, G., 1994. New Firm Formation and Regional Development: The Italian Case. *Regional Studies,* 28 (4), 381-393.

Gaskins, D., 1971. Dynamic Limit Pricing: Optimal Pricing Under Threat of Entry. *Journal of Economic Theory,* 3, 306-322.

Georganta, Z., Kotsis, K. and Kounaris, E., 1994. *Measurement of Total Factor Productivity in the Manufacturing Sector of Greece, 1980-1991.* Athens: Centre of Planning Economic Research Discussion Paper No. 35.

Georgiou, G.A., 1991. *Spatial Distribution and Sectoral Composition of N. 1262/82 Investments.* Athens: Centre of Planning and Economic Research, Reports No.3.

Gerlach, K. and Wagner, J., 1994. Regional Differences in Small Firm Entry in Manufacturing Industries: Lower Saxony, 1979-1991. *Entrepreneurship and Regional Development,* 6, 63-80.

Geroski, P.A. and Masson, R.T., 1987. Dynamic Market Models in Industrial Organization. *International Journal of Industrial Organization,* 5 (1), 1-13.

Geroski, P.A. and Pomroy, R., 1990. Innovation and the Evolution of Market Structure. *Journal of Industrial Economics,* 38 (3), 299-314.

Geroski, P.A. and Schwalbach, J., 1989. *Barriers to Entry and Intensity of Competition in European Markets.* Brussels and Luxembourg: Commission of the European Communities.

Geroski, P.A. and Schwalbach, J., 1991. *Entry and Market Contestability.* Oxford UK: Basil Blackwell.

Geroski, P.A., 1982. Simultaneous Equations Models of the Structure-Performance Paradigm. *European Economic Review,* 19 (1), 145-158.

Geroski, P.A., 1983. *The Empirical Analysis of Entry: A Survey.* Southampton: Discussion Paper 8318, University of Southampton.

Geroski, P.A., 1988. *The Effect of Entry on Profit Margins in the Short and Long-run.* London: London Business School Working Papers No. 47.

Geroski, P.A., 1989. Entry, Innovation and Productivity Growth. *Review of Economics and Statistics,* 71 (4), 572-578.

Geroski, P.A., 1990. Innovation, Technological Opportunity, and Market Structure. *Oxford Economic Papers,* 42 (3), 586-602.

Geroski, P.A., 1991a. *Market Dynamics and Entry.* Oxford UK & Cambridge USA: Basil Blackwell.

Geroski, P.A., 1991b. Some Data-Driven Reflections on the Entry Process. *In:* Geroski, P.A. and Schwalbach, J., eds. *Entry and Market Contestability: An International Comparison.* Oxford UK and Cambridge USA: Blackwell, 1991, 282-296.

Geroski, P.A., 1991c. Domestic and Foreign Entry in the United Kingdom: 1983-1984. *In:* Geroski, P.A. and Schwalbach, J., eds. *Entry and Market Contestability.* Oxford UK and Cambridge USA: Basil Blackwell, 1991, 63-88.

Geroski, P.A., 1991d. Entry and the Rate of Innovation. *Economics of Innovation and New Technology,* 1, 203-214.

Geroski, P.A., 1995. What Do We Know About Entry? *International Journal of Industrial Organization,* 13 (4), 421-440.

Geroski, P.A., Gilbert, R. and Jacquemin, A., 1990. *Barriers to Entry and Strategic Competition.* London: Harwood.

Giannitsis, T., 1985. *The Greek Industry: Development and Crisis.* Athens: Guttenberg.

Giannitsis, T., 1988. *Accession to EEC and Effects on Industry and Trade.* Athens: Foundation of Mediterranean Studies.

Gilbert, R.J., 1989. The Role of Potential Competition in Industrial Organization. *Journal of Political Economy,* 3 (3), 101-127.

Gorecki, P.K., 1975. The Determinants of Entry by New and Diversifying Enterprises in the UK Manufacturing Sector 1958-1963: Some Tentative Results. *Applied Economics,* 7, 139-147.

Gort, M. and Klepper, S., 1982. Time Paths in the Diffusion of Product Innovations. *Economic Journal,* 92 (3), 630-653.

Gould, A. and Keeble, D., 1984. New Firms and Rural Industrialization in East Anglia. *Regional Studies,* 18 (3), 189-201.

Greene, W.H., 1993. *Econometric Analysis.* New York: Macmillan.

Gudgin, G. and Fothergill, S., 1984. Geographical Variation in the Rate of Formation of New Manufacturing Firms. *Regional Studies,* 18 (3), 203-206.

Gudgin, G., 1978. *Industrial Location Processes and Regional Employment Growth.* Farnborough, Hants: Saxon House.

Gudgin, G., Brunskill, I. and Fothergill, S, 1979. *New Manufacturing Firms and Regional Employment Growth.* London: Centre for Environmental Studies, Research Series no. 9.

Guesnier, B., 1994. Regional Variations in New Firm Formation in France. *Regional Studies,* 28 (4), 347-358.

Gupta, V.K., 1981. Minimum Efficient Scale — a Determinant of Concentration: A Reappraisal. *The Manchester School,* 49 (2), 153-164.

Hamermesh, D., 1993. *Labor Demand.* Princeton: Princeton University Press.

Hamilton, R.T., 1986. The Influence of Unemployment on the Level and Rate of Company Formation in Scotland, 1950-1984. *Environment and Planning A,* 18, 1401-1404.

Hamilton, R.T., 1989. Unemployment and Business Formation Rates: Reconciling Time-Series and Cross-section Evidence. *Environment and Planning A,* 21 (2), 249-255.

Harrison, R.T. and Hart, M., 1983. Factors Influencing New Business Formation: A Case Study of Northern Ireland. *Environment and Planning A,* 15, 1395-1412.

Hart, M. and Gudgin, G., 1994. Spatial Variations in New Firm Formation in the Republic of Ireland, 1980-1990. *Regional Studies,* 28 (4), 367-380.

Hart, M. and Hanvey, E., 1995. Job Generation and New and Small Firms: Some Evidence from the Late 1980s. *Small Business Economics,* 7, 97-109.

Hasid, J., 1987. The Picture of Greek Manufacturing Does Seem to Change. *Economicos Tachydromos,* 30, 49-53.

Hause, J.C. and Du Rietz, G., 1984. Entry, Industry Growth, and the Microdynamics of Industry Supply. *Journal of Political Economy,* 92 (4), 733-757.

Hausman, J.A. and Wise, D.A., 1979. Attrition Bias in Experimental and Panel Data: The Gary Income Maintenance Experiment. *Econometrica,* 47 (2), 455-473.

Haynes, K.E. and Machunda, Z.B., 1987. Considerations in Extending Shift-Share Analysis. *Growth and Change,* 18 (2), 69-78.

Hays, W.L., 1994. *Statistics.* New York, London: Harcourt Brace.

Hazledine, T., 1985. The Anatomy of Productivity Growth Slowdown and Recovery in Canadian Manufacturing. *International Journal of Industrial Organization,* 3, 307-326.

Heckman, J.J., 1979. Sample Selection Bias as a Specification Error. *Econometrica,* 47 (1), 153-161.

Henderson, J.V., 1986. Efficiency of Resource Usage and City Size. *Journal of Urban Economics,* 19, 47-70.

Henderson, R.A., 1980. An Analysis of Closures amongst Scottish Manufacturing Plants between 1966 and 1975. *Scottish Journal of Political Economy,* 27 (2), 152-174.

Highfield, R. and Smiley, R., 1987. New Business Starts and Economic Activity: An Empirical Investigation. *International Journal of Industrial Organization,* 5 (1), 51-66.

Hilke, J.C., 1984. Excess Capacity and Entry: Some Empirical Evidence. *The Journal of Industrial Economics,* 33 (2), 233-240.

Hines, H.H., 1957. Effectiveness of "Entry" by Already Established Firms. *Quarterly Journal of Economics,* 71 (1), 131-150.

Holden, D.R., Swales, J.K. and Nairn, A.G.M., 1987. The Repeated Application of Shift-Share: A Structural Explanation of Regional Growth? *Environment and Planning A,* 19 (9), 1233-1250.

Hoover, E. and Vernon, R., 1959. *Anatomy of a Metropolis.* Cambridge Massachusetts: Harvard University Press.

Hsiao, C., 1986. *Analysis of Panel Data.* Cambridge: Econometric Society Monographs No. 11 Cambridge University Press.

Hudson, J., 1986. An Analysis of Company Liquidations. *Applied Economics,* 18, 219-235.

Hudson, J., 1987. Company Births in Great Britain and the Institutional Environment. *International Small Business Journal,* 6, 57-69.

Hudson, J., 1989. The Birth and Death of Firms. *Quarterly Review of Economics and Business,* 29 (2), 68-86.

Illeris, S., 1986. New Firm Creation in Denmark: The Importance of Cultural Background. *In:* Keeble, D. and Wever, E., eds. *New Firms and Regional Development in Europe.* London: Croom Helm, 1986, 141-150.

Jarque, C.M. and Bera, A.K., 1980. Efficient Tests for Normality, Homoscedasticity and Serial Independence of Regression Residuals. *Economics Letters,* 6, 255-259.

Jeong, K-Y and Masson, R.T., 1991. Entry During Explosive Growth: Korea During Take-Off. *In:* Geroski, P.A. and Schwalbach, J., eds. *Entry and Market Contestability: An International Comparison.* Oxford UK and Cambridge USA: Blackwell, 1991, 143-167.

Johnson, P. and Parker, S., 1994. The Interrelationships Between Births and Deaths. *Small Business Economics,* 6, 283-290.

Johnson, P. and Parker, S., 1996. Spatial Variations in the Determinants and Effects of Firm Births and Deaths. *Regional Studies,* 30 (7), 679-688.

Johnson, P.S. and Cathcart, D.G., 1979. The Founders of New Manufacturing Firms: A Note on the Size of their 'Incubator' Plants. *Journal of Industrial Economics,* 28 (2), 219-224.

Johnson, P.S., 1983. New Manufacturing Industries in the U.K. Regions. *Scottish Journal of Political Economy,* 30 (1), 75-79.

Johnson, P.S., 1986. *New Firms: An Economic Perspective.* London: Allen & Unwin.

Johnston, J., 1984. *Econometric Methods.* 3rd edition. New York: McGraw-Hill Book Company.

Jovanovic, B., 1982. Selection and Evolution of Industry. *Econometrica,* 50 (3), 3-37.

Judge, G.G., Griffiths, W.E., Hill, C.R., Lütkepohl, H. and Lee, T.C., 1988. *Introduction to the Theory and Practice of Econometrics.* New York: Wiley & Sons.

Judge, G.G., Griffiths, W.E., Hill, C.R., Lütkepohl, H. and Lee, T.C., 1985. *The Theory and Practice of Econometrics.* New York: Wiley & Sons.

Keeble, D. and Gould, A., 1985. Entrepreneurship and Manufacturing Firm Formation in Rural Regions: The East Anglia Case. *In:* Healey, M.J. and Ilbery, B.W., eds. *The Industrialisation of the Countryside.* Norwich: Geo Books, 1985, 197-219.

Keeble, D. and Tyler, P., 1995. Enterprising Behaviour and the Urban-Rural Shift. *Urban Studies,* 32 (6), 975-997.

Keeble, D. and Walker, S., 1994. New Firms, Small Firms and Dead Firms: Spatial Patterns and Determinants in the United Kingdom. *Regional Studies,* 28 (4), 411-427.

Keeble, D. and Wever, E., 1986. *New Firms and Regional Development in Europe.* London: Croom Helm.

Keeble, D., Tyler, P., Broom, G. and Lewis, J., 1992. *Business Success in the Countryside: the Performance of Rural Enterprise.* London: HMSO for the Department of the Environment.

Keeble, D., Walker, S. and Robson, M., 1993. *New Firm Formation and Small Business Growth in the United Kingdom: Spatial and Temporal Variations and Determinants.* London: Employment Department, Research Series No. 1.

Keener, R.W., Kmenta J. and Weber N.C., 1991. Estimation of the Covariance Matrix of the Least-Squares Regression Coefficients when the Disturbance Covariance Matrix is of Unknown Form. *Econometric Theory,* 7, 22-45.

Kessides, I.N., 1986. Advertising Sunk Cost and Barriers to Entry. *Review of Economics and Statistics,* 68 (1), 84-95.

Kessides, I.N., 1991. Entry and Market Contestability: The Evidence from the United States. *In:* Geroski, P.A. and Schwalbach, J., eds. *Entry and Market Contestability: An International Comparison.* Oxford UK and Cambridge USA: Blackwell, 1991, 23-48.

Khemani, R.S. and Shapiro, D.M., 1986. The Determinants of New Plant Entry in Canada. *Applied Economics,* 18 (11), 1243-1257.

Kihlstrom, R. and Laffont, J., 1979. A General Equilibrium Entrepreneurial Theory of Firm Formation Based on Risk Aversion. *Journal of Political Economy,* 87 (4), 719-748.

Kleijweg, A.J.M. and Lever, H.C., 1994. *Entry and Exit in Dutch Manufacturing Industries.* Zortemeer: EIM Fundamental Research, Research Report 9409/E.

Kleijweg, A.J.M. and Lever, M.H.C., 1996. Entry and Exit in Dutch Manufacturing Industries. *Review of Industrial Organization,* 11 (2), 375-382.

Klepper, S. and Graddy, E., 1990. The Evolution of New Industries and the Determinants of Market Structure. *Rand Journal of Economics,* 21 (1), 27-44.

Kmenta, J., 1986. *Elements of Econometrics.* 2nd Edition. New York: MacMillan.

Knight, F., 1921. *Risk, Uncertainty and Profit.* New York: Houghton Mifflin.

Knudsen, D.C. and Barff, R., 1991. Shift-Share Analysis as a Linear Model. *Environment and Planning A,* 23 (3), 421-431.

Korte, W.B., 1986. Small and Medium-Sized Establishments in Western Europe. *In:* Keeble, D. and Wever, E., eds. *New Firms and Regional Development in Europe.* London: Croom Helm, 1986, 35-53.

Krugman, P., 1991a. History and Industry Location: The Case of the Manufacturing Belt. *American Economic Review,* 81 (2), 80-83.

Krugman, P., 1991b. *Geography and Trade.* Cambridge MA: MIT Press.

Labrianidis, L. and Papamichos, N., 1990. Regional Distribution of Industry and the Role of State in Greece. *Environment and Planning C: Government and Policy,* 8, 455-476.

Lane, S.J. and Schary, M., 1991. Understanding the Business Failure Rate. *Contemporary Policy Issues,* 9, 93-105.

Leone, R.A. and Struyk, R., 1976. The Incubator Hypothesis: Evidence from Five SMSAs. *Urban Studies,* 13, 325-331.

Lieberman, M.B., 1987. Excess Capacity as a Barrier to Entry: An Empirical Appraisal. *The Journal of Industrial Economics,* 35 (4), 607-627.

Little, A.D., 1977. *New Technology-Based Firms in the UK and the Federal Republic of Germany.* London: Witon House Publications.

Lloyd, P.E. and Dicken, P., 1982. *Industrial change: Local Manufacturing Firms in Manchester and Merseyside.* London: Inner Cities Research Programme 6 Department of Environment.

Lloyd, P.E. and Mason, C.M., 1983. New Firm Formation in the UK. *SSRC Newsletter,* 49, 23-24.

Lloyd, P.E. and Mason, C.M., 1984. Spatial Variations in New Firm Formation in the United Kingdom: Comparative Evidence from Merseyside, Greater Manchester and South Hampshire. *Regional Studies,* 18 (3), 207-220.

Louri, H. and Anagnostaki, V., 1995. Entry in Greek Manufacturing Industry: Athens vs. Rest of Greece. *Urban Studies,* 32 (7), 1127-1133.

Louri, H., 1985. *Regional Policy and Investment in Greek Manufacturing Industry: 1971 1982.* Unpublished Ph.D. Thesis, University of Oxford.

Louri, H., 1988. Scale Economies in Urban Manufacturing Production. *Greek Economic Review,* 10 (2), 371-382.

Louri, H., 1989. Regional Policy and Investment Behaviour: The Case of Greece, 1971-1982. *Regional Studies,* 23 (3), 231-239.

Love, J.H., 1996. Entry and Exit: a County-Level Analysis. *Applied Economics,* 28 (4), 441-451.

Lucas, R.E., 1978. On the Size Distribution of Business Firms. *Bell Journal of Economics,* 9, 508-523.

Lyons, B., 1991. Barriers to Entry. *In:* Davies, S., Lyons, B., Dixon, H. and Geroski, P.A., eds. *Economics of Industrial Organisation.* London, New York: Longman, 1991, 26-72.

MacDonald, J.M., 1986. Entry and Exit on the Competitive Fringe. *Southern Economic Journal,* 52 (3), 640-652.

Mackay, D.I., 1968. Industrial Structure and Regional Growth: A Methodological Problem. *Scottish Journal of Political Economy,* 15, 129-143.

MacLeod, W.B., 1987. Entry, Sunk Costs and Market Structure. *Canadian Journal of Economics,* 20 (1), 140-157.

Maddala, G.S., 1983. *Limited Dependent and Qualitative Variables in Econometrics.* Cambridge UK: Econometric Society Monographs No.3 Cambridge University Press.

Malecki, E.J., 1984. High Technology and Local Economic Development. *Journal of American Planning Association,* 50, 260-269.

Malecki, E.J., 1990. New Firm Formation in the USA: Corporate Structure, Venture Capital, and Local Environment. *Entrepreneurship and Regional Development,* 2, 247-265.

Mansfield, E., 1962. Entry, Gibrat's Law, Innovation, and the Growth of Firms. *American Economic Review,* 52 (5), 1023-1051.

Marcus, M., 1967. Firms' Exit Rates and their Determinants. *Journal of Industrial Economics,* 16, 10-22.

Marshall, A., 1920. *Principles of Economics.* 8th edition. London: Macmillan.

Mas, M., Maudos, J., Perez, F. and Uriel, E., 1996. Infrastructures and Productivity in the Spanish Regions. *Regional Studies,* 30 (7), 641-649.

Mason, C., 1983. Some Definitional Difficulties in New Firms Research. *Area,* 15 (1), 53-60.

Mason, C., 1991. Spatial Variations in Enterprise. *In:* Burrows, R., ed. *Deciphering the Enterprise Culture.* London: Routledge, 1991, 74-104.

Mason, C.M. and Harrison, R.T., 1995. Closing the Regional Equity Gap: The Role of Informal Venture Capital. *Small Business Economics,* 7, 153-172.

Mason, C.M., 1989. Explaining Recent Trends in New Firm Formation in the UK: Some Evidence from South Hampshire. *Regional Studies,* 23 (4), 331-346.

Mason, E.S., 1949. The Current State of Monopoly Problem in the United States. *Harvard Law Review,* 62, 1265-1285.

Masson, R.T. and Shaanan, J., 1982. Stochastic-Dynamic Limiting Pricing: An Empirical Test. *Review of Economics and Statistics,* 64 (3), 413-422.

Mata, J., 1991. Sunk Costs and Entry by Small and Large Firms. *In:* Geroski, P.A. and Schwalbach, J., eds. *Entry and Market Contestability.* Oxford UK and Cambridge USA: Blackwell, 1991, 49-62.

Mata, J., 1993a. Entry and Type of Entrant: Evidence from Portugal. *International Journal of Industrial Organization,* 11 (1), 101-122.

Mata, J., 1993b. Firm Entry and Firm Growth. *Review of Industrial Organization,* 8 (5), 567-578.

Mata, J., 1996. Small Firm Births and Macroeconomic Fluctuations. *Review of Industrial Organisation,* 11 (2), 173-182.

Mayer, W.J. and Chappell, W.F., 1992. Determinants of Entry and Exit: An Application of the Compounded Bivariate Poisson Distribution to U.S. Industries 1972-1977. *Southern Economic Journal,* 58, 770-778.

McGuckin, R., 1972. Entry, Concentration Change, and Stability of Market Shares. *Southern Economic Journal,* 38 (3), 363-370.

Meade, J., 1952. External economies and diseconomies in a competitive situation. *Economic Journal,* 62, 54-67.

Meager, N., 1992. Does Unemployment Lead to Self-employment? *Small Business Economics,* 4, 87-103.

Mills, D.E. and Schumann, L., 1985. Industry Structure with Fluctuating Demand. *American Economic Review,* 75 (4), 758-767.

Moyes, A. and Westhead, P., 1990. Environments of New Firm Formation in Great Britain. *Regional Studies,* 24 (2), 123-136.

Mueller, D. and Tilton J., 1969. Research and Development Costs as a Barrier to Entry. *Canadian Journal of Economics,* 2, 570-579.

Mueller, D.C., 1991. Entry, Exit, and the Competitive Process. *In:* Geroski, P.A. and Schwalbach, J., eds. *Entry and Market Contestability.* Oxford UK and Cambridge USA: Blackwell, 1991, 1-22.

Munnell, A.H., 1992. Infrastructure Investment and Economic Growth. *Journal of Economic Perspectives,* 6 (4), 189-198.

Nicholson, B.M., Brinkley, I. and Evans, A.W., 1981. The Role of the Inner City in the Development of Manufacturing Industry. *Urban Studies,* 18, 57-71.

O'Farrell, P.N. and Crouchley, R., 1983. Industrial Closures in Ireland 1973-1981: Analysis and Implications. *Regional Studies,* 17 (6), 411-427.

O'Farrell, P.N. and Crouchley, R., 1984. An Industrial and Spatial Analysis of New Firm Formation in Ireland. *Regional Studies,* 18 (3), 221-236.

O'Farrell, P.N., 1986. The Nature of New Firms in Ireland: Empirical Evidence and Policy Implications. *In:* Keeble, D. and Wever, E., eds. *New Firms and Regional Development in Europe.* London: Croom Helm, 1986, 151-183.

Oakey, R.P., 1983. New Technology, Government Policy and Regional Manufacturing Employment. *Area,* 150, 53-60.

Orr, D., 1974a. The Determinants of Entry: A Study of the Canadian Manufacturing Industries. *Review of Economics and Statistics,* 56 (1), 58-66.

Orr, D., 1974b. An Index of Entry Barriers and its Application to the Market Structure-Performance Relationship. *Journal of Industrial Economics,* 23, 39-49.

Oxenfeldt, A.R., 1943. *New Firms and Free Enterprise: Pre-war and Post-war Aspects.* Washington: American Council on Public Affairs.

Pashigian, P., 1969. The Effect of Market Size on Concentration. *International Economic Review,* 10 (3), 291-314.

Piore, M.J. and Sabel, C.F., 1984. *The Second Industrial Divide: Prospects for Prosperity.* New York: Basic Books.

Porter, M.E., 1979. The Structure within Industries and Companies' Performance. *Review of Economics and statistics,* 61, 214-228.

Pratten, C., 1991. *The Competitiveness of Small Firms.* Cambridge: University of Cambridge, Department of Applied Economics Occasional Paper 57 Cambridge University Press.

Revelli, R. and Tenga, S., 1989. The Determinants of New Firm Formation in Italian Manufacturing. *Small Business Economics,* 1, 181-191.

Reynolds, P. and Maki, W., 1990. *Business Volatility and Economic Growth.* US Small Business Administration: Final project report submitted to the Office of Advocacy, Contract SBA 3067-OA-88.

Reynolds, P. and Maki, W., 1991. *Regional Characteristics Affecting Growth: Assessing Strategies for Promoting Regional Economic Well-being.* Project report submitted to the Rural Poverty and Resource Programme. Grant 900-013, the Ford Foundation.

Reynolds, P., 1994. Autonomous Firm Dynamics and Economic Growth in the United States, 1986-1990. *Regional Studies,* 28 (4), 429-442.

Reynolds, P., Miller B. and Maki, W., 1992. *Explaining Regional Variation in Business Births and Deaths: US 1976-1988.* Pittsburgh, PA: American Sociological Association annual meetings.

Reynolds, P., Storey, D.J. and Westhead, P., 1994a. Cross-National Comparisons of the Variation in New Firm Formation Rates: An Editorial Overview. *Regional Studies,* 28 (4), 343-346.

Reynolds, P., Storey, D.J. and Westhead, P., 1994b. Cross-National Comparisons of the Variation in New Firm Formation Rates. *Regional Studies,* 28 (4), 443-456.

Reynolds, P.D., Miller, M. and Maki, W.R., 1993. Regional Characteristics Affecting Business Volatility in the United States, 1980-1984. *In:* Karlsson, B., Johannisson, B. and Storey, D.J., eds. *Small Business Dynamics: International, National and Regional Perspectives.* London: Routledge, 1993, 78-116.

Richardson, H.W., 1978. *Urban and Regional Economics.* Harmondsworth: Penguin.

Robson, R.T., 1991. Self-employment and New Firm Formation. *Scottish Journal of Political Economy,* 38 (4), 352-368.

Robson, R.T., 1996. Housing Wealth, Business Creation and Dissolution, in the U.K. Regions. *Small Business Economics,* 8, 39-48.

Rosenbaum, D.I. and Lamort, F., 1992. Entry Barriers, Exit and Sunk Costs: An Analysis. *Applied Economics,* 24 (3), 297-304.

Rosenbaum, D.I., 1993. Profit, Entry and Changes in Concentration. *International Journal of Industrial Organization,* 11, 185-203.

Rothwell, R., 1982. The Role of Technology in Industrial Change: Implications for Regional Policy. *Regional Studies,* 16, 361-369.

Rothwell, R., 1989. Small Firms, Innovation and Industrial Change. *Small Business Economics,* 1, 51-64.

Santarelli, E. and Piergiovanni, R., 1995. The Determinants of Firm Start-up and Entry in Italian Producer Services. *Small Business Economics,* 7, 221-235.

Santarelli, E. and Sterlacchini, A., 1994. New Firm Formation in Italian Industry: 1985-1989. *Small Business Economics,* 6, 95-106.

Saving, R.T., 1961. Estimation of Optimum Size of Plant by the Survivor Technique. *Quarterly Journal of Economics,* 75, 560-607.

Schary, M.A., 1991. The Probability of Exit. *Rand Journal of Economics,* 22 (3), 339-353.

Scheffé, H., 1959. *Analysis of Variance.* New York: Wiley.

Schmalensee, R., 1989. Inter-Industry Studies of Structure and Performance. *In:* Schmalensee, R. and Willing, R., eds. *Handbook of Industrial Organization, Vol. 2.* Amsterdam: North-Holland, 1989, 951-1009.

Schumacher, U., 1991. Buyer Structure and Seller Performance in US Manufacturing Industries. *Review of Economics and Statistics,* 73 (2), 277-284.

Schumpeter, J.A., 1950. *Capitalism, Socialism and Democracy.* 3rd. New York: Harper and Row.

Schutt, J. and Whittington, R., 1987. Fragmentation Strategies and the Rise of Small Units. *Regional Studies,* 21, 13-23.

Schwalbach, J., 1987. Entry by Diversified Firms into German Industries. *International Journal of Industrial Organization,* 5 (1), 43-49.

Schwalbach, J., 1990. Small Business in German Manufacturing. *In:* Acs, Z.J. and Audretsch, D.B., eds. *The Economics of Small Firms: A European Challenge.* Dordrecht: Kluwer Academic Publishers, 1990, 63-73.

Schwalbach, J., 1991. Entry, Exit, Concentration, and Market Contestability. *In:* Geroski, P.A. and Schwalbach, J., eds. *Entry and Market Contestability.* Oxford UK and Cambridge USA: Blackwell, 1991, 121-142.

Schwartz, M. and Reynolds, R.J., 1983. Contestable Markets: An Uprising in the Theory of Industry Structure: Comment. *The American Economic Review,* 73 (3), 488-490.

Shaanan, J., 1994. Sunk Costs and Resource Mobility: An Empirical Study. *Review of Industrial Organisation,* 9, 717-730.

Shapiro, D. and Khemani, R.S., 1987. The Determinants of Entry and Exit Reconsidered. *International Journal of Industrial Organization,* 5 (1), 15-26.

Shepherd, W.G., 1967. What does the Survivor Technique Show about Economies of Scale? *Southern Economic Journal,* 34, 113-122.

Shepherd, W.G., 1984. Contestability vs. Competition. *American Economic Review,* 74 (4), 572-587.

Siegfried, J.J. and Evans, L.B., 1994. Empirical Studies of Entry and Exit: A Survey of the Evidence. *Review of Industrial Organisation,* 9 (2), 121-155.

Simon, H.A. and Bonini, C.P., 1958. The Size Distribution of Business Firms. *American Economic Review,* 48 (4), 607-617.

Sleuwaegen, L. and Dehandschutter, W., 1991. Entry and exit in Belgian manufacturing. *In:* Geroski, P.A. and Schwalbach, J., eds. *Entry and Market Contestability.* Oxford UK and Cambridge USA: Blackwell, 1991, 111-120.

Smiley, R., 1988. Empirical Evidence on Strategic Entry Deterrence. *International Journal of Industrial Organisation,* 6, 167-180.

Spence, M.A., 1977. Entry, Capacity, Investment and Oligopolistic Pricing. *The Bell Journal of Economics,* 8 (2), 534-544.

Spilling, O.R., 1996. Regional Variation of New Firm Formation: The Norwegian Case. *Entrepreneurship and Regional Development,* 8, 217-243.

Stewart, J., 1991. *Econometrics.* London: Philip Allan.

Stigler, G.J., 1968. *The Organisation of Industry.* Irwin: Homewood.

Stiglitz, J.E. and Weiss, L., 1981. Credit Rationing in Markets with Imperfect Information. *American Economic Review,* 71 (3), 393-410.

Stilwell, F.J.B., 1970. Further Thoughts on the Shift-Share Approach. *Urban Studies,* 4, 451-458.

Stonebraker, R.J., 1976. Corporate Profits and the Risk of Entry. *Review of Economics and Statistics,* 58, 33-39.

Storey, D.J. and Johnson, S., 1987. Regional Variations in Entrepreneurship in the UK. *Scottish Journal of Political Economy,* 34 (2), 161-173.

Storey, D.J. and Jones, A.M., 1987. New Firm Formation — A Labour Market Approach to Industrial Entry. *Scottish Journal of Political Economy,* 34 (2), 37-51.

Storey, D.J., 1981. New Firm Formation, Employment Change and the Small Firm: The Case of Cleveland County. *Urban Studies,* 18, 335-345.

Storey, D.J., 1982. *Entrepreneurship and the New Firm.* London: Croom Helm.

Storey, D.J., 1983. How Beautiful is 'Small'? *SSRC Newsletter,* 49, 18-20.

Storey, D.J., 1990. Firm Performance and Size. *In:* Acs, Z.J. and Audretsch, D.B., eds. *The Economics of Small Firms: A European Challenge.* Dordrecht: Kluwer Academic Publishers, 1990, 43-50.

Storey, D.J., 1991. The Birth of New Firms — Does Unemployment Matter? A Review of the Evidence. *Small Business Economics,* 3, 167-178.

Suits, D., 1984. Dummy Variables: Mechanics vs. Interpretation. *Review of Economics and Statistics,* 66 (1), 177-180.

Sweeney, G.P., 1987. *Innovation, Entrepreneurs and Regional Development.* London: Frances Pinter.

Sylos-Labini, P., 1962. *Oligopoly and Technical Progress.* Cambridge, Mass.: Harvard University Press.

Theil, H. and Gosh, R., 1980. A Comparison of Shift-Share and RAS Adjustment. *Regional Science and Urban Economics,* 10 (2), 175-180.

Thomadakis, S.B. and Droucopoulos, V., 1996. Dynamic Effects in Greek Manufacturing: The Changing Shares of SMEs, 1983-1990. *Review of Industrial Organization,* 11 (1), 69-78.

Thompson, W., 1968. Internal and External Factors in the Development of Urban Economies. *In:* Perloff, H.S. and Wingo, L., eds. *Issues in Urban Economics.* Washington D.C.: The Johns Hopkins Press for Resources for the Future, Inc, 1968, 43-62.

Vernon, R., 1960. *Metropolis 1985.* Cambridge Massachusetts: Harvard University Press.

Vernon, R., 1966. International Investment and International Trade in the Product Life Cycle. *Quarterly Journal of Economics,* 80, 190-207.

Vivarelli, M., 1991. The Birth of New Enterprises. *Small Business Economics,* 3, 215-223.

von der Fehr, N.H.M., 1991. Domestic Entry in Norwegian Manufacturing Industries. *In:* Geroski, P.A. and Schwalbach, J., eds. *Entry and Market Contestability.* Oxford UK and Cambridge USA: Blackwell, 1991, 89-120.

von Weizsacker, C.C., 1980. A Welfare Analysis of Barriers to Entry. *Bell Journal of Economics,* 11, 399-420.

Wagner, J., 1994. Small Firm Entry in Manufacturing Industries: Lower Saxony, 1979-1989. *Small Business Economics,* 6, 211-222.

Waterson, M., 1984. *Economic Theory of Industry.* Cambridge: Cambridge University Press.

Weeden, R., 1974. *Regional Rates of Growth of Employment: An Analysis of Variance Treatment.* Cambridge UK: National Institute of Economic and Social Research, Regional Paper No. 3, Cambridge University Press.

Weiss, L.W., 1963. Factors in Changing Concentration. *The Review of Economics and Statistics,* 45 (1), 70-77.

Weitzman, M.L., 1983. Contestable Markets: An Uprising in the Theory of Industry Structure: Comment. *The American Economic Review,* 73 (3), 486-487.

Westhead, P. and Moyes, T., 1992. Reflections on Thatcher's Britain: Evidence From New Production Firm Registrations 1980-1988. *Entrepreneurship and Regional Development,* 4, 21-56.

Westhead, P., 1989. A Spatial Analysis of New Manufacturing Firm Formation in Wales, 1979-1983. *International Small Business Journal,* 7 (2), 44-68.

White, H., 1980. A Heteroscedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroscedasticity. *Econometrica,* 48 (4), 817-838.

White, K.J., 1997. *SHAZAM User's Reference Manual Version 8.0.* Toronto: McGraw Hill.

White, L.J., 1982. The Determinants of the Relative Importance of Small Business. *Review of Economics and Statistics,* 64 (1), 42-49.

Whittington, R.C., 1984. Regional Bias in New Firm Formation in the UK. *Regional Studies,* 18 (3), 253-256.

Winter, S., 1984. Schumpeterian Competition in Alternative Technological Regimes. *Journal of Economic Behavior and Organization,* 5, 287-320.

Yamawaki, H., 1991. The Effects of Business Conditions on Net Entry: Evidence from Japan. *In:* Geroski, P.A. and Schwalbach, J., eds. *Entry and Market Contestability.* Oxford UK and Cambridge USA: Blackwell, 1991, 168-186.

Yip, G., 1982. *Barriers to Entry: A Corporate Strategy Perspective.* Lexington, MA: D. C. Heath.

Zellner, A., 1962. An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregation Bias. *Journal of the American Statistical Association,* 57, 348-368.

Appendix

Table A.1. Yearly pairwise Spearman correlation coefficients for the twenty two-digit sectors

r.82.83	-0.1242								
r.83-84	0.2986	-0.0359							
r.84-85	0.0617	0.0090	0.1079						
r.85-86	-0.2754	0.2829	-0.3250	-0.0647					
r.86-87	0.3710	-0.3017	0.3541	0.4129	-0.6704★				
r.87-88	0.2777	0.2588	0.3348	-0.1173	0.0290	0.1949			
r.88-89	0.3156	-0.1333	-0.2389	0.1777	0.3540	-0.2215	-0.2049		
r.89-90	0.2802	0.0000	0.0045	-0.0045	-0.0173	-0.0264	-0.1266	0.2202	
r.90-91	0.3571	0.1974	-0.0816	0.0045	-0.2267	0.01461	-0.0520	-0.1176	0.3137
	r.81-82	**r.82-83**	**r.83-84**	**r.84-85**	**r.85-86**	**r.86-87**	**r.87-88**	**r.88-89**	**r.89-90**

★ significant at the 0.05 level

Table A.2. Various measures of net entry ranked

	Net entry	**Absolute net entry**	**Net entry rate**	**Absolute net entry rate**
Food	14	6	11	17
Beverage	12	11	13	13
Tobacco	11	13	18	7
Textiles	18	1	20	3
Footwear & sewing of fabric	1	2	5	11
Wood & Cork	16	4	19	4
Furniture	2	4	4	6
Paper	3	8	3	5
Printing & publishing	13	7	17	8
Leather & fur	5	10	6	14
Rubber & plastics	11	13	12	16
Chemical	6	12	7	15
Petroleum & coal	7	14	2	2
Non metallic & mineral	9	17	9	20
Basic metal	4	9	1	1
Fabricated metal except machinery	17	3	16	9
Machinery	10	15	10	19
Electrical machinery	15	5	15	10
Transport equipment	13	7	14	12
Miscellaneous manufacturing industries	8	16	8	18

Absolute values ignore the sign positive or negative. Rate values are calculated as described in the text

Table A.3. GLS estimation of net entry of firms in Greek manufacturing industries 1981-1991

PCM	**SCALE**	**ARDT**	**KR**	**EMPLGR**	**PINVR**	**GDPGR**	**IMP**	**EXP**	**CONSTANT**
0.027	-0.298	-0.110	-0.005	0.016	-0.184	-0.292	-0.001	0.012	0.029
(4.13)	(-4.63)	(-3.90)	(-0.33)	(6.24)	(-6.29)	(-2.08)	(-0.29)	(3.74)	(9.75)

t-ratios in parentheses
Number of observations is 190

Table A.4. Spearman inter-temporal correlation of net entry by size class measures

Size class 1

	S1NER83	S1NER84	S1NER85	S1NER86	S1NER87	S1NER88	S1NER89	S1NER90
S1NER84	-0.2203							
S1NER85	-0.4070	0.0603						
S1NER86	-0.0591	0.2626	-0.1354					
S1NER87	-0.0450	-0.3091	0.2641	0.1061				
S1NER88	0.0556	-0.1704	-0.1858	0.0584	0.1120			
S1NER89	-0.3389	0.2106	0.0361	0.1534	-0.1375	0.0138		
S1NER90	0.6026**	-0.3811	-0.3701	-0.1598	-0.3028	0.1657	-0.2551	
S1NER91	0.1826	0.0344	-0.0995	-0.0423	0.3146	-0.0181	-0.0831	0.1108

Size class 2

	S2NER83	S2NER84	S2NER85	S2NER86	S2NER87	S2NER88	S2NER89	S2NER90
S2NER84	0.1304							
S2NER85	0.1082	0.0451						
S2NER86	-0.2801	-0.1762	0.1320					
S2NER87	-0.0737	0.2265	0.2255	-0.3042				
S2NER88	0.0897	0.2512	0.2055	-0.2630	0.5469*			
S2NER89	0.2784	-0.1345	0.1369	0.0008	-0.4717*	-0.3384		
S2NER90	-0.1780	-0.0479	-0.1697	-0.1214	-0.1591	-0.1111	-0.0251	
S2NER91	-0.1255	0.1016	-0.4318	0.0706	-0.3548	-0.1625	0.0137	-0.1979

Size class 3

	S3NER83	S3NER84	S3NER85	S3NER86	S3NER87	S3NER88	S3NER89	S3NER90
S3NER84	-0.2540							
S3NER85	-0.1620	0.0645						
S3NER86	0.5416*	-0.4538*	-0.4395					
S3NER87	-0.3737	0.5120*	-0.2773	-0.2539				
S3NER88	0.1107	-0.1843	-0.2720	-0.0338	0.0938			
S3NER89	0.0370	-0.1791	0.4799*	-0.0385	-0.2597	-0.2237		
S3NER90	-0.1075	-0.0738	0.0323	-0.0065	0.0473	0.0434	0.0865	
S3NER91	-0.1069	-0.5109*	-0.0282	0.2417	-0.1740	0.0791	0.2159	0.0161

Size class 4

	S4NER83	S4NER84	S4NER85	S4NER86	S4NER87	S4NER88	S4NER89	S4NER90
S4NER84	-0.0517							
S4NER85	0.0491	0.3582						
S4NER86	0.1784	-0.5052*	-0.2500					
S4NER87	-0.1794	0.2455	-0.0740	-0.1577				
S4NER88	0.0366	-0.2737	-0.3057	-0.0673	0.0362			
S4NER89	-0.3574	-0.0998	-0.3763	-0.0887	0.2614	-0.1760		
S4NER90	-0.0822	0.3206	0.0175	-0.1430	0.4546*	-0.1576	0.2534	
S4NER91	-0.1280	0.1033	0.0850	0.0570	-0.0163	-0.1224	-0.0693	-0.1143

Size class 5

	S5NER83	S5NER84	S5NER85	S5NER86	S5NER87	S5NER88	S5NER89	S5NER90
S5NER84	-0.0883							
S5NER85	0.1543	-0.0548						
S5NER86	-0.0042	0.1055	0.0745					
S5NER87	0.0554	0.4077	0.5061*	-0.0699				
S5NER88	0.2407	-0.1622	0.4228	0.2032	0.1383			
S5NER89	-0.0303	0.0743	-0.0424	0.0277	-0.1340	-0.1098		
S5NER90	0.0784	-0.3066	0.0817	-0.3355	-0.2707	0.4506*	-0.1779	
S5NER91	0.1030	0.3486	0.1452	0.0473	0.3848	0.0941	0.0511	-0.3027

* Significant LE 0.05 ** Significant LE 0.01 (2-tailed)

Table A.5 Simple-correlation matrix of net entry rates by size class in Greek manufacturing industries 1983-1991

	S1NER	S2NER	S3NER	S4NER
S2NER	0.30403**			
S3NER	0.38806**	0.31609**		
S4NER	0.27830**	-0.15126*	-0.04783	
S5NER	0.16194*	0.15535*	0.35590**	-0.21812**

* Significant LE 0.05 ** Significant LE 0.01 (2-tailed)