International competition
and
the efficiency of firms

CHRISTIAN H. M. KETELS

Thesis submitted for the degree of Ph.D.

London School of Economics *April 1998*

Abstract

The thesis includes four chapters highlighting different aspects of the link between international competition and the efficiency of firms.

Chapter I analyses how inefficiencies in technology choice due to asymmetric information between firm owners and managers are affected by international competition. Both the level and the cost responsiveness of profit influence the optimal contract. The effect of trade policies on technology choice is analysed for a number of oligopoly trade models. Conditions are derived under which more exposure to foreign competition increases the incentives to choose the socially efficient technology.

Chapter II develops a framework to analyse industry restructuring in response to trade liberalisation. It uses a free entry oligopoly model featuring firm heterogeneity and sunk entry costs. Trade liberalisation is shown to eliminate high cost firms by both exit and mergers. All private merger activity is constrained welfare improving. Because entry investments are sunk, the post-liberalisation equilibrium depends on initial conditions. Finally, the model allows to make predictions about merger motives and participants over the restructuring process.

Chapter III analyses how trade policy affects firms' incentives to cut costs depending on owners' control of management. It focuses on two ambiguous roles of profits, being both a resource for investments and a cushion for survival. Protection can create windfall profits detrimental to performance: if managers are only partially controlled by owners integrating a market leads to the convergence of firms' performance levels; if, however, managers' actions are fully controlled an initial disadvantage leads to divergence.

Chapter IV links trade liberalisation to the rise in wage differentials. It proposes a free entry model of technology choice adding two features: first, it relates labour market developments to intra-industry competition. Second, it links the transmission channels technology and trade. A rise in international competition due to trade liberalisation encourages firms to switch technologies. This increases the wage differential between high- and low-skilled workers.

Marcet sine adversario virtus

(Seneca)

CONTENTS

Chapter II.

Page

Chapter III.

Page

Chapter IV.

List of figures

CHAPTER III:

CHAPTER IV:

Introduction

Economists are convinced that trade liberalisation brings many economic advantages to countries. Increased trade allows economies to exploit differences of factor endowments as well as economies of scale due to an increased division of labour. These arguments have been forcefully made both in the old and new trade theory. The main focus of this literature is on the question of *what* is done within a country.

Economists are also convinced that trade liberalisation brings additional advantages by enforcing performance improvements within firms. Increased trade raises the degree of international competition and thus drives out inefficient firms or activities within firms. This argument is the topic of advances in both the contract theory and new industrial organisation literature. The main focus of this analyses is on the question of *how* things are done within a country. This second line of thinking is the point of departure for the four chapters in this thesis.

A prominent example is the discussion about the expected gains of implementing the European Union's Common Market Project. In its own assessment[1] the Commission concludes that

"...the new competitive pressures brought about by completion of the internal market can be expected to lead to rationalization within European enterprises and thus produce appreciable gains in internal efficiency. It is clear that the mechanisms referred to here [...] constitute much of what can be called the dynamic effects of the internal market."

In this thesis we investigate the basis for the Commission's claim. We extend the theoretical framework to capture more of the positive effects associated with competition. The existing trade literature incorporates these competition effects only partially because even though the new trade theory has introduced imperfectly competitive market structures it applies the same model of the firm as the old trade theory. In the old trade theory this classical model of the firm is appropriate: assumptions about the internal contractual structure of the firm and about the heterogeneity of firms are of limited importance if the product market is perfectly competitive. In the new trade theory, however, the product market is imperfectly competitive and there is more scope for different assumptions on firm structure. So far, the new trade literature concentrates on exploring the effects of an imperfect market structure in an international context. We add to this perspective by analysing the effects of different assumptions on firm structures in imperfectly competitive markets.

---

[1] *European Economy* (1988), p. 126. Also quoted in HORN ET AL. (1995).

The positive link between competition and the internal efficiency of firms is sometimes taken to be obvious but both theorists and econometricians have argued for caution. CORDEN (1974, p. 231) concludes his theoretical discussion by stating that " ... *it must be stressed that the efficiency effects of protection can go either way. Quite specific assumptions have to be made to lead to the result that tariffs reduce efficiency.*" He reaches this conclusion within a framework where no inefficiency can exist and a change in a specific input, management's effort, is treated as an indicator of efficiency. But 20 years later contract theorists like HERMALIN (1992) using incomplete information models with endogenous inefficiencies came to a similar conclusion: *"All... effects [of competition] have ambiguous signs indicating that there is no definitive relationship between the level of competition and [the efficiency of] executive behaviour."*

The positive link between trade liberalisation and the efficiency of firms finds stronger support from econometric work. Appendix I.A provides a list of these contributions that all find a positive link between fewer barriers to trade and the growth rate of total factor productivity. At the end of his extensive survey RODRIK (1995), however, points out measurement and causality problems. In RODRIK (1992, p. 172) he even states: *"Warning! Trade liberalization cannot be shown to enhance technical efficiency; nor has it been empirically demonstrated to do so."* In the later survey he qualifies this position but remains sceptical. In our view at least some of the criticised ambiguities in the empirical work are a consequence of gaps in the underlying theoretical models. The present thesis closes a number of these gaps and should thus help to inform future empirical work.

The chapters collected in this thesis highlight different aspects of the link between international competition and the efficiency of firms. In the first chapter, we examine the internal efficiency of firms and the effect of different types of trade liberalisation. In the second chapter, we investigate the elimination of underperforming firms by exit, merger, and internal restructuring in response to multilateral trade liberalisation. The third chapter analyses the interaction of market structure and owner information on firms' incentives to invest in cost cutting and applies this model to the formation of a free trade area. The final chapter builds on the previous results to shed light on the link between liberalisation of intra-industry trade and the observed increase in wage differentials between skill groups. The results of the four papers clarify the positive impact of international competition on the efficiency of firms and put ambiguities in the literature into perspective. This can help to devise better empirical tests of the impact of competition on efficiency and to select policies that avoid potential problems.

International competition and the internal efficiency of firms

The first chapter "International competition and the internal efficiency of firms" examines the link between trade liberalisation and performance incentives given to managers. We find that all trade policies that result in a reduction of firm profit lead to private decisions on firm structure that increase welfare. Trade polices that increase firm output lead to private decisions on firm structure that reduce marginal cost. The private decisions in response to output changes are, however, welfare neutral in a certain sense and are not driven by the underlying incentive problem.

The existing literature on international competition and internal efficiency of firms suffers from two pitfalls. First, the results of this literature are driven by effects unrelated to the central incentive problem. Second, this literature applies a misleading indicator to evaluate the welfare effects of the change in performance incentives in response to trade liberalisation. We address both these pitfalls.

First, we introduce an effect of competition that is directly linked to the incentive problem through the profit level. Competition reduces the cost of implementing better performance and thus reduces the scale of the underlying incentive problem. We show that the results in the existing literature are driven by the change in the output level. Performance incentives are a fixed cost to reduce the marginal cost of production. If competition reduces the output level a fixed investment on marginal cost reduction is less profitable.

Second, we restrict the social planner to operate under the same informational constraints as the private firm owner and neglect consumer surplus. Under this assumption competition affects welfare only if it has an impact on the informational problem. A change in the profit level has an impact on the informational problem while a change in the output level has not. The existing literature has either used a full information benchmark or included consumer surplus. We deviate from both these assumptions in order to single out the effect of competition on an incentive problem internal to the firm.

The chapter consists of two parts to analyse the model of the firm and undertake the trade policy experiments. In the first half, we develop a model of technology choice with informational asymmetry. Owners choose between either a traditional technology with known cost parameters or a sophisticated new technology with uncertain cost parameters that can be influenced by unobservable management actions. In the second half, we implement the model of the firm in different imperfectly competitive trade models. We analyse quota and tariff protection, price and quantity market games, unilateral and multilateral liberalisation, and the integration of segmented markets.

Trade liberalisation affects technology choice through two separate channels: the change in the level of profit and the change in the cost responsiveness of profit. Trade policies that lead to a profit reduction reduce the cost to implement an unobservable management action because the expected informational rent to the manager falls. Firms are thus more willing to use the sophisticated technology. Trade policies that increase the output level push up the cost responsiveness of profit. Firms are more willing to use the sophisticated technology because the advantage of lower marginal cost compared to the traditional technology is increased. The same argument, however, applies to a social planner running the firm such that this output level effect has no impact on the welfare indicator.

Trade liberalisation as facilitating merger

The second chapter "Trade liberalisation as facilitating merger" analyses merger, exit, and internal restructuring as part of an industry restructuring process in response to trade liberalisation and is motivated by the merger wave in the European Union in the run-up to the completion of the Single Market in 1992. We find that trade liberalisation eliminates high cost firms through exit and merger. Multinationals are particularly active in the process, both in the merger market and in restructuring their operations to become domestic firms. The whole industry restructuring, including all privately profitable mergers, is constrained welfare improving.

We develop an industry model with heterogeneous firms, sunk entry costs, and cost-cutting mergers. We describe the industry equilibrium by the number of active firms and the cost level of the worst performer. The industry has to satisfy three conditions in steady-state equilibrium: first, no active firm looses money (*exit condition*); second, no active firm can be bought up profitably (*merger condition*); and third, no outside firm has an incentive to enter the industry (*entry condition*). In a final section equilibrium further requires firms to be indifferent between having a domestic or multinational production structure (*type choice condition*). We look at two equilibria that satisfy these steady-state equilibrium conditions but result from different initial industry conditions, i.e., numbers of firms. In the first equilibrium, which we call *initial equilibrium*, both the entry and the merger condition bind while the exit condition may be slack. In the second equilibrium, which we call *post-liberalisation equilibrium* because it is the result of a trade liberalisation experiment, only the merger condition binds while both the exit and entry conditions may be slack.

We analyse the effect of trade liberalisation on an *initial equilibrium.* On the way to the *post-liberalisation equilibrium* the industry restructures by eliminating high cost firms in a process of exit, merger, and internal restructuring (i.e., type change). Multinational firms (only active for intermediate trade costs) are very active in these areas such that their relative and absolute number in the economy falls.

The existing trade literature has focused on the role of exit in response to trade liberalisation. Our model adds to the literature in allowing for merger and firm heterogeneity. The firm heterogeneity assumption allows us to identify firms that exit and firms that merge. High cost firms are eliminated because they find it hard to survive alone and because they promise high gains from cost reductions as merger partners. The merger policy literature has sometimes neglected the role of the private incentives to merge and the implications of assuming free entry. Our model adds both these perspectives within an international context. We show that all mergers triggered by trade liberalisation are welfare improving. Trade liberalisation facilitates a practice, i.e., merger, that is often considered to be anti-competitive but turns out to be socially beneficial.

A note on the effect of trade policy on the speed of cost-cutting

The third chapter "A note on the effect of trade policy on the speed of cost-cutting" analyses how trade policy affects firms' incentives to cut costs under different assumptions about firm owners' control of management actions. We find that trade liberalisation in a small open economy with heterogeneous firms leads to further divergence in performance if owners have full control over their management. If, however, owners have only limited control over managers through a fixed dividend target firms with an initial disadvantage manage to catch-up.

The existing literature on trade liberalisation and cost cutting assumes full control by firm owners leading to profit maximisation. In these models, an increase in competitive pressure on the product market as a result of trade liberalisation often reduces the incentives to invest in cost-cutting. The literature on trade and growth derives positive growth effects from trade liberalisation only by introducing external effects or by liberalising the market for R&D (i.e., blueprints for cost-cutting). These negative theoretical predictions on the effects of competition are at odds with empirical results on trade liberalisation and growth (see appendix I.A).

The first part of the chapter develops a model of infrequent cost-cutting by costly restructuring financed from accumulated profit. We identify the properties of the restructuring strategies and attached cost dynamics for each of the two assumptions about control within the firm. First, we look at the case of owners with full control interested in a maximum dividend and firm survival. Second, we look at the case of owners with limited control setting a dividend target for managers that delay restructuring as long as the survival of the firm and thus managers' jobs are not in danger. The second part undertakes trade policy experiments. In the first experiment we analyse the comparative statics of the cost-cutting behaviour with respect to an unilateral increase in protection. We show that different rates of protection lead to cost differences between firms. These results are then applied to study the effects of the formation of a free trade area. We show that depending on owners' control the creation of a custom union can lead either to the divergence (owner control) or the convergence (manager control) of heterogeneous firms.

The two different assumptions on owners' information allow us to highlight two different roles of profit. Profit is used as a resource to finance further performance improvements (i.e., cost-cutting) and dividends if firm owners have full information about market conditions. Profit is used as a cushion to secure survival without investing in further performance improvement if firm owners control managers imperfectly by setting a dividend target. Thus depending on the assumption made about owners' control of management a policy that changes the level of profit has opposite effects.

Some observers, like BAILEY/GERSBACH (1995), claim that German firms delayed productivity improvements because they received windfall profit from German unification and easier access to other European markets. We show that their claim is consistent with our theoretical model for the case of manager control.

Trade liberalisation and within-firm incentive contracts:

An application to the labour market

The final chapter "Trade liberalisation and within-firm incentive contracts: An application to the labour market" builds on the previous chapters to address the effects of a trade induced change in technology on wage differentials. International competition has an effect on the relative wages for different skill groups that is independent of general-equilibrium factor price effects because it forces more firms to switch to a technology with higher wages for high-skill labour.

The previous literature on the link between trade and wages assumes technology to be isolated from trade flows. Changes in relative wages that can not be accounted for by the change in factor supply incorporated in traded goods or trade induced price change have been attributed to exogenous technological change and by implication trade between countries of identical relative factor endowments has no effect on relative wages. This perspective neglects the importance of international competition on technology change. In our model firms react to tougher international competition by switching to a technology with higher wage levels for high-skill labour. Empirical studies that do not take the effect of international competition on technology choice into account thus underestimate the role of trade in the recent rise of wage differentials.

In the chapter we first solve a free entry industry model embedded in a labour market for the number of firms of different types, and for the wages paid to two types of labour. In the second part we analyse exit and a shift in technology choice as a response to trade liberalisation. More firms opt for a technology where high-skilled labour is paid a rent for reducing per-unit low-skilled labour input requirements. Thus the change in technology increases the difference between the average wage for high-skill and low-skill labour. The free entry assumption magnifies the effect of trade liberalisation on technology choice and wage differentials further.

The four chapters of this thesis have a common theoretical point of departure. The new trade theory has integrated imperfectly competitive market structures into the realm of international economics but it continues to use a model of the firm that was most appropriate for perfectly competitive markets. In this classical model of the firm internal structure, inefficiency and heterogeneity play only a very limited role. In imperfectly competitive markets these aspects of the firm are potentially important. Hence within the new trade theory it is useful to adopt a more detailed model of the firm to allow for these additional aspects. Only such a detailed model of the firm is able to analyse the full impact of increasing competitive pressure in international markets on firms and economies. The chapters in this thesis investigate some of the questions in this research program.

Chapter I

International competition and the efficient choice of technology

1. INTRODUCTION

It is almost a folk theorem in economics that competitive pressure is beneficial because it reduces "slack" in firms. In political discussions this line of thinking is often used as an additional argument to engage in liberalisation and deregulation efforts. Empirical work, some of which is listed in appendix I.A, gives substance to this claim although the results are not always unambiguous. Theoretical work produces even less straightforward answers but recent advances in contract theory and industrial organisation help to better understand the forces involved.

In this chapter we develop a framework to look at the effect of international competition on the internal efficiency of firms. The aim is to gain a better understanding of the forces linking competition and efficiency, and eventually design trade policies with these links in mind. Central to our approach is the analysis of the private choice between technologies differing in their degrees of informational asymmetry within the firm. This set-up is meant to be indicative of similar models with imperfections due to matching or bargaining mechanisms.

First, we identify two forces that link the degree of competition to the technology choice: the level and the cost responsiveness of profit. These two forces allow us to explain some of the ambiguity in earlier results. Second, we show that, under the assumption that the social planner acts under the same informational constraints as the private owner, private technology choice is inefficient. With this informational assumption we avoid judging a constrained-optimal allocation by comparing it to an infeasible benchmark. The picture that emerges underlines the positive link between trade liberalisation and sharpened incentives to use a socially preferable technology. It also highlights the relationship between trade policy induced output changes and the direction of technology choice that is independent of welfare. Making the roles of both size and profit level effects explicit proves to be crucial in understanding contradictory results from previous theoretical as well as empirical work.

The complete contract literature studying the link between competition and the internal efficiency of firms has been initiated by HART (1983). His analytical tool is the theory of contracts under asymmetric information where a change in the market structure leads to modifications of the optimal contract. We group the literature according to the channels linking competition and the optimal contract. In HART (1983) and SCHARFSTEIN (1988) increased competition provides additional information.[1] With very restrictive assumptions on the manager's utility function this leads to a more efficient effort choice but the result does not generally hold. In WILLIG (1987), MARTIN (1993), and PANUNZI (1994) a change in the market structure affects the impact of the unobserved action on

[1] See also the literature on tournaments and yardstick competition, which is not reviewed.

profit.[2] The sign of the change depends on the specific market model applied. AGHION ET AL. (1995, 1997), HERMALIN (1992), KAMEKE (1993), and SCHMIDT (1997) focus on the absolute level of profit. The specific reasoning differs but in all models lower profit increases the effort level. HORN ET AL. (1994) analyse different types of market games and show how moving from monopoly to quantity and then to price competition changes effort incentives non-continuously. Finally, NICKELL (1995) gives a broad perspective on the literature.

In parallel, international economists have studied the effects of trade liberalisation on the internal efficiency of firms. General-equilibrium effects play a dominate role in the early literature. CORDEN (1974) was first to analyse the question in a full-information perfect-competition framework. Less protection might increase the effort level by managers in the industry concerned but neither the economy-wide effects nor the welfare implications are clear cut. MARTIN (1978) extended the analysis using a specific-factor model. These attempts have been rather unconvincing because they lack any kind of inefficiency internal to the firm. The economy moves from one first best allocation to another.

HORN ET AL. (1995, 1990) fundamentally change the theoretical framework of the analysis. First, they model the market as being imperfectly competitive. This clarifies the meaning of competitive pressure. Second, they adopt a principal-agent model of the firm. This allows an informational asymmetry to create a deviation from the first-best allocation. Increased international competition affects the contract between the principal and the agent. Their results, however, turn out to be ambiguous: effort is increased because as a

[2] STENNEK (1994) and GAL-OR (1992) are related, even though they analyse different settings.

consequence of the general equilibrium structure wages rise; hence cutting down on labour input becomes more valuable. The distance to the full information benchmark, however, is increased; the fully informed social planner would cut labour input even more. VOUSDEN/CAMPELL (1995) use a similar model of the firm but implement it in a perfectly competitive market to study the effects of an export subsidy.[3] Welfare increases if the informational rents paid to managers increase. This is a result well known from the literature on gains from trade in a distorted economy: gains from trade are assured if output in the distorted sector increases with trade liberalisation. In DAS (1996) firms face an internal moral hazard problem. An increase in protection reduces welfare as a consequence of free trade being the optimal policy in this type of model. The moral hazard problem has no independent influence on the result.

We combine these approaches from the contract and trade literature. In section 2 the technology choice model is presented and analysed. Section 2.1 solves for the optimal incentive contract, and Section 2.2 specifies the technology choice condition. The profit responsiveness and profit level effects are analysed in subsections 2.2.1 and 2.2.2 respectively. Section 2.3 investigates the welfare implications of the private technology choice. In section 3 the international market games are presented. Sections 3.1 to 3.4 analyse the effects of competition in output vs. price, of unilateral vs. multilateral trade policy and of different types of trade barriers (quotas, tariffs, and market segmentation). Section 3.5 gives a summary of the results. Section 4 concludes.

---

[3] Other papers using contract theory in trade models are HORSTMANN/MARKUSEN (1996) on FDI and DINOPOULUS ET AL. (1995), COMBES ET AL. (1995), and BRAINARD/MARTIMORT (1996) on trade policy, i.e., principal-agent relationships between governments and firms.

2. THE TECHNOLOGY CHOICE MODEL

The model proceeds in three stages with the full timing of moves in appendix I.B. In the *first stage*, the firm owner has to choose to implement one out of two available technologies/production functions. One technology is traditional; all parameters of its cost function are well known and not liable to shocks or changes. The other technology is more sophisticated; the parameters of its cost function can be improved by appropriate management actions but are subject to adverse shocks. Shocks are observable to the manager but not to the owner. In the *second stage*, owners offer managers an incentive contract given the earlier technology choice. Shocks occur and firms' costs are determined in interaction with management action. In the *final stage*, firms compete in the international product market given their production cost. Owners have to weight the additional cost of hiring managers to take some discretionary action against the advantage to have them implement a lower cost level and thus boost profit.

The structure of the market game affects both the cost of hiring the manager and the advantage of competing with a lower production cost. Changes in trade policy can shift the balance from one technology to another. We proceed backwards taking the reduced-form profit function as given. The derivation of the profit function in international market games follows in section 3. In section 2 the outcome of the final stage is given as a closed-form representation of profit Π depending on own cost c and trade costs t. Section 2.1 sets t constant to look at technology choice; section 2.2 varies t to identify the role of competition.

(1) $\Pi(c,t)$

2.1 The Incentive Contract

In this section we analyse the contract between the firm owner and the manager at the second stage where technology is given and labelled z. Owners are endowed with an investment project and have the capital to finance it. They aim to maximise profit given by (1) net of transfers to managers. Managers have zero wealth but possess human capital essential for the project to generate any returns. As in LAFFONT/TIROLE (1986) a firm's cost function is perfectly observable and c is an argument of this function. The variable c is determined by a random shock s, for example a machine break-down, and an action a taken by the manager. Both a and s are unobservable to the owner, while the manager chooses a knowing the value of s.

(2) $$c(a,s) = s - a$$

The technology choice z determines the possible values of actions and shocks. If the owner has chosen a technology with a higher z, he has access to a wider set of possible cost parameters. The variables a and s are elements from the sets A and S defined by z according to

(3) $$A \equiv [0,z];\; S \equiv [c^0, c^0 + z];\; A,S \subseteq R^+;\; c^0 > z \geq 0$$

Within S the distribution of the shock is given by the distribution function $f(s)$ and the cumulative density function $F(s)$. We assume $f(s)$ to be uniform for computational ease but the results do not depend on this assumption. The size of both A and S is increasing in z.[4]

Owners cannot choose managers' actions directly because the action a is unobservable. They can, however, offer managers an incentive contract to induce them to reveal the shock s. From these reports actions can be perfectly discerned with the observation of c using the technological relationship in (2).

Consider a risk-neutral manager with a utility function U separable and linear in both income tr and an action a with a constant marginal disutility of v. If the manager reports a shock of size s the owner orders him to take an action $a(s)$. The manager gets a monetary reward $tr(s,a(s))$ if he complies with the owner's cost and action target.[5] The owner checks compliance using (2).

(4) $$U = tr(s,a(s)) - va(s)$$

The separability assumption is made to abstract from income effects that played a prominent role in the early literature (MARTIN (1978)). The linearity assumption is made to rule out a standard source of inefficiency. Appendix I.C uses a convex disutility of action function $v(a)$ and shows that our results remain valid under some additional conditions standard in the literature.

[4] In this specification the higher indexed technology not only suffers from more severe informational asymmetry but also a worse distribution of shocks. At first sight, a symmetric expansion of the set S with the index seems more appropriate. But with risk-neutral agents and a profit function convex in marginal costs an extended set $S(i)$ would be preferred to a set $S(j)$ whenever $i > j$. This is an uninteresting effect and thus we rule it out by expanding the set S asymmetrically with z.

[5] We assume that it is infeasible to base the contract on any other outside information like market price or competitor behaviour such that yardstick competition or tournaments can not be used.

When offering a contract, the owner has to take account of three constraints: first, the manager has to be offered an utility equal or above his outside opportunity (normalised to zero) for every value of s (*individual rationality constraint* (IR)) because he takes his action only after learning the value of the shock.

(5) $tr(s, a(s)) - va(s) \geq 0 \forall s \in S$

Second, the manager has to be induced to report the value of the shock s truthfully (*incentive compatibility constraint* (IC)). This is a direct application of the revelation principle: a truth-telling mechanism is at least as good as any other contract. Let the manager's report be s' while the true value of the shock is s. Then for truth telling to be optimal the manager's utility is maximised by a report s' equal to s:

(6) $s' \arg\max U = tr(s', a(s')) - va(s|s')$ and $s = s'$
where $a(s|s') = s - s' + a(s')$ is needed to mimic the outcome $c(a(s'), s')$

Finally, for some values of the shock it may be unprofitable to run the firm altogether. For this subset of S both the manager and the owner receive only their outside utility of zero; no informational rent is paid to the manager for his truthful report. Hence ex ante the owner has an incentive to overstate the region S for which no payments are made. Ex post, however, he can offer the manager some positive utility and commence production. The manager understands these incentives for the owner, so he will accept contracts only when there is no advantage for the owner to renege on the cut-off point $s*$ above which no production takes place (*renegotiation proofness constraint* (RP)). This point is reached where profit is insufficient to pay for the disutility of the manager.

(7) $$\Pi(c(s,a(s))) - va(s) \le 0 \forall s \ge s*$$

The owner's optimisation problem can then be written as

(8) $$\max_{a(s),tr(s,a),s*} \int_{\underline{s}}^{s*} \{\Pi(c(s,a(s))) - tr(s,a(s))\} f(s) ds$$

s. t. $tr(s,a(s)) - va(s) \ge 0 \forall s \in S$ **IR constraint**

$s' \arg\max U = tr(s',a(s')) - va(s|s')$; $s = s'$ **IC constraint**

$\Pi(c(s,a(s))) - va(s) \le 0 \forall s \ge s*$ **RP constraint**

The IC constraint is applied by differentiating utility (4) and imposing the first-order condition required by (6). This expression is then evaluated at the truth-telling point resulting in the dynamic constraint (9) to the problem.

(9) $$\dot{U}(s|s') = \frac{dtr(s')}{ds'} - v\left[\frac{da(s|s')}{ds} + \frac{da(s|s')}{ds'}\right] = -v$$

Substituting out the transfer *tr* by use of (4), the action *a* by use of (2), and using manager's utility *U* as the state variable the problem can be solved by defining the free-endpoint Hamiltonian *H* (10), where $\lambda(s)$ is the shadow value of the dynamic constraint on *U*. The IR and RP constraints are introduced later.

(10) $$H \equiv [\Pi(c(s,a(s))) - U(s,a(s)) - v[s - c(s,a(s))]] f(s) - \lambda(s) v$$

Before maximising the Hamiltonian by choice of $c(s) \equiv c(s, a(s))$ the shape of H has to be checked. We find that for a linear utility function and a profit function convex in own cost the Hamiltonian is convex and the standard first-order condition describes a minimum. Both conditions are present in our contract model and all market games studied later. To obtain the maximum, we check the boundaries of the sets A and C. Let upper bars define the upper bound of a set. We make the following simplifying but not essential assumption: [6]

Assumption 1: $\Pi(c(s,\bar{a})) - v\bar{a} - U(s,\bar{a}) \geq \Pi(c(s,0)) \forall s \leq s*$

The assumption implies that for all states in which the firm is active, inducing effort is the optimal decision. Figure I.1 gives a graphical representation. For this assumption to hold the effect of cost changes on profit has to be relatively large compared to the disutility of action for a manager. Under assumption 1 the relationship between cost levels and shocks is particularly simple (11). The remaining optimality conditions are (12) and (13).

(11) $c(s) = s - \bar{a}$

(12) $-\dfrac{\partial H}{\partial U} = \dot{\lambda}(s) = f(s)$

(13) $\dfrac{\partial H}{\partial \lambda(s)} = -v = \dot{U}(s)$

---

[6] In the absence of assumption 1 there exists a second cut-off point $s** < s*$. Below $s**$ maximum effort is induced and informational rents are paid. Between $s**$ and $s*$ production takes place but transfers, actions, and informational rents are zero. $s**$ is implicitly defined by $\Pi(c(s**,\bar{a})) - v\bar{a} = \Pi(c(s**,0))$.

Using the RP constraint and the optimal cost target (11) we can identify the cut-off point s^*. If profits are everywhere higher than the manager's disutility, production takes place in all states and $s^* = \bar{s}$. Otherwise s^* is defined as the state s at which profit is equal to manager's disutility.

(14) $$\Pi(c(s^*)) = v[s^* - c(s^*)] = v\bar{a}$$

From (13) the manager's utility is decreasing in s for all active states. Utility is decreasing in s because otherwise the manager would have an incentive to over-report s and thus cut back on action. Incentive compatibility is achieved by giving the manager an informational rent in better states. Using the IR constraint the transfer in the worst active state is just sufficient to pay for the manager's disutility.

(15) $$tr(s^*) = v\bar{a}$$

We solve for the manager's utility by integrating (13) and using the transfer at the cut-off point s^* (15) to determine the constant term. Applying (4) we write the utility U and the transfer tr as a function of the state s only.

(16) $$U(s) = v[s^* - s] \qquad \forall s \leq s^*$$

(17) $$tr(s) = v[s^* - s + \bar{a}] \qquad \forall s \leq s^*$$

The manager's utility and the transfer are linear functions of the state, where the linearity follows from the assumptions on the manager's utility function. The manager's utility *U(s)* is, together with the action *a(s)* and cost level *c(s)*, shown in figure I.2. The transfer has two parts: first, it includes a fixed sum for the manager's disutility of taking a costly state-independent action from assumption 1. Second, it provides the manager with an informational rent to give the incentive for truthful reporting of states. The informational rent is a profit sharing device between owner and manager. The transfer *tr(s)* is, together with the profit level $\Pi(c(s))$ and the managers' disutility of action *va(s)*, drawn in figure I.3.

2.2 The Choice of Technology

This section defines the technology choice condition at the first stage. We restrict attention to two technologies but the set-up can be extended to allow for a continuum of technologies. The owner chooses between a technology where z is equal to zero (this technology is called *0*) and a technology where z is strictly positive (this technology we continue to call z). It is not essential who chooses the technology, only that the choice is perfectly observable. The *technology choice condition* (18) describes the trade-off: the left hand side gives the expected profit gain from switching to technology z, while the right hand side gives the expected transfer cost. Superscripts are used to link cost targets to technologies: c^0 is exogenously given by (3); $c^z(s)$ is endogenously given by (11). To look at the effect of changing trade costs we explicitly introduce t in the profit functions. In the next two sections we derive conditions upon the profit function $\Pi(c,t)$ that have to hold in order for a change in competition to affect technology choice in a certain direction.

The owner chooses technology *0* if

$$(18)\quad \int_{\underline{s}}^{s^*} \Pi\left(c^z(s),t\right)f(s)ds - \Pi\left(c^0,t\right) \leq \int_{\underline{s}}^{s^*} tr(s)f(s)ds$$

In figure I.4 we reduce the set *S* of possible states to two and can thus use a state-space diagram to represent the technology choice condition graphically. The example given corresponds to the case where the technology choice condition (18) holds and the private owner chooses technology 0.

2.2.1 The profit responsiveness effect

The first channel linking trade costs *t* to technology choice works through the gains of switching the technology. The advantage of having a low production cost *c* can differ with the level of trade barriers and hence the degree of international competition. To analyse this effect, the transfer expense *tr(s)* of the *z* technology is held constant by assuming that the RP constraint is nowhere binding in *S*; thus the cut-off point is constant at $s^* = \bar{s}$ before and after the change in trade costs. Differentiate the technology choice condition (18) with respect to *t* to obtain

$$(19)\quad \int_{\underline{s}}^{s^*} \frac{d\Pi\left(c^z(s),t\right)}{dt} f(s)ds - \frac{d\Pi\left(c^0,t\right)}{dt}$$

If expression (19) is negative, less competition due to higher trade costs favours the choice of technology *0* instead of technology *z*. In terms of the *technology choice condition* the left hand side of (18) is decreased and thus the inequality more likely to hold. Proposition 1 states this result that is similar to fixed technology models with effort choice.[7]

Proposition 1

More intense international competition favours the choice of the asymmetric information technology z if $\frac{d^2\Pi(c(s),t)}{dcdt}>0$. *This condition is fulfilled if profit becomes more responsive to cost with lower trade costs.*

Proof:

The condition of proposition 1 implies a negative sign for expression (19) because from the optimal cost schedule (11) and the definition of the state and action space (3) it follows that $c^z(s)\leq c^0 \forall s$ with a strict inequality for $s<\bar{s}$.

Proposition 1 is a condition upon the effect of competition on the relative levels of profit as function of cost. A positive cross-product of profit with respect to own cost *c* and trade cost *t* implies that higher-cost firms lose more profit for a given fall in protection; this is the case if lower trade costs increase output. In section 3 of the chapter we establish some trade policy experiments for which this condition holds. In figure I.5 we analyse the profit responsiveness effect in the state-space diagram under the condition that proposition 1 holds.

[7] See SCHMIDT (1997) and HERMALIN (1992).

2.2.2 The profit level effect

The second channel linking trade costs t to technology choice works through the transfer expenses of the technologies. For different levels of protection the expected cost of hiring the manager for the z technology can differ. Casual observation suggests that the absolute level of profit should have an impact upon the optimal contract between the principal and the agent. If a firm's exit becomes more likely, it might be easier to induce the manager to work harder or provide information to prevent bankruptcy. By applying an idea suggested by SCHMIDT (1997) in a slightly different model[8] we now introduce such a profit level-effect.

Trade liberalisation affects the level of profit for any technology. For the z technology the subset of states S for which production is profitable is altered. Any change in the cut-off state s^* affects the size of the expected transfer to the manager through the IR constraint. Lower trade costs affect s^* as given by (20) using the implicit function theorem on the definition of the cut-off state s^* (14).

$$(20) \qquad \frac{ds^*}{dt} = -\frac{d\Pi\left(c^z(s),t\right)/dt}{d\Pi\left(c^z(s),t\right)/dc - v[1-\dot{c}(s)]}$$

The relationship between protection levels and the cut-off state (20) is positive if profit is both decreasing in production cost and increasing in trade cost because $\dot{c}(s)=1$. Under these two conditions lower trade costs have the effect that the owner shuts down the firm for more realisations of the shock. Ignoring

[8] SCHMIDT uses the limited liability model by INNES (1990), where in contrast to the present setting the agent chooses his action <u>before</u> learning about the value of the shock. He exogenously assumes the probability of default to be increasing with competition.

the change in relative profit covered by proposition 1 we analyse the effect of changes in the cut-off state s* on the additional cost of technology z by differentiating the *technology choice condition* (18) with respect to the trade costs t by applying Leibnitz's Rule.

$$\text{(21)} \quad \frac{ds^*}{dt} vF(s^*) > 0$$

From (20) and (21), higher trade costs increase the expected additional cost of the z technology if profit is increasing in protection: less competition favours the choice of the *0* instead of the z technology. The right hand side of the *technology choice condition* (18) increases and thus the inequality is more likely to hold. In figure I.6 we analyse this profit level effect in the state-space diagram.

Proposition 2

(a) If profit is increasing in protection t more intense international competition favours the choice of the asymmetric information technology z.

(b) Drawing these proposition 1 and 2(a) together, inequality (22) is a necessary condition for trade liberalisation to lead to the adoption of the z technology.

$$\text{(22)} \quad \int_{\underline{s}}^{s^*} \frac{d\Pi(c^z(s),t)}{dt} f(s)ds - \frac{d\Pi(c^0,t)}{dt} < \frac{ds^*}{dt} vF(s^*)$$

Proof:

(a) From (20) and (21) the condition implies increasing additional costs for the z technology with higher trade costs t. Hence lower values for t imply lower additional costs and thus make it less likely that the *technology choice condition* (18) holds.

(b) Inequality (22) is the derivative of the *technology choice condition* (18) with respect to trade costs. If the combined effect is such that the inequality holds, higher (lower) values of t make it more (less) likely that (18) holds. The condition is necessary but not sufficient because the effect has to go not only in the right direction but also to be strong enough to change (18).

2.3 Welfare analysis

In the welfare analysis we abstract from the industry-wide allocational impact of competition on social welfare. For the imperfectly competitive trade models of section 3 the literature provides a set of established welfare theorems on this part of the problem.[9] The new issue at stake is the welfare effect of the technology choice within the firm.

For technology z the social planner solves a problem similar to the private owner without having any informational advantage.[10] Also, the social planner has to respect a balanced-budget constraint (BB): transfers have to be smaller or equal to profit. The social planner is interested in the joint utility of owner and manager, not in the distribution between them.[11] Hence the social planner has to respect the same constraints but maximises a different objective function. His problem is given by (23) together with the constraints familiar from the private contract problem.

---

[9] See WONG (1995), pp. 389 - 430 for a summary of these results.

[10] See HOLMSTRÖM/MYERSON (1983) on the appropriate assumptions on the information structure of the social planner in a private information framework.

[11] Including consumer surplus would obviously bias the social planner's choice towards using the lower marginal cost technology even further.

$$(23) \quad \max_{a(s),tr(s,a),s^*} W = \int_{\underline{s}}^{s^*} \left[\Pi\left(c(s,a(s)),t\right) - va(s)\right] f(s)ds$$

s. t.	$tr(s,a(s)) - va(s) \geq 0 \forall s \in S$	**IR constraint**
	$s' \arg\max U = tr(s',a(s')) - va(s \vert s')$; $s = s'$	**IC constraint**
	$\Pi(c(s,a(s))) - va(s) \leq 0 \forall s \geq s^*$	**BB constraint**

Substituting out the transfer *tr* by use of (4), the action *a* by use of (2), and using manager's utility *U* as the state variable the problem can be solved by defining the free-endpoint Hamiltonian *H* (24), where $\lambda(s)$ is the shadow value of the dynamic constraint on *U*. The IR and BB constraints are introduced later.

$$(24) \quad H \equiv \left[\Pi(c(s)) + U(s) - tr(s)\right] f(s)ds - \lambda(s)v$$

Maximising (24) by choice of $c(s) \equiv c(s, a(s))$ with state variable *U* gives the optimality conditions below, where again the convexity of *H* in conjunction with assumption 1 determines a boundary solution for (25).

$$(25) \quad c(s) = s - \bar{a}$$

$$(26) \quad -\frac{\partial H}{\partial U} = \dot{\lambda}(s) = -f(s)$$

$$(27) \quad \frac{\partial H}{\partial \lambda(s)} = -v = \dot{U}(s)$$

Equation (25) is equivalent to (11); both induce the same cost targets replicating the well-known result that the private contract gives the first best if the agent is risk-neutral.[12] Introducing limited liability usually makes the first-best solution infeasible but this is not the case here because the agent's utility function

---

[12]See HARRIS/RAVIV (1979).

is linear in the action. The first-best action is implemented, even though an informational rent is paid to the agent.[13]

Equation (27) is equivalent to equation (13); both owner and social planner face the same constraint on manager's utility. With the BB constraint equivalent to the RP constraint the cut-off point s^* is identical; at this point s^* the informational rent is zero and thus private and social objectives coincide. From (26) $\lambda(s) \leq 0 \forall s$ the state-dependent IC constraint never binds because the social planner's objective is indifferent to payments to the manager. This does not result in higher actions because action choice was already at the upper limit of A.

For the social planner to prefer technology *0* over technology z the *technology choice condition* (28) has to hold, where again the left hand side gives the gain and the right hand side the cost of switching to technology z.

$$\text{(28)} \quad \int_{\underline{s}}^{s^*} \Pi\left(c^z(s),t\right) f(s) ds - \Pi\left(c^0,t\right) \leq \int_{\underline{s}}^{s^*} va(s) f(s) ds$$

The two technology choice conditions for the social planner and the private owner differ only in the right hand side term: the social planner takes into account the disutility of the manager, while the private owner also includes the informational rents in the assessment. Thus the social planners' *technology choice condition* (28) is more stringent in the sense of less competition being sufficient to induce a switch to technology z.

---

[13]More precisely, SAPPINGTON'S (1983) properties 3 and 4 are not given in the present model. Equation (1.2) in the proof of his theorem 1 shows that the term biasing the output choice away from the optimal one is therefor zero for all shocks s.

Proposition 3

(a) If the inequality in proposition 2 (b) is satisfied and the firm is active in more than one state, the social planner chooses the z technology for lower trade barriers t than the private owner.

(b) If profit is increasing in protection t, i.e., proposition 2 (a) holds every reduction in trade costs reduces the differences in technology choice between a private owner and the social planner. Then more exposure to international competition gives extra welfare gains on top of the standard allocational advantages.

For the social planner only manager's disutility is costly in terms of the objective function (22); the informational rent shifts utility without affecting welfare. Hence the social cost of switching to the z technology is strictly lower than the private transfer for any positive weight given to managers' utility. This wedge creates the inefficiency in technology choice.

Our result relates directly to ESFAHANI/MOOKHERJEE (1995) and the inefficiency in their model of contract choice. Note that this is similar to problems studied in the incomplete contract literature (GROSSMAN/HART (1986), HART/MOORE (1990)). They analyse incentive problems due to sharing rules of the surplus tied to the ownership structure. In the present model contracts are complete but the informational asymmetry induces a lower bound to the profit share for the manager and thus distorts the private incentives for the owner.

3. INTERNATIONAL COMPETITION

We are now in a position to use the results of the preceding sections to analyse the effect of trade policy in the final stage. It is a common theme in both the Industrial Organisation literature on imperfectly competitive markets and in its applications in the New Trade Theory that results depend critically on the specific assumptions made about market structure. Here we give a broader view on the set of market games instead of picking one by random or taste.

We find that protectionist trade policies creating windfall profits for firms have a welfare cost in terms of a socially inefficient technology choice on top of the well-understood allocational distortions. Because there are two different channels through which trade policy changes affect technology choice, we are also able to shed light on some contradictory results in the literature.

Starting from a simple market game we add additional features using the most common imperfectly competitive trade models. Section 3.1 starts with a home monopoly protected from a competitive fringe of foreign firms by either a tariff or a quota. Section 3.2 introduces international duopolists competing in either quantities or prices. Section 3.3 compares unilateral to multilateral trade policies. Section 3.4 studies the move from a segmented to an integrated market. Finally, section 3.5 puts the results in context. Throughout section 3 cost functions are given by (3.0) with output q and a vector of technology parameters $\hat{c} = \{F, b, e\}$. Parameter c used in section 2 is an element of vector $\hat{c}$.

(3.0) $$K(q) = F + bq + \frac{e}{2}q^2$$

3.1 Different types of protection: Tariff vs. Quota

From the work by BHAGWATI (1965) it is known that tariffs and quotas limiting imports to the same level can have very different consequences for home firm behaviour. CABRAL ET AL. (1996) and REITZES (1991) look at the incentives for cost reduction under oligopolistic price competition and a quota. CABRAL ET AL. (1996) find the home firm's cost reduction decreasing in quota protection and explain this by the elimination of strategic considerations. In the present analysis only the home monopolist has a technology choice, i.e., there is no strategic interaction, and it faces a competitive fringe of foreign firms supplying at the world market price p^w. Protection takes the form of either a tariff t or a quota m. The home firm has a cost function $K(q)$ as given by (3.0) with $e>0$. Demand is given by $D(p)$, with the home market price p. Home firm profit is given by

(3.10) $$\Pi = \max_q \{pq - K(q)\}$$

Tariff

For tariff protection, the first-order condition to (3.10) is

(3.11) $$p^w + t - b - eq \geq 0 \qquad \forall 0 < q \leq q^1$$

$$p - b - eq + dp/dq\, q = 0 \qquad \forall q > q^1 \quad \text{where } p(q^1) = p^w + t$$

The top row gives the optimality condition for the region of home firm output, where the price is determined by the world market price plus the tariff. The bottom row gives the optimal output for the region where foreign firms find it unprofitable to serve the home market. We make the restriction that the monopoly output is below q^1 such that this segment never applies.[14]

The effects of a higher tariff level on technology choice are then given by

(3.12) $$\frac{d\Pi}{dt} = q = \frac{p^w + t - b}{e} > 0$$ Profit level effect

(3.13) $$\frac{d^2\Pi}{dtdb} = \frac{dq}{db} = -\frac{1}{e} < 0$$ Profit responsiveness effect

Quota

For quota protection, the first-order condition to (3.10) is

(3.14)
$$p(q+m) - b - eq + dp(q+m)/dq\, q = 0 \qquad \forall 0 \le q \le q^2;\ p(q^2+m) = p^w$$
$$p(q^2+m) - b - eq = 0 \qquad \forall q^2 < q \le q^3;\ p(q^3) = p^w$$
$$p(q) - b - eq + dp(q)/dq\, q = 0 \qquad \forall q^3 < q$$

The top row gives the optimality condition for the region of home firm output, where the home firm deducts the import quota m to act as a monopolist facing the residual demand function $D(p)-m$.[15] The middle row gives the segment

---

[14] This follows from the kinked shape of the home firm's marginal revenue (MR) curve: $MR = p + t\ \forall 0 \le q \le q^1$ and $MR = p + p'q\ \forall q > q^1$. Hence at q^1 the MR curve has a discontinuity. If the marginal cost curve cuts at this point, the home firm will maximise profits by moving up to the price p^w+t. If it cuts in the decreasing segment of the MR curve, foreign competition poses no threat.

[15] From the twice kinked shape of the home firm's marginal revenue curve: $MR = p(q+m) + dp/dq(q+m)q\ \forall 0 \le q \le q^2$, $MR = p(q^2+m)\ \forall q^2 < q \le q^3$ and $MR = p(q) + dp/dq(q)q\ \forall q^3 < q$. At q^2 and q^3 the MR curve has a discontinuity. If marginal cost cuts MR at these points, the firm chooses between an aggressive ($q = q^3$) or timid strategy ($q < q^2$). See HELPMAN/KRUGMAN (1992), p. 32. In the third segment foreign competition poses no threat.

where the home price is equal to the world market price and the home firm and the foreign fringe divide the fixed market demand $D(p^w)$ between them. The bottom row gives the optimal output for the region where foreign firms find it unprofitable to import. From the above restriction that the monopoly output is smaller than q^1, this last segment never applies since $q^1 < q^3$. In figure I.7 we draw the twice-kinked marginal revenue function and discuss the optimal output choice.

Neglecting second-order effects on prices a smaller quota affects technology choice by

(3.15) $-\frac{d\Pi}{dm} = -q\frac{dp}{dm} > 0$ Profit level effect

(3.16) $-\frac{d^2\Pi}{dmdb} = \frac{dq}{dm}$ Profit responsiveness effect

The profit level effect (3.15) is positive for all parameter values. The profit responsiveness effect (3.16), however, is negative as long as output is adjusted only within one of the regions defined by q^2 and q^3 but becomes positive if the optimal output choice moves from a binding to a non-binding quota for the foreign firms.

Comparison

In (3.17) we first define a quota m to be as restrictive as a tariff *t* if both allow the same level of imports where $q(t)$ is the equilibrium value of q given *t*.

(3.17) $m = D(p^w + t) - q(t)$

Profit under a tariff (a) and a quota (b) for a given level of imports is

(3.18a) $\Pi(t) = [p^w + t]q(t) - K(q(t))$

(3.18b) $\Pi(m) = p(q(m) + m)q(m) - K(q(m))$

The profit responsiveness to changes in own marginal cost is given by

(3.19a) $\frac{d\Pi^i(t)}{db^i} = -q(t) < 0$

(3.19b) $\frac{d\Pi^i(m)}{db^i} = -q(m) < 0$

Proposition 4

(a) Comparison of tariff and quota protection

Assume $p' + p''q < 0$ and e > 0, let the manager control the marginal cost parameter b, and let the autarky monopoly price p^a be larger than the world market price plus tariff: $p^a > p^w + t$. Then for all m such that (3.17) holds it is true that

(i) $\Pi(t) \le \Pi(m)$

(ii) $q(t) \ge q(m)$

(iii) $\frac{d\Pi(t)}{db^i} < \frac{d\Pi(m)}{db^i}$

The inequalities are strong for $\forall 0 \le q \le q^2$ given that $p^a > p^w + t$. Because for tariff protection profit is lower (i) and the cost responsiveness of profit is higher (iii), it follows from proposition 1 and 2 that switching to a quota reduces the incentives to use the socially beneficial technology z.

(b) Change in protection for a given policy instrument

For both policy instruments profit is decreasing in trade liberalisation; hence proposition 2(b) applies and lower trade barriers favour the choice of the socially efficient technology. Because the cost responsiveness of profit falls with trade liberalisation for both policies, the direction of technology change is ambiguous. For lower t (higher m) the z technology has a lower transfer cost but also a lower profit gain compared to the 0 technology.

Proofs are given in appendix I.D. Part (b) of the proposition extends sentence two of proposition 1 in CABRAL ET AL. (1996) to tariffs levels above zero. A worked example of the Cournot case is provided in appendix I.F.

3.2 Different types of market interaction: Cournot vs. Bertrand

Suppose two firms located in home and foreign produce good x. They have constant marginal cost [$e = 0$] and supply both the home and the foreign markets.[16] Markets have an identical linear inverse demand function. The foreign firm is an incumbent with an installed technology and thus given cost function.

Cournot Quantity Competition

Home firm i's profit is given by[17]

$$\text{(3.20)}\quad \Pi^i = [p_h - b_i]q_{ih} + [p_f - b_i - t_f]q_{if} - F^i$$

[16]The model is due to BRANDER/KRUGMAN (1983).

[17]The first subscript indicates the location of production, the second one the location of sales. The index on the trade costs gives cost of supplying the indexed market.

The first-order conditions on output choice are given by

$$\text{(3.21)}\quad p_h - b_i + \frac{dp_h}{dq_{ih}} q_{ih} = 0 \qquad \text{home market}$$

$$p_f - b_i - t_f + \frac{dp_f}{dq_{if}} q_{if} = 0 \qquad \text{foreign market}$$

At the equilibrium of this market game output and prices are given by

$$\text{(3.22)}\quad q_{ih} = \frac{A^h + c^f + t^h - 2b^i}{3} \qquad q_{if} = \frac{A^f + c^f - 2[b^i + t^f]}{3}$$

$$p_j = \frac{A^j + c^f + b^i + t^j}{3}$$

We first analyse the effects of variations in home market protection t_h. Higher protection increases the level (3.23) and the cost responsiveness of home firm profit (3.24).

$$\text{(3.23)}\quad \frac{d\Pi^i}{dt_h} = \frac{dp^h}{dt_h} q_{ih} + \frac{dq_{ih}}{dt_h}[p_h - b_i] = \frac{2}{3} q_{ih} > 0$$

$$\text{(3.24)}\quad \frac{d^2\Pi^i}{dt_i db_i} = \frac{dp^i}{dt_i}\frac{dq_{ii}}{db_i} + \left[\frac{dp^i}{db_i} - 1\right]\frac{dq_{ii}}{dt_i} = -\frac{2}{9} - \frac{2}{9} = -\frac{4}{9} < 0$$

Secondly, we analyse the effect of higher protection t_f on the export market (lower export subsidies by the domestic government, for example as part of a strategic trade policy, are equivalent policy instruments) the level (3.25) as well as the cost responsiveness of profit decreases (3.26).

$$\text{(3.25)}\quad \frac{d\Pi^i}{dt_f} = \left[\frac{dp^f}{dt_f} - 1\right] q_{if} + \frac{dq_{if}}{dt_f}[p^f - t_f - b_i] = -\frac{4}{3} q_{if} < 0$$

$$\text{(3.26)}\quad \frac{d^2\Pi^i}{dt_j db_i} = \left[\frac{dp^j}{dt_j} - 1\right]\frac{dq_{ij}}{db_i} + \left[\frac{dp^j}{db_i} - 1\right]\frac{dq_{ij}}{dt_j} = \frac{4}{9} + \frac{4}{9} = \frac{8}{9} > 0$$

It has been argued that export subsidies as part of a strategic trade policy have detrimental effects on the efficiency of the exporting industry.[18] In our model, this will be the case if the profit level effect (3.25) outweighs the profit responsiveness effect (3.26), i.e., proposition 2 (b) holds. Under the same condition non-participation in trade liberalisation efforts by trading partners will incur extra costs in terms of a socially inefficient technology choice.

Bertrand Price Competition

In equilibrium firms charge a price just below the sum of the foreign firm's cost plus trade costs if this price is below the monopoly price. No trade occurs and profit is

(3.27) $\Pi^i = [p_i - b_i]q_{ii} - F$ for both countries *h, f*
where $p_i = b_j + t_i$ and $q_{ii} = D(p_i)$ with *D* as the demand function.

Higher import barriers (t_i) raise the level (3.28) and the cost responsiveness (3.29) of profit. Lowering export barriers (t_j) or higher export subsidies have no effect on home firm technology choice. Proposition 5 collects these results.

(3.28) $$\frac{d\Pi^i}{dt^i} = q_{ii} + [p^i - b_i]\frac{dq_{ii}}{dt_i} = q_{ii} + [p^i - b_i]D'(p) > 0$$

(3.29) $$\frac{d^2\Pi^i}{dt_i db_i} = -D'(p) > 0$$

---

[18]This relates to results by BRAINARD/MARTIMORT (1992).

The positive sign of the profit level effect (3.28) follows from a revealed preference argument. The positive profit responsiveness effect (3.29) follows from the downward sloping shape of the demand function.

Proposition 5

(a) Cournot Quantity Competition

Lower import tariffs, lower export subsidies, and participation in multilateral trade liberalisation reduce profit and increase the efficiency of technology choice. Lower import tariffs, lower export subsidies, and participation in trade liberalisation by others reduce the responsiveness of profit to cost. Hence the combined effect on technology choice cannot be signed unambiguously.

(b) Bertrand Price Competition

Lower import tariffs reduce profit and increase the efficiency of technology choice. Lower import tariffs increase the responsiveness of profit to cost, so the combined effect favours the z technology. Export policy has no effect.

3.3 Unilateral vs. multilateral trade liberalisation

In the previous section we looked at the effects of a unilateral change in trade policy by one country. Many practical examples are of a different kind: both within the European Union and WTO the focus is on multilateral liberalisation. Using the results from section 3.2 and setting $dt_i = dt_j$ we get the profit level (3.31) and the profit responsiveness effect (3.32).

(3.31) $$\frac{d\Pi^i}{dt} = \frac{dp}{dt}\left[q_{ih} + q_{if}\right] + \frac{dq_{ih}}{dt}\left[q_{ih} - 2q_{if}\right] - q_{ij} = \frac{2}{3}q_{ih} - \frac{4}{3}q_{if}$$

(3.32) $$\frac{d^2\Pi^i}{dtdb_i} = \left[2\frac{dp}{dt} - 1\right]\frac{dq_{ii}}{db_i} - \left[\frac{dq_{ii}}{db_i} - 1\right]\frac{dq_{ii}}{dt} = -\frac{4}{9} + \frac{8}{9} = \frac{4}{9} > 0$$

Lower trade costs unambiguously increase the responsiveness of profit to own costs (3.32). Lower trade costs only decrease profit if home markets are sufficiently more important to firms than foreign markets: in (3.31) the term in the first brackets, the change in the price level times output, is positive; the term in the second brackets, the change in sales times price-cost margins, however, is only positive for home sales twice as large as exports; the final term is negative and captures the direct cost effect of the tariff on export sales. Appendix I.G provides a worked example of this case where both the profit level and profit responsiveness effect are positive.

Proposition 6

Multilateral trade liberalisation increases the incentives to choose the efficient technology z from both the profit responsiveness and the profit level effect if home markets are sufficiently more important to firms than foreign markets.

Proposition 5 and 6 differ in their perspective: proposition 5 evaluates a country's policy given that other countries liberalise independently while proposition 6 evaluates a joint policy given that otherwise the status quo prevails. Governments have to assess their influence on other countries policies before they can evaluate the effect of their trade policies.

3.4 Integrated vs. segmented markets in duopoly

Trade theory has pointed out the importance of linkages between pricing strategies on different markets. In the context of the European Union's 1992 project these contributions have also entered the political discussion.[19] With market integration firms loose the option to charge different producer prices in different markets. Using the model by MARKUSEN/VENABLES (1988) we analyse the properties of a one-time switch from segmentation to integration. Firms compete in two symmetric markets by supplying differentiated products where β measures the closeness of the products. In each country there is one firm and exports incur trade costs t. Let the combined market size be one with the home market of size s and define $B \equiv [2\beta + 1]/[\beta + 1]$. Then the segmented market equilibrium is characterised by

(3.41) $\Pi^S = B\left[s(p_{11} - b_1)^2 + (1-s)(p_{12} - b_1)^2\right] - F$ profit of home firm

(3.42) $p_{ii}(B + \beta + 1) - p_{ji}\beta - b_i B = a + \beta t$ producer prices
$p_{ji}(B + \beta + 1) - p_{ii}\beta - b_j B = a - (1 + \beta)t$ $\{i, j\} = \{1,2\}; i \neq j$

The integrated market equilibrium in comparison is characterised by

(3.43) $\Pi^I = B(p_1 - b_1)^2 - F$ profit of home firm

(3.44) $p_1(B + \beta + 1) - p_2\beta - b_1 B = a + st\beta - (1 + \beta)(1 - s)t$ producer prices
$p_2(B + \beta + 1) - p_1\beta - b_2 B = a + \beta(1 - s)t - (1 + \beta)st$

[19] EMERSON ET AL. (1988), pp. 145ff.

We can solve for the equilibrium prices in the integrated and the segmented market case. With segmented markets firms have an additional degree of freedom in setting their prices and use this freedom by in(de)creasing their price-cost mark-up on markets where they have more (less) market power. Because firms were free to choose the integrated market price vector solving (3.44) already in the segmented market case, from revealed preference profit is equal or lower after markets have been integrated (3.45).

(3.45) $\Pi^I - \Pi^S \leq 0$

The profit responsiveness effect is given by (3.46). The effect is zero because the producer price under market integration is equal to the producer prices under segmentation weighted by market size. In this class of models the linear demand function implies that producer price cost margins are proportional to sales. Hence market integration changes the distribution of sales over markets but leaves total output/sales constant.

(3.46) $\frac{d\Pi^I}{db} - \frac{d\Pi^S}{db} = 2B\left[\frac{dp}{db} - 1\right]\left[p_1 - sp_{11} - (1-s)p_{12}\right] = 0$

Proposition 7

Market integration increases the private incentives to choose the socially efficient technology because the profit level is reduced. Market integration unambiguously favours technology z because the profit responsiveness effect is zero.

Proof: See appendix I.E

3.5 Imperfect competition models and the effects of trade policy on technology choice: Some general remarks

The preceding sections have analysed the effect of trade policies in different market environments. Two forces, the profit level and the profit responsiveness effect, are shown to drive the results. From propositions 2 and 3 the first force, the new profit level effect, is the only one affecting welfare because in contrast to the profit responsiveness effect it tackles the informational asymmetry. It is "as if" information is cheaper to obtain with lower profits. With one qualification[20] in all trade policy experiment less (lower import tariffs or export subsidies) or more market-friendly (tariff instead of quota) intervention is linked to higher incentives to choose the socially preferred technology. Market integration has the same positive effect.

The previous literature has focused almost exclusively on the second force, the profit responsiveness effect. Propositions 1 and 3 show that this effect has no independent welfare implications even though it has an impact on the direction of technology change. The sign of the effect turns out to be sensitive to the market structure. The ambiguity is a result of the incentive payment to the manager being a fixed cost; hence when choosing a technology owners effectively choose among different pairs of fixed and marginal costs. When output falls, lowering fixed cost becomes more important than lowering marginal cost: the change in profit responsiveness is determined by the change in output (sections 3.1 to 3.3). If output is constant (section 3.4), the effect disappears.[21] Only the profit level effect is present if managers control fixed cost.

---

[20] When firms sell a large share of their output abroad, they receive a windfall profit from multilateral trade liberalisation.

[21] In a related model this has been noted by BERTOLETTI/POLETTI (1995, 1997).

4. CONCLUSIONS

This chapter analyses the effects of increased competition on the efficient choice of technology by a firm owner with incomplete information about the actions taken by a hired manager. The informational asymmetry is indicative of a more general link between competition in the sense of international trade barriers and deviations from the intra-firm structure of a firm as caused by other imperfections like bargaining or matching. Both would create extra gains/costs for a lower production cost technology improving the agents' bargaining position or necessitating it to find an agent with specific characteristics. Both the cost responsiveness of profit and the level of profit are linked to this trade-off.

First, we show that competition provides additional welfare gains on top of the standard allocational benefits if increased competition reduces profit because competition has a beneficial effect on technology choice. The chosen technology has a lower production cost, if in a more competitive environment the advantage of being able to compete with lower cost outweighs the disadvantage of paying an informational rent to the manager. This is the case, whenever competition increases firm output. Note that the paper uses a metric different from the one sometimes applied in asymmetric information problems: the focus is on the inefficiency in technology choice, not the inefficiency in cost targets for a given technology. Private agents choose the "wrong" technology even when the first-best action for any asymmetric information technology can be implemented (section 2.2). On the contrary, it is sometimes socially beneficial to move to a technology with a stronger distortion of the action (appendix I.C).

Second, we apply this framework to a number of international trade settings. This contributes to an ongoing discussion about the internal efficiency of firms and international competition, where the level of trade protection gives a natural interpretation of competitive pressure. Some trade costs are a policy parameter, while this is not obvious for many other parameters used in the IO literature. The trade models analysed incorporate both effects described in the contract model.

The first, the profit level effect, gives the expected positive link between international competition and internal efficiency. More specifically, it points out extra welfare gains from import liberalisation, while it adds to the costs of engaging in strategic export subsidy policies and of not participating in liberalisation of trading partners. The profit level effect is present in all specification; it is the only effect if the manager controls the level of fixed cost or markets move from being segmented to being integrated. It represents what might be called the "Darwinian" element of competition. The empirical evidence provided in appendix I.A strongly supports this prediction.

The second, the profit responsiveness effect, is present in all other cases. Contrary to what one might expect profit is less responsive to cost in most models if import tariffs are reduced or export costs go up. This result parallels the "Schumpeterian" insight on the link between market structure and the incentives to undertake R&D and has appeared in may previous models in the literature. The link is driven by the fixed cost character of management compensation: any policy increasing the output per firm favours the choice of a lower marginal cost technology. Note that this result is not driven by the informational friction and has no independent welfare effects. This would change with a broader measure of welfare including consumer utility.

The structure of the model can be extended to include simultaneous technology choice, allow for a continuum of technologies, feature free entry, or introduce other more complex interactions between firms. Especially the free entry assumption is interesting because it has implications for firm size and thus output levels. In our model we capture the degree of competition through the trade cost parameter t. For other applications the number of firms, a parameter describing demand behaviour, or the cost of entering the industry could be the appropriate parameter to vary.

The model has some obvious applications outside the field of international trade. Deregulation through its effect on entry costs and the number of competitors is one example. Privatisation through its effect on the budget constraint (here assumed to be hard for both the private and the social planner firm) is another. For these applications other models for the internal structure of the firm, for example incomplete contract approaches, might be more useful than the complete contract view adopted here.

Figure I.1

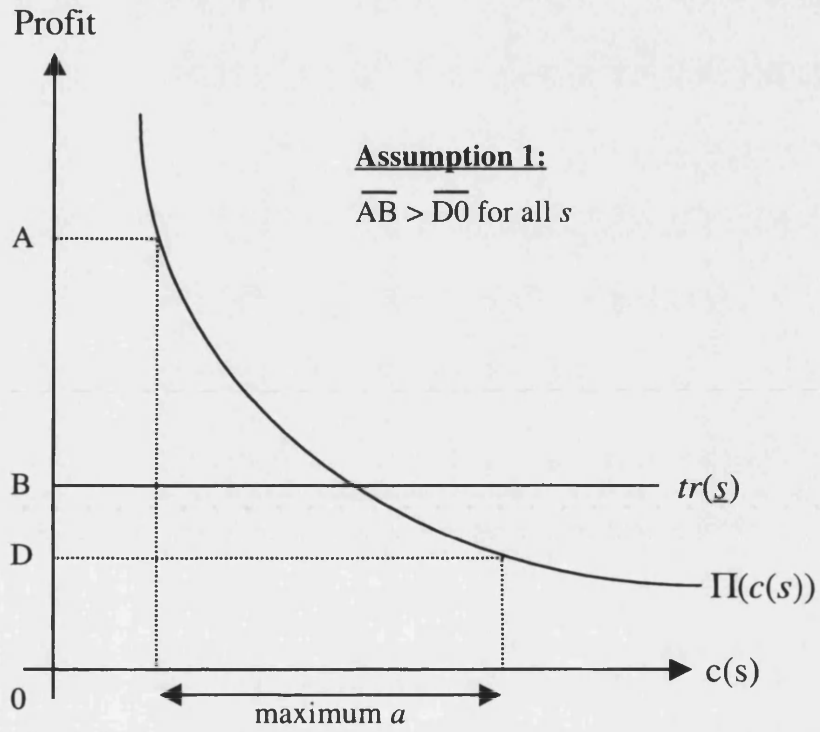


Figure I.1: Effort choice

Figure I.2

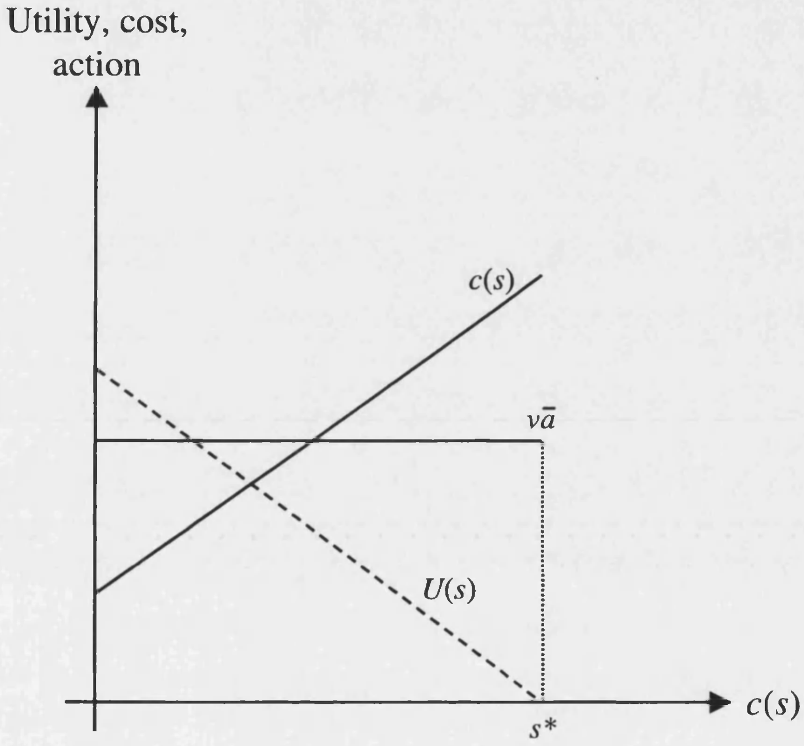


Figure I.2: The optimal incentive contract A

Figure I.3

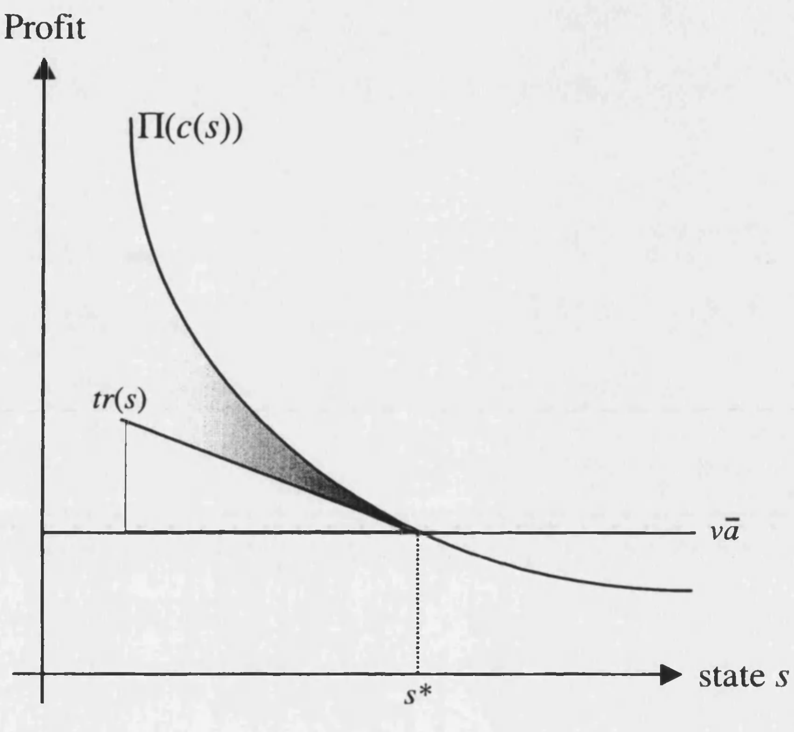


Figure I.3: The optimal incentive contract B

The shaded area corresponds to the net profit remaining for the firm owner after the transfer to the manager has been paid.

Figure I.4

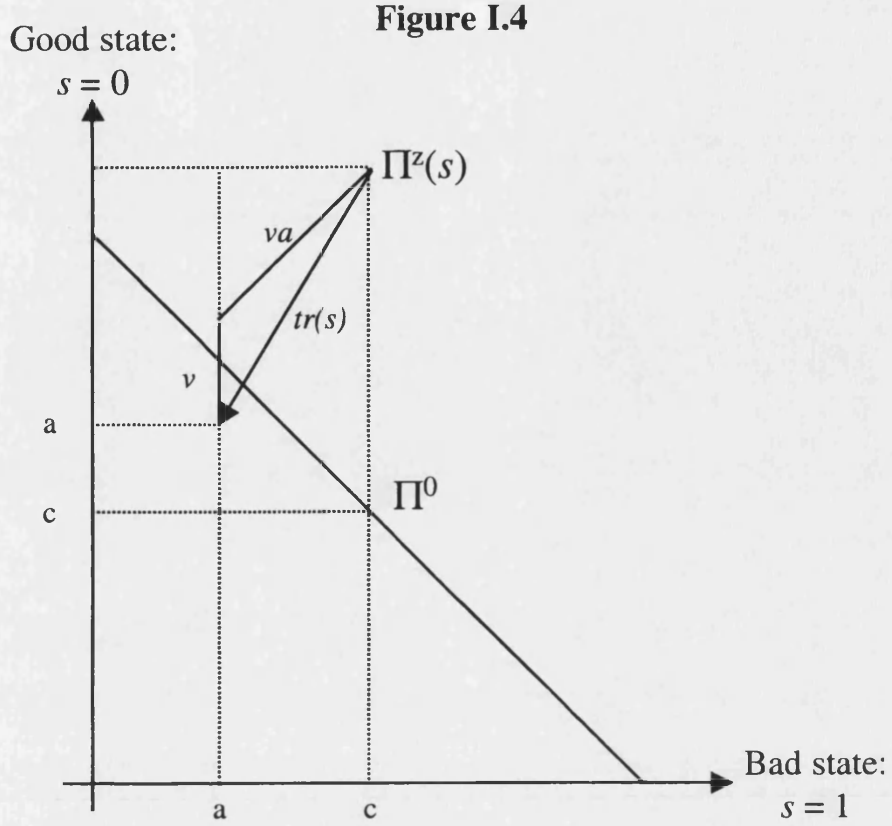


Figure I.4: The technology choice condition

We reduce the state space S to (0;1) with equal probability. On the horizontal line we draw the bad state (s = 1) and on the vertical line the good state (s = 0). The *0* technology has a state-independent cost parameter *c* and its profit is thus on the 45^0-line at point (c;c). We normalise the figure such that the *0* technology profit does not move with changes in competition. The pay-off for the *z* technology requires some more steps: first, the state-dependent profit is above the 45^0-line indicating higher profit (lower cost) in the good state. In the bad state both technologies have the same cost. Second, we deduct the state-independent payment *va* to the manager covering the disutility of effort. Third, in the good state an additional informational rent *v* is paid to the manager. The sum of these two payments is the transfer *tr(s)* indicated by the arrow. After these steps we find the pay-off for the *z* technology at point (a,a).

By comparing (a,a) to (c,c) we can find the preferred technology. The solid line through (c,c) with slope minus unity (the slope depends on the probabilities of the two states) gives the combination of pay-offs equivalent to the safe return. Any point to the right (left) of this line is preferred (worse) to the save return. Hence for the example drawn the owner chooses the *0* technology.

Figure I.5

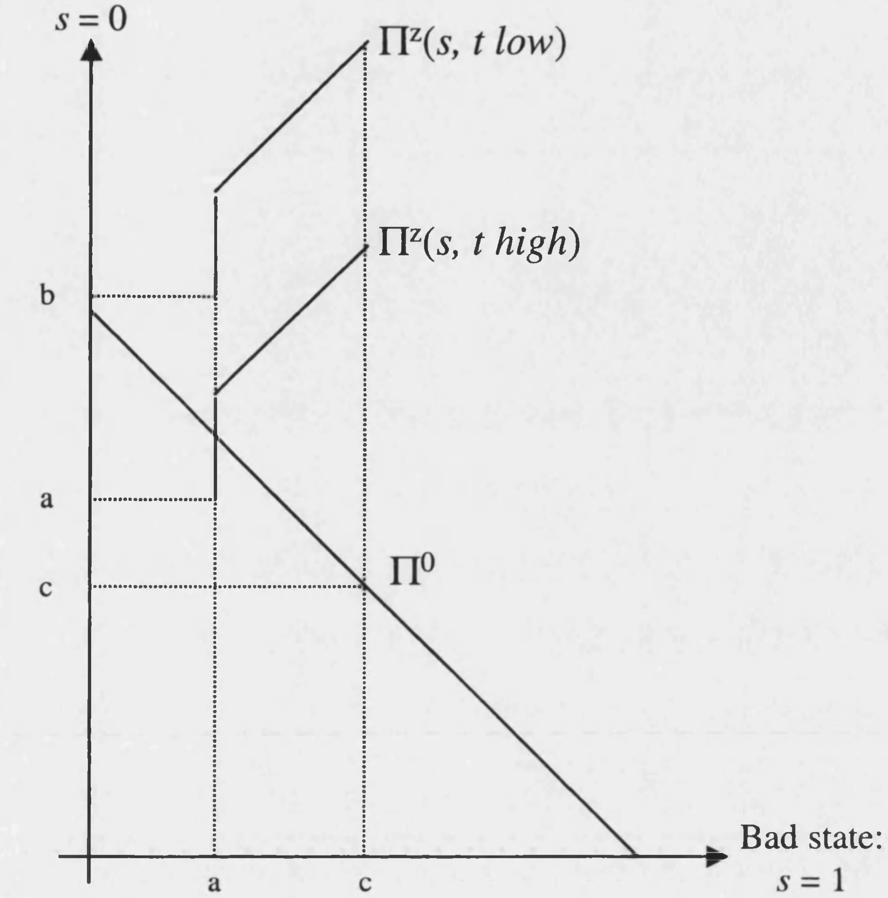


Figure I.5: The profit responsiveness effect

The profit responsiveness effect is a condition on profit differences as a function of cost differences. As drawn here the profit difference increases when t is decreased. At a high t, i.e., low competition, an owner prefers technology 0 because the pay-off for the z technology at point (a,a) is below the solid decreasing line indicating all pairs of returns equivalent to the safe return at (c,c). At a low t, however, i.e.,high competition, an owner prefers technology z because the pay-off for this technology at point (a,b) is above the solid line and thus the expected return from technology z is larger than the save return.

Figure I.6

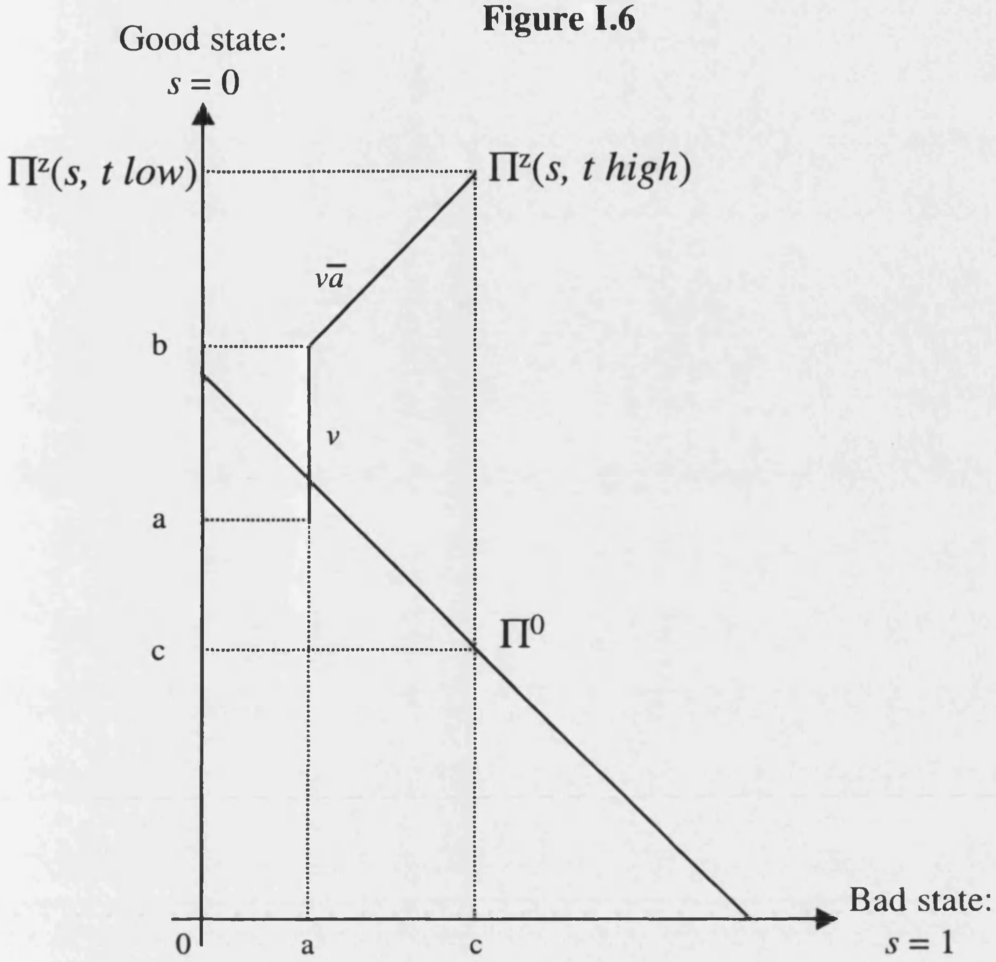


Figure I.6: The profit level effect

The profit level effect works through the influence of competition on the size of the expected transfer payment *tr(s)*. To isolate the effect we set the profit differencebecause of the cost difference to be identical for both levels of *t*. A firm using the *0* technology produces in both states and receives a pay-off at point (c,c) independently of *t*. A firm using the *z* technology produces in both states only for low competition, i.e., a high *t*. In this case the owner has to pay the manager a transfer *tr(s)* including an informational rent *v* and receives a total pay-off given at point (a,a). This point is below the solid line and thus the owner prefers technology *0*.

For high competition, i.e., a low *t*, the firm using the *z* technology produces only in the good state. In the bad state no profit is made but also no transfer has to be paid. In the good state the firm makes a profit and reimburses the manager for his disutility but pays no informational rent. The total pay-off for high competition is given at point (b,0). This point is above the solid line and thus the owner prefers technology z.

Figure I.7

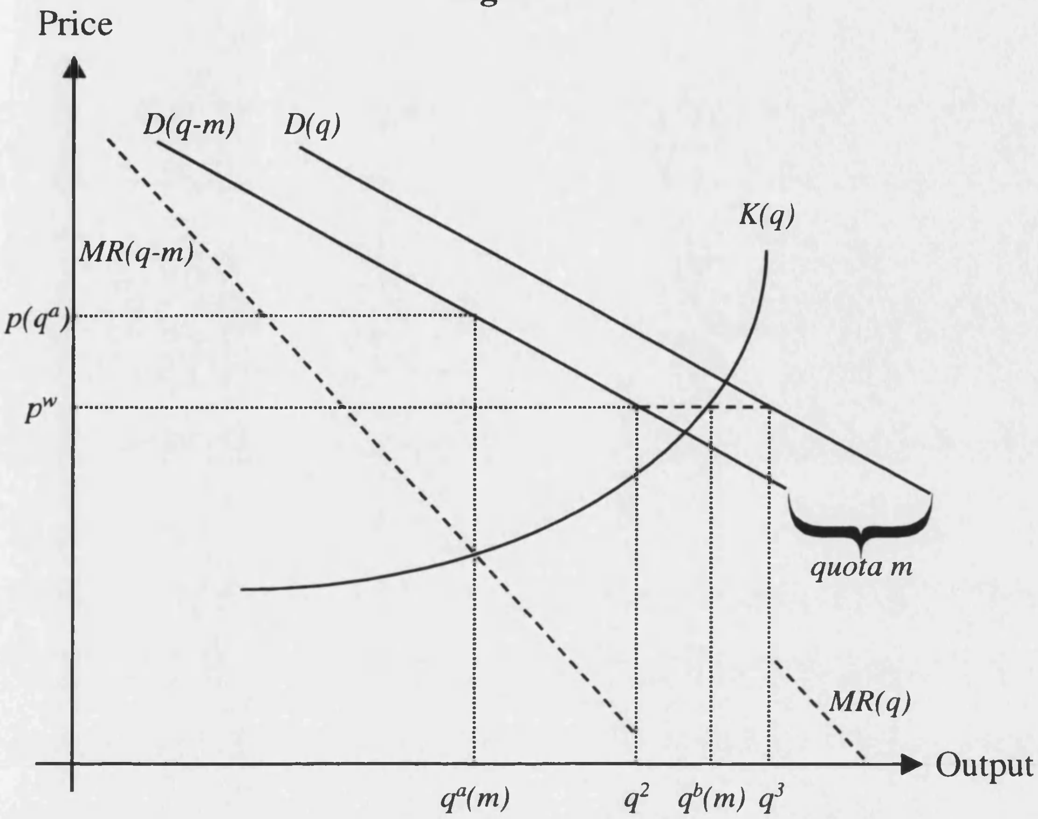


Figure I.7: Home monopoly protected by a quota

In this figure we present the twice-kinked marginal revenue function, represented by the dashed line, for a home monopolist protected by a quota. In the left segment the home firm acts as a monopolist on the residual demand deducting the quota from total market demand. In the middle segment the home firm shares the demand at the world price p^w with the foreign firms. In the right segment the home firm acts as a monopolist and no imports occur. Potentially optimal output choices are given at the intersection of the marginal revenue function with the increasing and convex marginal cost function.

In the case drawn the two lines cross twice: the optimal output is either $q^a(m)$ or $q^b(m)$. For output $q^a(m)$ the quota is binding and the price level high; for output $q^b(m)$ the price level is lower and home and foreign firms divide the market between them. To find the optimal output level $q(m)$ the absolute profit levels have to be compared.

Appendix I.A

Empirical Evidence

A. OECD countries

Author	Countries	Result
McKinsey Global Institute (1993)	United States, Japan, Germany	TFP positively correlated with "globalisation index"
Australian Economic Planning Advisory Commission (1996)	OECD countries	Strong lagged impact of trade liberalisation on growth rates
Irene Bertschek (1995)	Germany	Higher imports and FDI correlated with more product/process innovation
James M. MacDonald (1994)	USA	Rise in Import Share positively correlated with labour productivity growth in concentrated industries

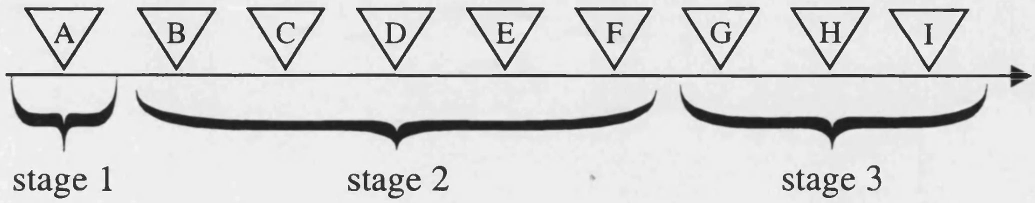
B. Developing Countries

Authors	Country	Result
Ghani/Jayarajah (1995)	seven developing countries	negative link between labour productivity and tariff level
Handoussa/Nishimizu/ Page (1986)	Egypt	positive link between output growth and TFP after trade liberalisation
Harrison (1994)	Côte d'Ivoire	positive link between world market exposure and firm efficiency
Levinshon (1993)	Turkey	negative link between imports and price-cost margins
Nishimizu/Robinson (1984)	Korea, Turkey, Yugoslavia	TFP growth in(de)creasing in larger export (import competing) industry output
Nishimizu/Page (1991)	cross-country	positive link between exports and TFP growth
Tybout/de Melo/ Corbo (1991)	Chile	positive link between trade liberalisation and TFP
Tybout/Westbrook (1995)	Mexico	positive link between trade liberalisation and TFP

TFP - Total Factor Productivity

Appendix I.B.

Timing of moves



stage 1	• Owner chooses technology *z* or 0
stage 2	• contract with cost *c(s)* and transfer *tr(s)* schedules as functions of the shock *s* is signed with symmetric information F(*s*) • nature revealsthe shock *s* to the manager • manager reports the shock *s* to the owner • manager takes action *a(s)* at disutiliy *v(a)* • technology determines *c(s, a(s))*
stage 3	• market game is played • profit Π*(s)* accrues to the owner • manager gets paid *tr(s)* if the cost target has been met

Appendix I.C

In this appendix the optimal incentive contract for technology z is solved for a more complex convex disutility of effort function, a specification that is standard in contract models. We establish that all the main findings of the paper remain true for this modification. The utility function from (1) is now given by

(A1) $U(s,a) = tr(s,a) - v(a)$ with $\dot{v} \geq 0; \ddot{v} \geq 0$

Applying the same procedures as in the main text the problem is one of maximising the following free-end-point Hamiltonian:

(A2) $H = [\Pi(c(s)) - U(s) - v(s - c(s))]f(s) - \lambda(s)\dot{v}(s - c(s))$

The Hamiltonian yields the following optimality conditions:

(A3) $-\frac{\partial H}{\partial U} = \dot{\lambda}(s) = f(s)$

so $\lambda(s) = F(s)$ by the IR condition $U(s) \geq 0 \rightarrow \lambda(\underline{s}) = 0$

(A4) $\frac{dH}{dc} = \frac{d\Pi(c(s))}{dc} + \dot{v}(s - c(s)) + \ddot{v}(s - c(s))\frac{F(s)}{f(s)} = 0$

(A5) $\frac{\partial H}{\partial \lambda(s)} = -\dot{v}(s - c(s)) = \dot{U}(s)$

Equation (A4) defines the optimal cost target *c(s)*. For this solution to be a maximum the SOC in (A6) has to hold. Note that this was not the case in the main text and therefore we had to look for corner solutions.

(A6) $\frac{d^2\Pi(c(s))}{dc^2} - \ddot{v}(s - c(s)) - \dddot{v}(s - c(s))\frac{F(s)}{f(s)} < 0$

In addition, the second-order condition on truth-telling has to be checked. This condition requires the cost target *c(s)* to be non-decreasing in the shock. In the main text this was not a problem as there $\dot{c}(s)=1$; a result which was used later. Here we take the derivative of condition (A4) to obtain

$$\textbf{(A7)}\quad \dot{c}(s)=\frac{\ddot{v}[1+d(F(s)/f(s))/ds]+\dddot{v}[F(s)/f(s)]}{\ddot{v}+\dddot{v}[F(s)/f(s)]-d^2\Pi(c(s))/dc^2}\geq 0$$

A sufficient condition for the numerator to be positive is that the monotone likelihood condition $d(F(s)/f(s))/ds \geq 0$ is fulfilled and $\dddot{v}\geq 0$. Both assumptions are standard in this type of contract problems and are assumed to hold. The denominator is positive by the SOC (A6). Equation (A4) determines $c(\underline{s})$ as the solution to $d\Pi(c(\underline{s}))/dc+\dot{v}(\underline{s}-c(\underline{s}))=0$. Note that this implies the absence of distortions in the cost schedule for the best shock ("at the top").

Finally, we establish the cut-off point s^* for production to take place. For any shock larger than s^* production is unprofitable. Note that the cut-off point does not affect the shape of the cost target schedule, only its domain.

$$\textbf{(A8)}\quad \Pi(c(s^*))=v(a(s^*))$$

Using the above results the utility and the transfer can be written as

$$\textbf{(A9)}\quad U(s)=\int_{\underline{s}}^{s^*}\dot{v}(s-c(s))ds-\int_{\underline{s}}^{s}\dot{v}(s-c(s))ds$$

$$\textbf{(A10)}\quad tr(s)=\int_{\underline{s}}^{s^*}\dot{v}(s-c(s))ds-\int_{\underline{s}}^{s}\dot{v}(s-c(s))ds+v(s-c(s))$$

Having solved for the optimal contract for technology *z* the choice condition for technology *0* is written as (A11), where the left hand side gives the gain and the right hand side the cost of switching to technology *z*.

(A11) $\int \Pi(c^z(s)) f(s)ds - \Pi(c^0) \leq \int [v(s - c^z(s)) + U(s)] f(s)ds$

Changes in competitive pressure as represented by the trade costs t affect the optimal trajectory of cost targets according to:

(A12) $$\frac{dc(s)}{dt} = \frac{d^2\Pi(c(s))/dcdt}{\ddot{v}(s-c(s)) + \dddot{v}(s-c(s))[F(s)/f(s)] - d^2\Pi(c(s))/dc^2}$$

The denominator is positive under the standard assumptions discussed with (A7). The numerator is positive, if proposition 2 from the main text holds. Then cost targets go up with higher trade costs, i.e., protection.

Like in the main text we proceed in two stages: first, the cost of changing technology is hold constant by fixing s^*. Differentiate equation (A11) under this assumption with respect to t and apply the envelope theorem to obtain

(A13) $$\int_{\underline{s}}^{s^*} \Pi_t(c^z(s)) f(s)ds - \Pi_t(c^0) + \int_{\underline{s}}^{s^*} \Pi_c(c^z(s)) \frac{dc^z(s)}{dt} f(s)ds$$

Increased competition leads to the choice of technology z instead of technology 0 if expression (A13) is positive because the inequality in (A11) changes its sign. $\Pi_{ct} > 0$ is a sufficient condition for (A13) to be positive if the expected cost of the z technology (denoted by a tilde) is below the cost of the 0 technology: $\tilde{c}^Z(s) < c^0$. This assures the third term in (A13) to be not too large. Equation (A6) already imposed a condition in this direction. Hence the profit responsiveness pointed out in Proposition 1 continues to hold.

Second, we turn to the profit level effect focusing on the transfer cost side of the choice decision keeping the benefit of changing technology fixed. Recall that the owner only implements cost targets that generate a positive profit (A8). Using this condition we find the effect of an increase in trade costs on the cut-off point s^*:

(A14) $$\frac{ds^*}{dt} = \frac{d\Pi(c(s^*),t)/dt}{\dot{v}(s^*-c(s^*)) - \dot{c}(s)[d\Pi(c(s^*),t)/dc + \dot{v}(s^*-c(s^*))]}$$

If profit is increasing in trade costs then the cut-off point is increasing in protection and expression (A14) is positive as in the main text. This follows from (A7) and (A4), where the latter assures that the term in brackets is negative. Hence with protection generating windfall profits, firms start producing in states with more adverse shocks.

The profit responsiveness effect is ruled out by setting $d^2\,\Pi/dcdt = 0$. Now differentiating the inequality (A11) with respect to the competition parameter t by applying Leibnitz's Rule gives (A15).

(A15) $$\frac{ds^*}{dt}\dot{v}(s^*-c(s^*))F(s^*) > 0$$

From (A14) this expression is positive and the profit level effect in proposition 2 continues to hold. More active states increase the expected size of the informational rent to be paid to the manager and thus increase the costs of switching to the lower production cost technology.

Finally we can turn to the social planner's problem. First the optimal contract for technology z has to be found. The social planner is assumed to have no informational advantage and has to respect a balanced-budget constraint: transfers have to be smaller or equal to profit. This implies that the social planner will implement the same cut-off point s^* as the private owner. The social planner, however, maximises a different objective function. He cares about the joint utility of owner and manager, not the distribution between them. As a consequence, only the disutility of effort to the manager is deducted from the firm's profit. The Hamiltonian of this problem is given by (A16) with the relevant optimality conditions in (A17) and (A18).

$$\text{(A16)} \quad H \equiv [\Pi(c(s)) + U(s) - tr(s)]f(s) - \lambda(s)\dot{v}(s-c)$$

$$\text{(A17)} \quad -\frac{\partial H}{\partial U} = \dot{\lambda}(s) = -f(s)$$

$$\text{(A18)} \quad \frac{\partial H}{\partial c} = \frac{d\Pi(c(s))}{dc} + \dot{v}(s - c(s)) + \ddot{v}(s - c(s))\frac{\lambda(s)}{f(s)} = 0$$

The IC constraint never binds, even though the social planner has no informational advantage because the social planner values manager's utility equal to profit. Lambda is equal to zero throughout and hence $\lambda(s) = 0 \forall s \in S$.

Turning to the technology choice the expected welfare indicator *EW* is

$$\text{(A19)} \quad EW = \int_{\underline{s}}^{s^*} [\Pi(c^z(s)) - v(s - c^z(s))] f(s) ds$$

Technology *0* is preferred over technology *z* condition if

$$\text{(A20)} \quad \int \Pi(c^z(s),t) f(s) ds - \Pi(c^0,t) \leq \int v(s - c^z(s)) f(s) ds$$

Compare this to condition (A11). Condition (A20) is more stringent and thus the first part of Proposition 3 continues to hold. The convex disutility function only imposes a second distortion upon the private owner. The less favourable cost schedule makes it even harder for the *z* technology to be optimal from his perspective.

Appendix I.D: Proof of Proposition 4

The proposition holds in its equality form $\forall q^2 < q$ Comparing (3.11) with (3.13) we find identical first-order conditions describing optimal output choices independently of the policy instrument. Hence the rest of the proof looks at the strong inequality for $\forall 0 \leq q^* \leq q^2$.

(a) $\Pi(t) \leq \Pi(m)$

Suppose the home firm under a quota *m* sets the optimal output *q(t)* it would set under a tariff. Then it would have the same profit in both situations. Plug output in the first row of the first-order condition (3.14) and evaluate at *q(t)* using (3.17):

(D1) $p^w + t - b - eq + dp(q+m)/dq < 0$

While *q(t)* solves (3.11), it is not optimal given the negative *p'*-term in (D1). Profits can be increased by moving to *q(m)*.

(b) $q(t) \geq q(m)$

From (a) we know that the first-order condition under a quota evaluated at the optimal output given a tariff is negative. The second-order condition is

(D2) $2\,dp/dq + d^2p/dq^2\,q - e < 0$ by assumption

(D2) implies that the first-order condition under the quota will hold for a lower q.

(c) $\frac{d\Pi^i(t)}{db^i} < \frac{d\Pi^i(m)}{db^i}$

(D3) $\frac{d\Pi^i(m)}{db^i} - \frac{d\Pi^i(t)}{db^i} = -[q(m) - q(t)] > 0$

(D3) follows directly from (b).

Appendix I.E: Proof of Proposition 7

We start by solving the system of equations in (3.42) and (3.44) for the equilibrium producer prices. The relevant prices are given by

(E1)
$$p_1 = \frac{[B+\beta+1][Bb_1 + a + t\{2s\beta - 1 + s - \beta\}] - \beta[Bb_2 + a + t\{\beta - 2s\beta - s\}]}{[B+\beta+1]^2 - \beta^2}$$

$$p_{11} = \frac{[B+\beta+1][Bb_1 + a + t\beta] - \beta[Bb_2 + a - t\{1+\beta\}]}{[B+\beta+1]^2 - \beta^2}$$

$$p_{12} = \frac{[B+\beta+1][Bb_1 + a - t\{1+\beta\}] - \beta[Bb_2 + a + t\beta]}{[B+\beta+1]^2 - \beta^2}$$

so we can write $X \equiv \frac{dp_1}{db_1} = \frac{dp_{11}}{db_1} = \frac{dp_{12}}{db_1} = \frac{[B+\beta+1]}{[B+\beta+1]^2 - \beta^2} > 0$ with $\frac{1}{2} \geq X \geq \frac{1}{3}$

Also note that $p_{11} \geq p_1 \geq p_{12}$ with strict inequalities for $t > 0$ and $0 < s < 1$.

Using this result and the profit expressions (3.41) and (3.43) we get (E2) proving (3.46) in the main text. The producer price in the integrated market case is equal to the market size weighted producer price in the segmented market case.

(E2) $p_1 = sp_{11} + [1-s]p_{12}$

The profit difference can be written as (E3). (E3) follows from the quadratic and thus convex transformation of the individual prices in (E2). Normalising the integrated market producer price to unity, the inequality in (E3) holds in its strict form if trade costs are positive and both markets exist: $0 < s < 1$. If one of these two conditions is violated, (E3) holds as an equality.

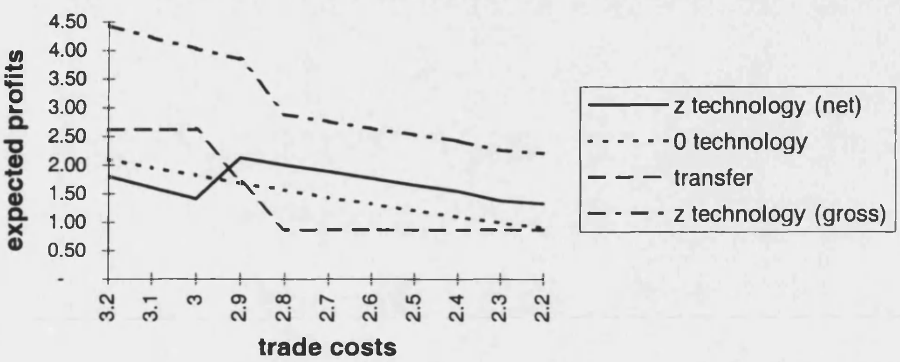
(E3) $p_1^2 \leq sp_{11}^2 + [1-s]p_{12}^2$

This proves (3.45) and proposition 7.

Appendix I.F

In appendices I.F. and I.G we provide two worked examples. The market models have inverse linear demand with unit slope. Parameter values are given below. The state space is reduced to two with equal probability. The values for own costs give marginal costs in each state. The base transfer equals the disutility of effort for maximum action.

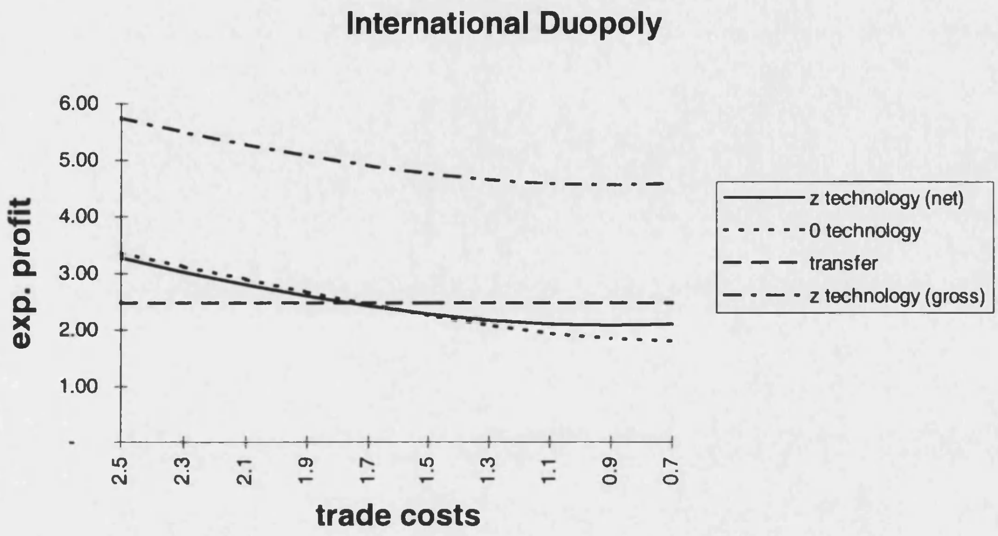
Home Monopoly: The profit level effect



World market price 4; own cost b in good (bad) state: 2 (4.3), $e = 1$, base transfer: 1.75, informational rent: 1.75

The home monopoly case shows the profit level effect. When trade costs fall below 3, production in the bad state is unprofitable. All informational rents disappear and the z technology is chosen even though production takes place only 50% of the time. The social planner chooses technology z for all trade cost values shown.

Appendix I.G



Market size: 10(10); own cost: 3.5(5), competitor's costs: 3, base transfer: 1.65.

The international duopoly case shows the profit responsiveness effect. When trade costs fall below 1.8, the advantage of lower marginal costs for the z technology dominates the transfer payment. The social planner chooses the z technology for all trade costs shown.

Chapter II

Trade liberalisation as facilitating merger

1. INTRODUCTION

In this chapter we develop a framework to analyse the link between trade liberalisation and industry restructuring. Our model analyses how entry, exit, and merger determine the number and cost distribution of firms. We show that trade liberalisation facilitates merger, exit, and internal restructuring to eliminate high cost firms from the industry and that multinational firms respond particularly strongly in response to the reduction of trade barriers. The whole restructuring process, including all privately profitable mergers, is welfare improving.

Our work is motivated by the increase in take-over and merger activity through out the European Union in the early 1990s. This merger activity is viewed as part of the restructuring process European industry is going through in response to the Single European Market. Many observers welcome this process because they argue that restructuring is a necessary condition for the productivity improvements expected from the Single Market. This perspective represents a remarkable shift away from the usual, more critical view of mergers focusing on market power effects.

Before outlining the model and reviewing the related literature we establish some stylised facts about the merger activity in the EU based on appendix II.A. The time period covered stretches from the early 1980s to the completion of the Single European Market in 1992:[1]

(1) The number of mergers rose sharply until 1990 but decreased afterwards.

(2) The share of cross-border mergers rose towards the peak of the merger wave

(3) Merger motives shifted from cost reduction to increases in market share.

To analyse these facts we build upon a standard new trade theory model with free entry adding two new elements: first, firms face ex-ante uncertainty about their own type and are ex-post heterogeneous. Second, incumbent firms can merge at any time to reduce cost and potentially increase market power. We describe the industry by the number of active firms and the highest fixed cost of any active firm. In steady-state equilibrium the industry satisfies the following conditions: first, no active firm looses money (***exit condition***); second, no active firm can be bought up profitably (***merger condition***); and third, no outside firm has an incentive to try and enter the industry (***entry condition***). In a final section equilibrium further requires firms to be indifferent between having a domestic or a multinational production structure (***type choice condition***).

While the first condition is standard we concentrate on the second and third condition in a framework of heterogeneous firms. We find that the merger condition has a discontinuity at the number of firms where the entry condition binds. Below that critical number of firms mergers only reduce cost while above

[1] The data applies to all mergers while the model is restricted to horizontal mergers; in 1992 this group accounted for 47% of all mergers observed at the three-digit industry level.

that number they also increase market power. Finally, we give an interpretation of the type choice condition slightly different from the previous literature.

We look at two equilibria that both satisfy the steady-state equilibrium conditions but arise from different initial industry conditions, i.e., numbers of firms. In the first equilibrium, which we call ***initial equilibrium***, both the entry and the merger condition bind while the exit condition may be slack. We think of this initial equilibrium as the outcome of an entry and merger process starting from a number of firms below the steady-state equilibrium level. In the second equilibrium, which we call ***post-liberalisation equilibrium*** because it is the result of a trade liberalisation experiment, only the merger condition binds while both the exit and entry conditions may be slack. We think of this post-liberalisation equilibrium as the outcome of an exit and merger process starting from a number of firms above the steady-state equilibrium level. The existence of two types of equilibrium, a simple form of history dependence, follows from the sunk character of entry cost. Potential entrants compare expected future profit to the sunk entry cost while incumbent firms only calculate future profit neglecting the sunk entry cost.

We draw on different strands of the industrial organisation and new trade theory literature. From the industrial organisation literature SALANT ET AL. (1983) provide the background for the merger analysis. They sum up their results on the private incentives for horizontal mergers in the "merger-for-market-power paradox": in the absence of sizeable cost reductions a merger to increase market power is not privately profitable, unless the merging firms already dominate the market. Subsequent work by DAVIDSON/DENECKERE (1985), PERRY/PORTER

(1985), DUTZ (1989), WILLIG (1991), and FAULÍ-OLLER (1997) shows how this effect can be weakened, or even eliminated as in REITZES/LEVY (1995), by making diverging assumptions on market and cost structures. DUTZ (1989) and VAN WEGBERG (1994) look at the comparative statics of the model in response to price and demand shocks. We analyse the implications of the "merger-for-market-power-paradox" in the context of international trade liberalisation.

ROSS (1988), ORDOVER/WILLIG (1986), VAN LONG/VOUSDEN (1995), and recently HORN/PERSSON (1996) analyse mergers in an international context. Merger policy is analysed in FARELL/SHAPIRO (1990), MCAFEE/WILLIAMS (1992), and extended to an international setting by BARROS/CABRAL (1994). Except for HORN/PERSSON (1996), who use a co-operative bargaining approach, all these papers take the private profitability of a merger as given and focus on the residual effects on competitors and consumers. VARIAN (1995) and VICKERS (1995) show that the welfare results of this literature change when free entry of firms is assumed. We analyse welfare for an endogenously determined number of firms and the restriction that all mergers have to be privately profitable.

From the international trade literature BRANDER/KRUGMAN (1983), VENABLES (1985), and HORSTMANN/MARKUSEN (1986) provide the background of the market structure analysis. The two latter papers characterise the comparative statics of trade liberalisation in the context of free entry and homogenous firms, while we add merger as an adjustment mechanism and allow for heterogeneous firms. MERCENIER/SCHMITT (1996) provide an entry model where all fixed costs are assumed to be sunk. This assumption reduces the welfare gains of trade liberalisation and may even lead to welfare losses. We introduce a sunk entry cost but assume that all future fixed costs can be recovered.

MARKUSEN/VENABLES (1995), MARKUSEN (1995), BRAINARD (1993), and HORSTMANN/MARKUSEN (1992) analyse multinational firms which in our model can arise endogenously as a consequence of cross-border merger. In contrast to their general-equilibrium setting with a focus on factor costs we restrict the analysis to partial-equilibrium and concentrate on the effects of competition.

The idea of competition as a selection mechanism to eliminate underperforming firms parallels work by CABALLERO/HAMMOUR (1994) and AGHION/HOWITT (1992) on the cleansing effects of recessions. SJÖSTRÖM/WEITZMAN (1996) use an evolutionary model of type survival but provide no specified market structure. We introduce firm heterogeneity as in LIPPMAN/RUMELT (1982) to analyse the characteristics of surviving firms after trade liberalisation.

The remainder of the chapter is organised as follows. Section 2 sets out the underlying product market game. Section 3 analyses autarky. In section 3.1 we derive the ***initial equilibrium*** in autarky. In section 3.2 we characterise the welfare properties of this equilibrium. Section 4 looks at the effect of trade liberalisation. Section 4.1 analyses the adjustment process to the free trade ***post-liberalisation equilibrium***. Section 4.2 characterises the welfare implications of the adjustment to this equilibrium. Section 4.3 studies intermediate trade costs and multinational firms. Section 5 concludes.

2. THE MODEL OF THE INDUSTRY

We analyse the partial equilibrium effects of trade liberalisation in an industry model with entry, exit, and merger. The industry produces a homogenous good and firms engage in NASH-COURNOT quantity competition in two countries called home h and foreign f. Production and consumption take place in both countries. Let the output of a representative firm be q^{jk} where superscript j indicates the location of production and k the market where the product is sold. Trade between two countries incurs a per-unit trade cost t.

Demand is given by a downward sloping inverse demand function D with limited convexity to assure the second-order conditions of the firms' problems to hold and firm output to be decreasing in the number of firms.

$$(1) \qquad P^k = D\left(\sum q^{jk}\right) \qquad \text{with} \qquad dD/dq + q^{jk}\, d^2D/dq^2 < 0$$

Firms have cost functions C^i with a constant marginal cost c equal for all firms and a firm-specific fixed cost F^i.

$$(2) \qquad C^i\left(q, F^i\right) = cq + F^i \quad \text{where} \quad F^i \in \left[\underline{F}; \overline{F}\right]$$

When entering the market, firms draw a fixed cost parameter F^i from a given and known cumulative distribution $G(F)$. If a firm stays in the market, it keeps this fixed cost draw in all time periods thereafter. Differences in marginal cost would allow more insights into the characteristics of the buyer in the merger process.[2] They come, however, at the cost of additional state variables in the

[2] VICKERS (1995) uses a heterogeneous marginal cost model to look at the welfare problems analysed in section 3.2.

system. On balance, we choose the heterogeneous fixed cost model because it allows us to address the main questions in a tractable framework.

Firms' optimal output choices satisfy the first-order conditions (3) and the attached second-order conditions.

(3) $P^k - c - t + q^{jk} dP^k / dq^{jk} = 0$ with $t = 0$ for domestic sales

The operating profit π of a firm located in country j is given by

(4) $\pi^j = \sum_{k=h,f} [P^k - t - c] q^{jk}$

The operating profit π evaluated at the NASH-equilibrium of the market game (i.e., at the output vector solving (3) simultaneously for all firms) depends on the number of active firms $N \equiv N^h + N^f$ and the level of trade costs t. It is identical for all active firms because all firms compete with the same level of marginal cost. The level of profit Π^i is linear in the operating profit π and a firm's own fixed cost F^i. Other firms' fixed cost draws do not influence own profit.

(5) $\Pi^i(N^h, N^j, t, F^i) = \pi(N^h, N^f, t) - F^i$

In appendix II.B we further establish that operating profit is decreasing and convex in the number of firms N in the industry

(6) $\frac{d\pi}{dN^j} < 0; \frac{d^2\pi}{dN^{j2}} > 0$

3. AUTARKY

In this section we analyse the industry equilibrium in autarky: no trade takes place and both country superscripts and trade costs can be dropped from the notation. The industry is described by the number of home firms N and the maximum of an ordering $F(i)$ over the fixed costs of active firms. We restrict the analysis to the steady-state equilibrium values defined by N^* and the maximum of $F(i)$ such that no further changes occur. At a steady-state equilibrium three conditions have to hold: first, no active firm finds it profitable to leave the industry (***exit condition***); second, no firm outside the industry finds it profitable to enter the industry (***entry condition***); and third, no pair of active firms finds it optimal to merge (***merger condition***). These three conditions are analysed in turn.

First we define two types of steady-state equilibrium depending on the initial number of firms active in the industry. In the remainder of section 3, we analyse the ***initial equilibrium*** where entry and merger determine the characteristics of the industry. In section 4, we analyse a ***post-liberalisation equilibrium*** where exit and merger are crucial.

Definition

We define the steady-state equilibrium of an industry by a number of firms N^* and the maximum $F^z = F(N^*)$ of an ordering $F(i)$ over the fixed costs of all active firms such that no further entry, exit, or merger occurs. If the steady-state is approached from a number of firms $N < N^*$ we call it an ***initial equilibrium****. If the steady-state is approached from a number of firms $N > N^*$ we instead call it a* ***post-liberalisation equilibrium****.*

3.1 Initial industry equilibrium

We describe the steady-state equilibrium by three conditions: one for entry, one for merger, and one for exit. It turns out that in the ***initial equilibrium*** the entry condition describes the number of active firms N in the industry while the merger condition describes the maximum of the fixed cost ordering $F(i)$. The exit condition determines the behaviour of firms after entry.

The ***exit condition*** for firms already in the industry is standard: firms stay in the industry if the operating profit is larger than the fixed cost. The function $F(i)$ sorts all active firms by their type-specific fixed cost level F^i in increasing order. Due to the heterogeneity of firms the exit condition can at most bind for the firm(s) at the top of the fixed cost ordering $F(i)$.

(7) $$\pi(N) \geq F^i \quad \forall i$$

The ***entry condition*** for firms outside the industry takes account of the ex-ante uncertainty of a firm's fixed cost type after entry. Firms draw their fixed cost type F^i from the distribution $G(F)$ with domain $[\underline{F};\overline{F}]$ and a marginal density function $g(F)$. This fixed cost draw is costly: a firm has to pay an amount E to learn its type, i.e., its fixed cost level. A firm stays in the market if it is able to generate a positive profit given the firm-specific level of fixed cost. Otherwise it pays E and never actively enters the industry.

Potential entrants calculate the expected return of entry in two steps: first, they find the discounted sum of profit for any given fixed cost type between the date of entry and the projected exit date for this type. Second, they sum up all expected profit weighted by the probability of such a fixed cost draw. Let the discount rate be r and the time path for the number of firms in the industry $N(\tau)$. From the definition of the initial equilibrium $N(\tau)$ is here weakly increasing over time. Entry attempts occur as long as the expected future profit is larger than the entry cost *E*. While the entry cost is given exogenously, the expected future profit depends on future market conditions. We assume that potential entrants view the time path $N(\tau)$ to be independent of their own action. Comparing expected future profit to the entry cost an entry attempt is profitable if

$$\text{(8)} \qquad \int_{\underline{F}}^{\overline{F}}\left[\int_{\tau}^{T(s)}\{\pi(N(\tau)+1)-s\}e^{-r\tau}d\tau\right]g(s)ds \geq E$$

where the exit date is given by $T(s)=\begin{cases}\tau & \text{if} \quad Max\pi(N(\tau)+1)<s \\ \pi(N(\tau)+1)=s & \text{otherwise} \\ \infty & \text{if} \quad Min\pi(N(\tau)+1)\geq s\end{cases}$

The left hand side of the entry condition (8) gives the discounted value of profit for a firm with a fixed cost draw sufficiently low to survive in the industry for some time. The exit date is given by *T(s)* when operating profit equals the fixed cost. Exit occurs immediately if the fixed cost draw is above the operating profit. Exit occurs never if the fixed cost draw is below the operating profit at all dates. The discounted value of profit is multiplied by the likelihood of the particular fixed cost draw. The right hand side of the entry condition (8) gives the cost of entering the market. The exogenous entry cost is given by *E*, the price of finding out about one own's fixed cost type.

Figure II.1 shows the entry condition determining the number of firms in the industry. The expected discounted future profit is convex and declining in *N* from the characteristics of the product market equilibrium (6) while the entry cost E is constant and exogenous. The intersection of both lines determines the equilibrium number of firms N^*. The steady-state equilibrium N^* is stable because the profit function intersects the entry cost line from above and thus entry is profitable only for $N < N^*$.

Two assumptions are embedded in the entry condition (8): first, entrants forecast the time path of $N(\tau)$ correctly. This expectation gives medium incentives to enter the industry because entrants include the expected profit of fixed cost draws that allow them to stay in the industry for a limited time. Alternatively, entrants could expect the number of firms to be stable after entry. This expectation gives the upper bound of the incentives to enter because entrants expect to get the next period profit for the indefinite future. Finally, entrants could expect the number of firms to reach the equilibrium value instantaneously. This assumption gives the lower bound of the incentives to enter because firms expect next periods profit to be eroded very quickly. In equilibrium no further entry occurs and the three beliefs converge to be all identical and correct.

Second, entrants to be bought up later assume they will receive the discounted value of their profit as the take-over price. Off-equilibrium this is a lower bound and depends on the bargaining process over the merger gains. In equilibrium merger gains go to zero and the belief is correct for the marginal firm.

The ***merger condition*** applies to firms already active in the industry. Mergers have two potential effects: first, the merging firms can reduce their fixed cost level; second, the merging firms might enjoy increased market power. A reduction of fixed cost is possible by exploiting the increasing returns character of the technology. Suppose the merger of two firms results in the reduction of combined fixed costs by $F^i + a$. F^i is the fixed cost of the merger target while a positive value for a indicates a fixed cost level for the merged entity below the fixed cost of the lower-cost pre-merger firm. One can think of this process as two firms joining the functions where they have a particular advantage and thus are able to achieve some "best practice" after merger. The cost reduction a is non-negative because firms always have the option to shut down the merger target.

An increase in market power can reduce a merger's opportunity cost of closing one of the merging firms and thus losing its potential profit. Market power is increased only if the merger is successful in reducing the number of firms in the industry, i.e., if after the merger entry by new firms is not profitable from (8). Below this threshold N^* new entry immediately restores the pre-merger number of firms and thus the level of market power enjoyed by any firm. Above the threshold N^* no entry occurs and merger raises market power. At the threshold N^* the merger condition thus has a discontinuity because the profitability of a merger jumps if $N > N^*$; this increase is denoted by the term b.

A merger is profitable if over the life time of the firms the cost reduction and the increase in market power generate a pay-off in excess of the opportunity cost of closing one operation. Let firm i have higher fixed cost than firm j: $F^i \geq F^j$ and let T^i be firm i's exit date without merger. A merger is profitable if

(9) $$F^i \frac{1-e^{-rT^i}}{r} + a\frac{1-e^{-rT^j}}{r} \geq \int_0^{T^i} \{\pi(N(\tau)) + b\} e^{-r\tau} d\tau$$

where $$\begin{aligned} &b = 0 && \text{if} \quad N-1 < N^* \\ &b = d\pi(N(\tau))/dN && \text{if} \quad N-1 \geq N^* \end{aligned}$$

and N^* is the number of firms below which entry is profitable.

The left hand side of the merger condition (9) gives the merger gain; the discounted value of the cost reduction over the projected life time of a firm in the absence of merger. The right hand side of (9) gives the merger cost; the discounted opportunity cost of eliminating one firm adjusted by the market power effect *b* if the number of firms after the merger is above the threshold N^*.

The profitability of the merger varies with the fixed cost of the take-over target. Buyers face a trade-off between the opportunity cost (decreasing in F^i) and the cost and market power gain (concave in F^i). In equilibrium all active firms correctly anticipate to survive indefinitely such that the highest fixed cost firm is the most profitable merger target.

Proposition 1

*The **initial equilibrium** is the outcome of an entry process where the equilibrium number of firms is approached from below. In the initial equilibrium the unique number of active firms N^* solves*

(10) $$\int_{\underline{F}}^{\pi(N^*)} \int_{\tau}^{\infty} \{\pi(N^*) - s\} e^{-r\tau} d\tau g(s) ds = E$$

The highest fixed cost of any firm in the initial equilibrium is given by

(11) $$F^z(a) = \pi(N^*) - a$$

Proof:

In equilibrium, entrants anticipate to either exit immediately, $F^i > \pi(N^*)$, or never, $F^i \leq \pi(N^*)$, and the expected future profit of an entrant is equal to the entry cost. With indifference about entry we assume firms to stay out. Condition (8) can be rewritten as (10).

No firm exits the industry and any merger would trigger entry, i.e., $b = 0$: (9) reduces to (11).

The steady-state equilibrium has a number of interesting features. First, even though there is entry all active firms make a profit. This is a result of both the sunk entry cost and the heterogeneity of firms. Second, the size of the cost saving *a* influences only the shape and upper limit of *F(i)* but not the equilibrium number of firms. Large efficiency gains through merger eliminate high fixed cost firms but also trigger entry. Third, proposition 1 implies the merger-for-market-paradox by SALANT ET AL. (1983): attempts to increase prices and thus mark-ups by reducing industry output through mergers are futile. New entrants push the industry output back to the pre-merger level and appropriate the positive merger externality. Mergers are only profitable when they reduce costs sufficiently.

Figure II.2 identifies the marginal firm in equilibrium. The function *F(i)* orders firms by their fixed cost level with $dF(i)/di \geq 0$ and $F(N^*) = F^z$. Suppose firm *i* has a fixed cost level $\pi(N) > F(i) > \pi(N) - a$. Then the cost of a merger is equal to the profit of firm *i*, i.e., $\pi(N) - F(i)$, but brings a gain of *a*. The net gain is positive, hence all firms with fixed cost above $\pi(N) - a$ are valuable merger targets. The merger process stops at the equilibrium defined by proposition 1 when for the marginal firm $F(i) = \pi(N) - a$.

3.2 Social welfare analysis

We assume that the government is unable to regulate firm output but can influence entry barriers and merger.[3] Under this policy restriction it is a well-known result[4] that the number of firms N^* in a free-entry equilibrium might be

[3] Otherwise the social planner would trivially choose one firm to sell at marginal cost and finance the losses by lump-sum taxation.
[4] This section draws upon VARIAN (1995), and VICKERS (1995) who build upon on an earlier literature especially on MANKIW/WHINSTON (1986).

too large from a social welfare perspective. We show that this result carries over to the present model.

Social welfare W as a function of the number of firms is given by

(12) $$W(N) = U(qN) - cqN - \sum_{i \in N} F^i$$ where U is consumer utility

Differentiating $W(N)$ with respect to the number of firms and evaluating at the industry equilibrium, i.e., at equilibrium such that (11) holds, we get

(13) $$\frac{dW}{dN} = [p(qN^*) - c]\left[q + \frac{dq}{dN} N^*\right] - F^z - a = \frac{dq}{dN} N^*[p(qN^*) - c] < 0$$

The final term in (13) is given by the difference between the increase in consumer surplus and the profit lost by all incumbent firms; this difference is neglected in the private entry decision. The neglect of the effect of entry on incumbents' profit is called "business stealing". From the equilibrium of the market game we show in appendix II.B that output per firm is decreasing in the number of firms N. Hence (13) has a negative sign; the number of firms at the private equilibrium is too large from a social planner's perspective.

Subsidising merger, i.e., increasing a, is an ineffective policy because it triggers additional entry. From (11) in proposition 1 the increase in a reduces the fixed cost of the marginal firm by an equal amount. This cost reduction, however, has no effect on the change in welfare because it only transforms public resources into a lower private cost one-to-one. An increase in entry cost E is the constrained optimal intervention.

Proposition 2

*A social planner constrained to choose entry cost sets them higher than given by technology at E. The increase in entry cost reduces the equilibrium number of firms to N**.*

(14) $N^{**} < N^{*}$

The fixed cost of the marginal firm F^{s} in the social planner equilibrium is increased compared to the private equilibrium.

(15) $F^{s}(a) = \pi(N^{**}) - a > F^{z}(a)$

Proof:

First apply the implicit function theorem on (10) to get $dN/dE < 0$ from the negative relationship between profit and the number of firms (6) implying (14). Second evaluate the equilibrium condition (11) at the lower number of firms $N^{**}<N^{*}$ to get (15) again using the properties of the profit function (6).

The proposition strengthens a result by HORSTMANN/MARKUSEN (1986) on inefficient entry in an international trade model. They point out that in a free entry model a policy of strategic export subsidies invites additional producers to the domestic industry and thus increases industry wide average cost. In the context of autarky an entry subsidy is a policy experiment with equivalent implications to an export subsidy in a trade model. From proposition 2 even zero entry (export) subsidies generate too many firms in the industry.

Figure II.3 graphs the entry decision. The social gains of entry are always smaller than the private gains by the sum of lost competitors' profit minus additional consumer surplus, i.e., (13), while both face the same entry cost *E*. A social planner favours a smaller number of active firms in the economy.

4. TRADE LIBERALISATION, EXIT, AND MERGER: THE POST-LIBERALISATION EQUILIBRIUM

In this section we analyse the second type of equilibrium defined at the beginning of section 3, the ***post-liberalisation equilibrium***. In contrast to the initial equilibrium of the previous section the industry approaches the steady-state from a given population of $N > N^*$ active firms again described by a fixed cost ordering $F(i)$ where N^* is the number of firms that would arise in an initial equilibrium given the market environment after the trade policy experiment. In contrast to the previous section now exit instead of entry complements merger to dominate the adjustment process to the steady-state equilibrium.

Suppose the industries in countries home h and foreign f are both in an initial steady-state equilibrium characterised by proposition 1. We analyse the comparative statics of this equilibrium with respect to a change in trade costs t. In section 4.1 we remove all trade barriers between countries and set $t = 0$. Taking the initial number of firms and their fixed cost distribution as the starting point we analyse the adjustment process to the post-liberalisation equilibrium.

In section 4.2 we introduce intermediate values for trade costs t. A new type of firm, called multinational M, with production facilities in both markets appears in the industry and in steady-state a new ***type choice condition*** applies assuring that firms do not want to change their type. A multinational firm has the advantage of serving both markets without incurring trade costs but faces an extra fixed cost H. From the OLI-framework[5] only locational factors in the sense of "tariff-hopping" are included.

[5] OLI stands for Ownership, Location, and Internalisation. See MARKUSEN (1995).

4.1 Moving to free trade

In this section we analyse the effect of moving from autarky to free trade on the steady-state equilibrium. To account for the effect of trade costs we write operating profit $\pi\left(N^h, N^f, t\right)$ and profit $\Pi^i\left(N^h, N^f, t, F^i\right)$ as functions of *t*. For simplicity we consider symmetric countries: country indices can be dropped.[6] In each country the steady-state equilibrium before trade liberalisation is described by a pair $\left\{N^*(t), F^z(a,t)\right\}$ for the number of active firms in the industry and the fixed cost level of the marginal firm satisfying proposition 1. The autarky equilibrium with $t = \infty$ is drawn for one of the two countries in figure II.4: the industry is described by the ordering *F(i)* with the maximum at $F\left(N^*(\infty)\right) = F^z(a)$. $N^*(\infty)$ is given by the intersection of the entry cost and the autarky profit and $F^z(a)$ is equal to the entry cost *E* minus the cost reduction *a*.

Suppose governments in both countries agree to eliminate all trade barriers between the two markets. This increases market size $(t \to 0)$ but also raises competitive pressure $(N \to 2N)$. VENABLES (1985) shows that the competitive effect dominates and thus firm profit falls for a constant number of firms. In figure II.4 this fall in profit is indicated by shifting the profit function downward to its free trade level.

(16) $$\Pi^i\left(2N, 0, F^i\right) - \Pi^i\left(N, \infty, F^i\right) < 0$$

[6] MARKUSEN/VENABLES (1995) explicitly analyse country asymmetries.

Industrial restructuring occurs in two steps: first, firms unable to generate a profit leave the industry, i.e., the ***exit condition*** binds. Second, surviving firms reorganise through a process of merger, i.e., the ***merger condition*** binds. The resulting equilibrium differs from the initial equilibrium characterised in proposition 1 because we approach it from a given distribution of incumbent firms *F(i)*. We analyse the two restructuring steps in turn.

Immediately after the (unexpected) change in trade policy some firms may ***exit*** the market. Recall that the profit of the marginal firm is a function of the potential cost reduction a through merger (10). Exit occurs if the fall in profit is larger than the profit of the marginal firm in the initial equilibrium.

(17) $$\pi(N^*(\infty),\infty) - \pi(2N^*(\infty),0) > a$$

From (17) exit is more likely if the cost reduction through merger is low. Exit continues until firm k breaks even and K firms produce in each location. In figure II.4 this firm is determined at the intersection of the free trade profit function with the function *F(i)* of active firms in the industry.

(18) $$\pi(2K,0) = F(k)$$

Apart from exit the industry also adjusts through ***merger***. The cost and the gain from a merger depend on the number of firms N and the distribution of incumbent firms *F(i)*. A merger occurs when the cost reduction is larger than the lost profit adjusted by the increase in market power.

$$(19) \quad F(i) + a \geq \pi(2i,0) + b \; ; \; b = \begin{cases} d\pi/dN & for \quad i > N^*(0) \\ 0 & for \quad i = N^*(0) \end{cases}$$

In figure II.4 the merger condition for free trade is drawn as a dashed line below the free trade profit line. At *N*(t)*, i.e., at the number of firms where entry becomes profitable, the merger condition has a discontinuity. The steady-state equilibrium is given at the intersection of the merger condition with the function *F(i)* of active firms in the industry. As drawn the two functions intersect at a number of firms *L(0)* and a fixed cost level *F(l(0))* of the marginal firm *l*. The intersections is drawn to the right of the discontinuity; if *F(i)* runs instead through the discontinuity, the steady-state is given by *N*(0)* and *F(N*(0))*.

Proposition 3

(a) Post-liberalisation equilibrium

Suppose two countries in initial equilibrium characterised by proposition 1 move from autarky to free trade. The post-liberalisation equilibrium is given by the pair $\{l, F^l\}$ *that satisfies*

$$(20) \quad \begin{aligned} F^l &= F(l) = \pi(2L,0) - a + \frac{d\pi(2L,0)}{dN} & \text{if} \quad & L > N^*(0) \\ F^l &= F(l) & \text{if} \quad & L = N^*(0) \end{aligned}$$

(b) Comparison of initial and post-liberalisation equilibrium

The number of firms in the post-liberalisation equilibrium lies between the number of firms in the initial equilibrium for free trade and autarky.

$$(21) \quad N^*(0) \leq L(0) < N^*(\infty)$$

Let the marginal firm avoiding exit be denoted k. The fixed cost of the marginal active firm l in the post-liberalisation equilibrium is lower than the fixed cost of firm k and the fixed cost of the marginal firm z in the initial equilibrium.

$$(22) \quad F^l(0,a) \leq F^k(0) \leq F^z(\infty, a) = F^z(0,a)$$

Proof: see appendix II. C

Expression (20) gives the intersection of the merger condition with the fixed-cost ordering $F(i)$ describing the population of incumbents. If $F(i)$ intersect the merger condition at the discontinuity, the pair $\{l,\ F^l\}$ is given by $F(i)$ evaluated at N^*. The first inequality in (22) is strict if all merger targets have identical fixed costs, i.e., the upper tail of $F(i)$ is flat before liberalisation. The second inequality is strict if no exit occurs. The final equality implies that the fixed cost level of the marginal firm z in an initial equilibrium is independent of trade costs.

Trade liberalisation affects an industry's cost distribution in two ways: first, exit and merger reduce the number of firms by eliminating the upper tail of $F(i)$. Second, the merger process shifts down remaining elements of $F(i)$ through cost reductions a (not drawn in figure II.4). Because the new equilibrium is approached from $N > N^*$ all mergers increase market power, i.e., b is negative.

The ***post-liberalisation equilibrium*** depends on initial conditions because incumbent firms face no uncertainty about their fixed cost types. Entry would not have been profitable for some of them at the post-liberalisation level of trade costs but with these entry costs already sunk they stay in the industry, depress profit levels, and reduce the profitability of entry for new firms. Without the threat of immediate entry merger can increase market power and is thus more profitable. Merger is a more important adjustment mechanism for an established industry than for a new and still growing industry.

4.2 Welfare implications

In this section we compare the welfare properties of the ***post-liberalisation equilibrium*** to the ***initial equilibrium***. Recall that the inefficiency in the private merger and entry decision stems partly from the "business stealing"-externality: private firms do not consider the impact of their entry or merger decision on the profit level of their competitors. The threat of "excessive entry" denies socially beneficial mergers to go ahead. We find that by moving to free trade (in general: an increase in market size) the entry threat can be reduced and thus the profitability of welfare increasing mergers can be increased. Differentiating *W(N)* with respect to the number of firms and evaluating at the industry equilibrium we get

$$(23)\quad \frac{dW}{dN}=\left[P(N)-c\right]\left[q+\frac{dq}{dN}N\right]-F^{i}-a=\frac{dq}{dN}N\left[P(N)-c\right]-\frac{d\pi}{dN}<0$$

The difference between (23) and the same expression evaluated at the initial equilibrium (13) is given by the last term capturing the market power effect of a merger. Due to the entry threat this term was absent in the initial equilibrium and hence the social planner is willing to raise entry costs. Trade liberalisation allows for a reduction in the number of firms without any additional intervention because potential profit falls relative to the size of the entry cost.

Note that from proposition 2 the social planner would like to induce even more mergers. The lower bound of active firms after liberalisation is given by *N*(0)* since any additional merger would trigger immediate entry. Even without this endogenous restriction on the number of firms private owners would not necessarily want to engage in too many mergers (see appendix II.D). This result corresponds to proposition 5 in FARRELL/SHAPIRO (1990). FAULÍ-OLLER (1997) analyses how the shape of the demand function affects this result.

Proposition 4

Trade liberalisation reduces the threat of entry and allows additional mergers to go ahead. All mergers privately profitable after trade liberalisation are constrained welfare increasing.

Proof:

Proposition 2 shows that mergers are constrained welfare improving at the number of firms N^* where entry is triggered. The number of firms after trade liberalisation is weakly larger than N^* and thus proposition 2 applies here as well.

The result is a consequence of combining the merger process with either firm heterogeneity or positive cost reductions a. Suppose merger brings no additional cost saving ($a = 0$). If firms are homogenous, i.e., $F(i)$ is a horizontal line, the entry and exit conditions bind at the same level of firms $N^*(t)$ for any t. After trade liberalisation has triggered exit no further mergers are privately profitable because no increase in market power is possible. If firms are heterogeneous, i.e., $F(i)$ is increasing, the entry condition binds for $N^*(t)$ while the exit condition binds for $K(t)$ where $N^*(t) \leq K(t)$. For N between these bounds merger is not only socially but also privately profitable because market power can be increased. A positive cost saving $a > 0$ has the same effect of separating the entry and exit condition after trade liberalisation.

4.3 Multinational firms, gradual trade liberalisation, and the choice between domestic and cross-border mergers

In this section we analyse how the presence of multinational firms in the industry affects the adjustment process to the post-liberalisation equilibrium. Multinational firms have production facilities in both markets avoiding trade costs but are subject to an extra fixed cost H of running a two-plant operation.[7] We first develop a ***type choice condition*** in addition to the exit, entry, and merger conditions of the previous sections to characterise the steady-state equilibrium and then analyse the effect of trade liberalisation.

The ***initial equilibrium*** before trade liberalisation is described by proposition 1 extended to two types of firms: multinationals and domestic firms. The three ***entry conditions*** for home (24), foreign (25), and multinational (26) firms determine the number of firms for each type in steady-state equilibrium.

(24) $$\int_{\underline{F}}^{\pi^h(.)}\int_{\tau}^{\infty}\left\{\pi^h\left(N^h,N^f,M,t\right)-s\right\}e^{-r\tau}d\tau g(s)ds=E$$

(25) $$\int_{\underline{F}}^{\pi^f(.)}\int_{\tau}^{\infty}\left\{\pi^f\left(N^h,N^f,M,t\right)-s\right\}e^{-r\tau}d\tau g(s)ds=E$$

(26) $$\int_{\underline{F}}^{\pi^M(.)}\int_{\tau}^{\infty}\left\{\pi^m\left(N^h,N^f,M,t\right)-s-H\right\}e^{-r\tau}d\tau g(s)ds=E$$

The ***merger conditions*** for domestic (27) and multinational (28) firms determine the fixed cost level for the marginal firm in steady-state equilibrium. Note that the marginal multinational firm has a fixed cost equal to the fixed cost of the marginal domestic firm minus the extra cost H.

---

[7] We think of H as plant-specific and F^i - H as firm specific fixed cost. This assumption is standard in the literature on multinational firms; see MARKUSEN (1995) and MARKUSEN/VENABLES (1995). In contrast to these papers we do not consider general equilibrium effects.

(27) $F^{zj}(a)=\pi^{j}-a\,;\; j\in\{h,f\}$

(28) $F^{zm}(a)=\pi^{m}-a=F^{zj}(a)-H$

These six conditions fully describe the equilibrium values for the number of firms of each of the three types and the highest fixed cost level of each of the three types. It is, however, not immediately obvious that such an equilibrium exist, i.e., that there is a triplet $\{N^{f}*,N^{h}*,M*\}$ simultaneously solving the entry conditions (24-26). We develop a ***type choice condition*** to show that such an equilibrium does indeed exist.

The ***type choice condition*** follows from the fact that each firm can freely choose its production structure in order to maximise profit; in equilibrium no firm wants to switch its type. For a large number of firms this implies that a firm with a given fixed cost F^{i} is indifferent between types: the extra fixed cost *H* for a multinational firm is equal to the difference between the profit of a domestic and a foreign firm at a given location. In the notation we split up profit according to the market where the profit is generated. Hence superscript *jk* indicates a country *j* firm's profit on market *k*. If only one superscript is used this describes the sum of profit for a representative firm located in the indicated country. The two ***type choice conditions*** thus are

(29) $H=\pi^{jj}(N^{f},N^{h},M,t)-\pi^{jk}(N^{f},N^{h},M,t)\quad j\neq k,\{j,k\}\in\{h,f\}$

The two *type choice conditions* (29) for home and foreign firms determine the relative number of firms of each type, while one of the free entry conditions ties down the absolute levels. For tractability we introduce country symmetry, i.e., the number of domestic firms in home and foreign is identical: $N = 2N^h = 2N^f$. In appendix II.E we show that the right hand side of the type choice condition (29) is increasing in the share of domestic firms in the industry, i.e., (30) is positive. Note that the total number of firms $N+M$ in the industry is held constant.

$$\text{(30)} \quad \frac{d\left[\pi^{ij}(N,M,t)-\pi^{jk}(N,M,t)\right]}{dN}-\frac{d\left[\pi^{ij}(N,M,t)-\pi^{jk}(N,M,t)\right]}{dM}>0$$

Expression (3) and figure II.5 show that the equilibrium values for N and M are stable because the profit difference line intersects the additional fixed cost line H from below; closing the foreign production plant to become a national firm is profitable for a multinational firm only as long as the number of national firms N is below its equilibrium value.

MARKUSEN/VENABLES (1995) come to a different conclusion and find that for symmetric countries multinationals and local producers cannot coexist in equilibrium. They view the number of production facilities as constant; thus one multinational firm uses the plants of two local firms ($N + 2M$ = constant). Here the number of firms is held constant; thus it takes two multinationals to eliminate two local firms ($N + M$ = constant). The assumption used here implies a positive relationship between the share of multinationals and the toughness of competition in an industry that is not present in MARKUSEN/VENABLES.[8] The general thrust of the results does not depend on this specific assumption.

[8] Competitiveness is used in the sense introduced by SUTTON (1991, p. 33): A market has tougher [price] competition if a given number of firms is mapped into a lower equilibrium market price.

After having established the steady-state equilibrium we now turn to the effects of trade liberalisation to find the ***post-liberalisation equilibrium***. We are especially interested in the role multinational firms play in the process of industry restructuring. Falling trade costs between the two countries trigger three different kinds of responses in the industry: first, firms can increase their profit by changing their type; second, firms with a fixed cost above the operating profit exit the industry; and third, the remaining firms reorganise by merger.

Firms change their type if after trade liberalisation the *type choice condition* (29) no longer holds. In this model trade and foreign direct investment are substitutes and the reason to run a multinational firm is to jump tariffs/trade costs. This advantage melts away with trade liberalisation and hence multinational firms suffer more from the reduction in trade costs. The type choice condition in figure II.5 is moved to the right: more firms choose to produce at only one location and service the other market by exports.

$$(31) \qquad -\frac{d\pi^{j=h,f}}{dt} > -\frac{d\pi^{m}}{dt} < 0$$

The vulnerability to a given fall in protection differs across types: trade liberalisation always reduces the profits of multinational firms, while the effect on domestic firms' profits is either positive or negative depending on the level of trade costs. Domestic firms gain from liberalisation in their export markets but lose in their home markets. The latter effect dominates for sufficiently high levels of trade costs such that exports are not too important. Multinational firms lose profit in all markets. Some of them react by closing their foreign operations, concentrating all production at one location, and thus saving the plant-specific fixed cost H. This process continues until the *type choice condition* (29) holds again as an equality.

The *exit condition* is the same as in the previous section. From (27) and (28) firms have the same profit "buffer" to weather the reduction of trade costs from t^0 to t^1. Firms start to leave the industry if the reduction in profit is larger than the profit of the marginal firm and thus

$$\text{(32)} \quad \pi^j\left(t^0, N, M\right) - \pi^j\left(t^1, N, M\right) > a\,;\; j = \{h, f, m\}$$

The process of exit and type change readjusts firm numbers such that the marginal firm is indifferent between types and makes no loss. These numbers are indicated by K as in the previous section with a superscript j for domestic and m for multinational firms and are given by the *zero profit condition* (33).

$$\text{(33)} \quad \Pi^{kj}\left(K^j, K^m, t^1\right) = F^{Kj};\; j = \{h, f\}$$

$$\Pi^{km}\left(K^j, K^m, t^1\right) = F^{Km} + H$$

In the final stage adjustment firms reorganise through *merger*. They face no immediate threat of entry because entry is unprofitable at the reduced profit levels. Hence when calculating cost and benefit of a merger, firms take account of the increase in market power.

Two types of firms are available for merger: domestic firms located either in home or foreign, and multinational firms. We start with the net gains from buying a domestic firm. These net gains depend on the type of the buyer: a foreign firm buying the local producer incurs additional headquarters costs *H*.

(34) $F^h(i) + a - \pi^{hh} - \pi^{hf} - d\pi^{hh}/dN^h - d\pi^{hf}/dN^h$ domestic buyer

(35) $F^h(i) + a - \pi^{hh} - \pi^{hf} - d\pi^{hh}/dN^h - d\pi^{ff}/dN^h$ multinational buyer

(36) $F^h(i) + a - H - \pi^{hf} - \pi^{fh} - d\pi^{ff}/dN^h - d\pi^{hh}/dN^f$ foreign buyer

Comparing expressions (34-36) it turns out that a multinational firm always has the strongest incentives to outbid potential local buyers. This is a consequence of the differences in market power gains available to different types of firms. A multinational has a strong initial position in both markets and is thus well equipped to exploit the reduction in the number of competitors. A domestic firm has the same advantage in its home market but gains less on the export market.

But does it make sense for this merger to go ahead? A merger is profitable if the cost reduction is larger than the opportunity cost of closing one firm adjusted by market power effects.

(37) $$a + F^h(i) \geq \pi^h + \frac{d\pi^{ij}}{dN^j} + \frac{d\pi^{kk}}{dN^j}$$

If trade liberalisation has triggered any exit of firms the operating profit of the marginal survivor is equal to its fixed cost. From the remaining cost reduction *a* and additional market power gains some mergers are profitable. As more domestic firms are bought up their fixed cost level $F^h(i)$ falls while the profit π^h increases. Eventually the inequality no longer holds and the merger process stops for domestic firms.

We now move to the net gains from buying a multinational firm that again depend on the buyer being a domestic (38) or a multinational (39) firm.

$$(38) \quad F^m(i) + a - \pi^{jk} - \pi^{jj} - d\pi^{kk}/dN^j - d\pi^{jj}/dN^j \, ; j \neq k$$

$$(39) \quad F^m(i) + a + H - \pi^m - d\pi^{jj}/dN^j - d\pi^{kk}/dN^k \;\; ; \; j \neq k$$

Comparing these expressions and noting the type choice condition (29) it turns out that a domestic firm never has sufficient incentives to outbid potential multinational buyers. Again this is due to the fact that a multinational firm with a strong position in all markets can gain the most from a reduction in the number of competitors.

But does it make sense for the multinationals to merge? Comparing the cost reduction with the opportunity cost adjusted by market power effects we get

$$(40) \quad a + H + F^m(i) \geq \pi^m + \frac{d\pi^{jj}}{dM} + \frac{d\pi^{kk}}{dM}$$

If trade liberalisation has triggered any exit of firms the operating profit of the marginal survivor is equal to its fixed cost. From the additional cost reduction a and the increase in market power some mergers between multinational firms are profitable. As more multinationals are bought up their fixed cost level $F^m(i)$ falls while the profit π^m increases. Eventually the inequality no longer holds and the merger process stops for multinational firms.

In figure II.6 we draw the post-liberalisation profit as a solid line for all firms where the additional plant fixed cost H is deducted for the multinational firm. The broken lines give the merger condition for multinationals and domestic firms: the two lines coincide to the left of the discontinuity of the merger condition but differ to the right. A merger with a multinational produces larger market power effects and thus the merger condition for multinational mergers is below the condition for domestic mergers. From figure II.6 we can read off the fixed cost level of the marginal multinational (41) and domestic (42) firm.

$$\text{(41)} \quad F^{Lj}(a) = \pi^j\left(L^j, L^j, t^1\right) - a + \frac{d\pi^{ij}}{dN^j} + \frac{d\pi^{kk}}{dN^j}$$

$$\text{(42)} \quad F^{Lm}(a) = \pi^m\left(L^j, L^m, t^1\right) - H - a + \frac{d\pi^{ij}}{dN^j} + \frac{d\pi^{kk}}{dN^k}$$

Proposition 5

Start from an initial equilibrium with trade costs $t > 0$ and numbers of firms $\{N^f *, N^h *, M *\}$ solving (24-26). A reduction in trade costs implies:

(1) The absolute number and the share of multinational firms is reduced.

(2) A positive number of multinationals concentrates its production in one location to become a domestic firm.

(3) Both multinationals and domestic firms leave the industry if the fall in profit is larger than the initial profit level a.

(4) A positive number of mergers occurs and multinational firms are involved in all of them.

(5) The marginal multinational firm has a lower total fixed cost than the marginal domestic firm, if trade costs are positive.

Proof: see appendix II.F

These results are consistent with the literature on multinational firms. The fall in the share and number of multinational firms as a response to trade liberalisation is also observed in the general equilibrium model of MARKUSEN/VENABLES (1995). BRAINARD (1993) provides empirical data consistent with this prediction. Our model provides an additional insight into the mechanism of this adjustment: first, multinationals are prone to concentrate their production in one location after trade liberalisation. Second, multinationals are very active in the take-over market both in buying multinational competitors and domestic firms. This prediction of the model seems to be in line with the empirical observations on merger trends.

5. CONCLUSIONS

In this chapter we analyse the restructuring of an industry in response to trade liberalisation in the presence of a sunk entry cost and firm heterogeneity. Trade liberalisation affects the incentives and the feasibility of merger. We add to the theoretical literature by introducing entry, focusing on the adjustment process from an *initial* to a *post-liberalisation equilibrium*, and giving a welfare assessment different from the one usually obtained. We find that lower trade barriers allow the industry to restructure with a mix of *exit*, *merger*, and internal restructuring (i.e., *type change*). Competition selects firms with low fixed costs for survival and the fixed cost level of the industry drops substantially after trade liberalisation. The number of firms falls because depending on their cost level firms with high fixed costs leave the industry by either exit or merger.

Our model provides a theoretical foundation for some of the productivity effects expected from the 1992 Single Market Programme.[9] Even though the parallels between theory and practice should not be overstated it is noteworthy that the empirical data presented in appendix II.A supports the predictions of the model. Mergers in the early period from 1986 to 1988 focused on cost cutting; this is in line with theoretical predictions of large gains by buying out high fixed cost firms in the early rounds of mergers. As the process continues and high cost firms are eliminated market power effects become the dominant motive, both in the model and the data. Finally, the biggest surge in merger activity in the EU involved cross-border mergers. In our model all mergers involve multinationals, but cross-border mergers might only count mergers between multinationals. The model predicts the adjustment process to be most active for this type of merger.

All privately profitable merger activity is welfare increasing from the perspective of aggregated welfare across the liberalising countries. This is a consequence of the free entry assumption that creates a market enforced limit to the number of privately profitable mergers. The standard merger policy literature has focused on the external effect of mergers taking the private profitability as given (FARELL/SHAPIRO (1990)) and thus neglects the fact that due to the positive externality of a merger on the whole industry some private mergers are not undertaken, even though they would be socially profitable. Trade liberalisation insures that at least part of the market power effect is taken into consideration by firms contemplating a merger.

[9] EUROPEAN COMMISSION (1988).

MERCENIER/SCHMITT (1996) present a much gloomier outlook on welfare implications of trade liberalisation in the presence of sunk costs. In their one-period model all fixed costs are sunk, while here this is only true for the entry costs. Thus future fixed costs are not yet sunk; entry and merger are then welfare increasing in both their general and our partial equilibrium case.

BARROS/CABRAL (1994) extended the standard merger policy framework to an international setting. In their work, the distribution of profit after a cross-border merger determines the national welfare assessment. In our model the bargaining process between the merging firms has not been made explicit. The distribution of merger gains and profit within a multinational firm is undetermined but from the entry assumption all privately profitable mergers are welfare increasing independently of any specific assumption on the distribution of profit. This result suggest that anti-trust authorities should focus on studying entry barriers when evaluating mergers.

The role of multinationals in a world of falling trade costs is analysed in one of the final sections. The absolute number of multinationals is shrinking but they are the most active in the restructuring process. Even for horizontal mergers and multinationals there may be forces in the opposite direction increasing the share of multinationals. MARKUSEN/VENABLES (1995) note that both an increase in market size, say as a result of economic development, and a fall in the level of production cost c throughout the economy, say due to technological progress, has this result. In the present context this can be shown from the type choice condition.

Sunk entry costs introduce history dependence to the model. After a change in policy the characteristics of equilibrium depend on the initial number of firms being above or below the level solving the free-entry condition. We describe a trade policy experiment starting from equilibrium, such that the number of firms is initially above the free-entry level with lower protection. An empirical example for such a situation seems to be the European chemicals industry[10].

The model can be extended in several ways. One straightforward step would be to allow for technological progress, modelled as a shifting support for the distribution of fixed costs. New entrants appear and the industrial structure would be more dynamic and thus better resemble the empirical facts. Another step could be to look at merger motives other than the ones mentioned in this paper. Especially investments in Central and Eastern Europe is more of a vertical integration type exploiting differences in factor costs. De-mergers and focusing on core activities are important within the OECD countries. Future work could thus profit from using a more detailed model of the firm allowing for multiple tasks and influence activities.

[10] The Financial Times (1997).

Figure II.1

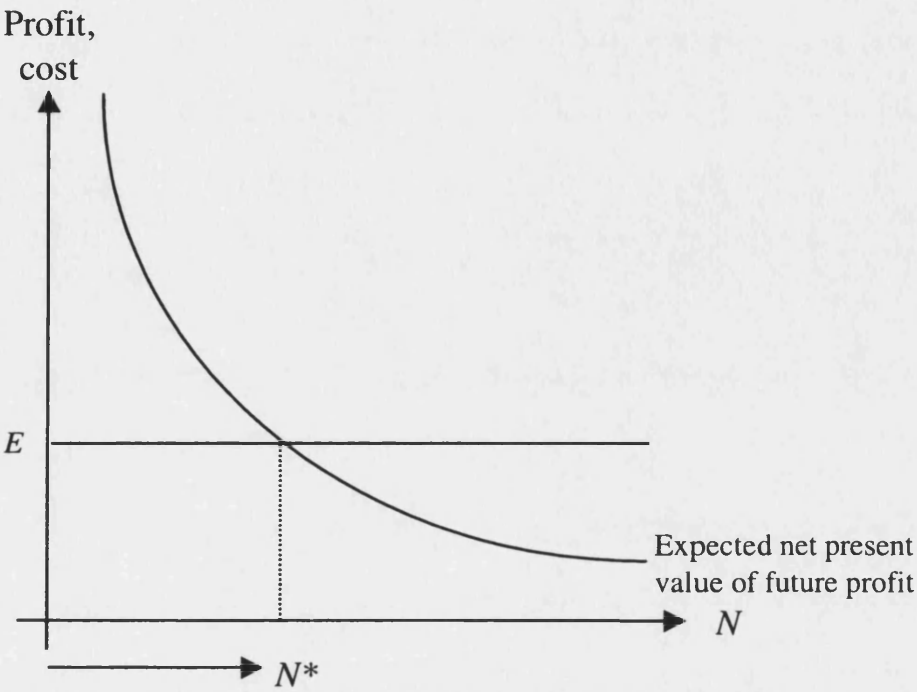


Figure II.1: Entry conditions

Figure II.2

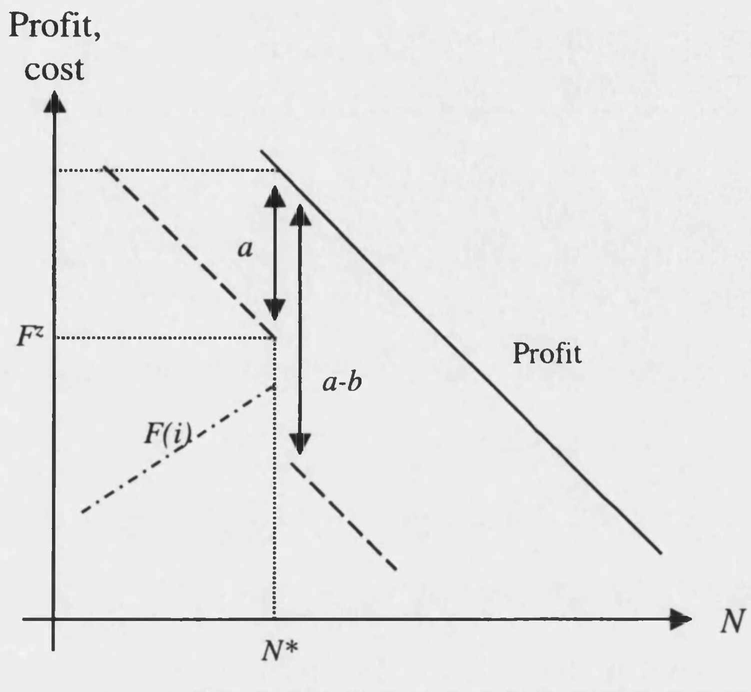


Figure II.2: The initial equilibrium

This picture is used to characterise the initial steady-state equilibrium. The solid line gives a linear approximation of the convex operating profit function. The dashed line gives the right hand side of the merger condition and has a discontinuity at N^*. The entry condition binds where the upper dotted line intersects the operating profit line. The merger condition binds at its intersection with the ordering of firms *F(i)*. This point gives the initial steady-state equilibrium. The exit condition would bind where the ordering of firms *F(i)* intersects the operating profit line. In the initial steady-state *F(i)* does not exist in that region if $a > 0$.

Figure II.3

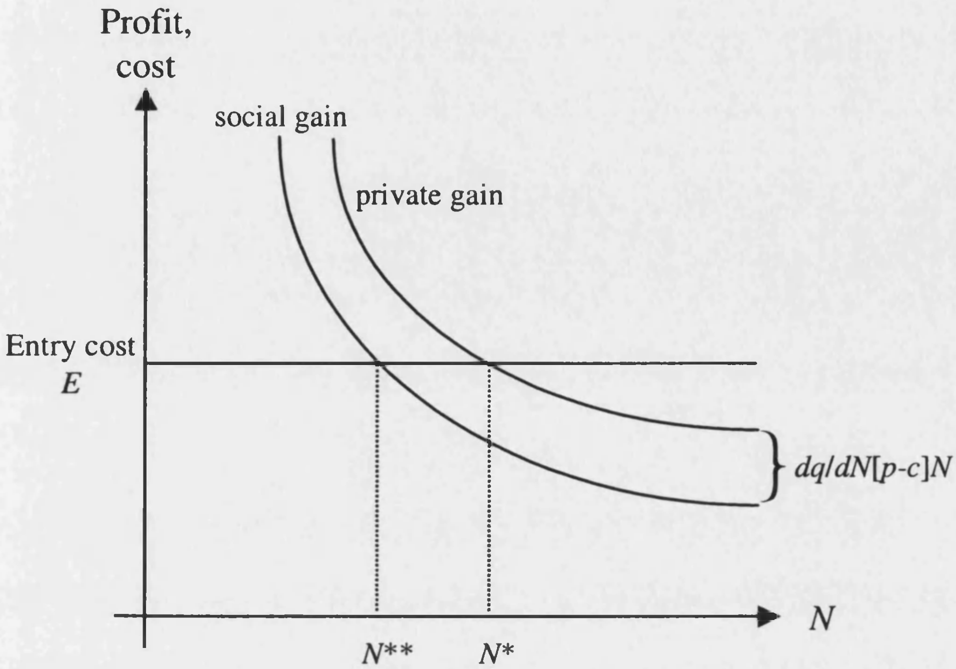


Figure II.3: Private and social entry decision

The private gain for an entrant is given by a measure of expected future operating profit. The cost is given by E. While the gain is falling with the number of incumbent firms, the entry cost is given by technology and is thus not affected.

The social gain of entry is given by the sum of changes in consumer surplus, changes in incumbent profit, and the entrant's profit. The cost is given by the uncertainty of the entrant's fixed cost level. While the social gain of entry is falling with the number of incumbent firms, the entry cost is given by technology and is thus unaffected.

The difference between social and private merger incentives relates to the difference in the gain of entry. The difference in the gain of entry is the sum of changes in consumer surplus and incumbents' profit. From (11) this sum is negative and thus the social incentives for entry are smaller than the private incentives.

Figure II.4

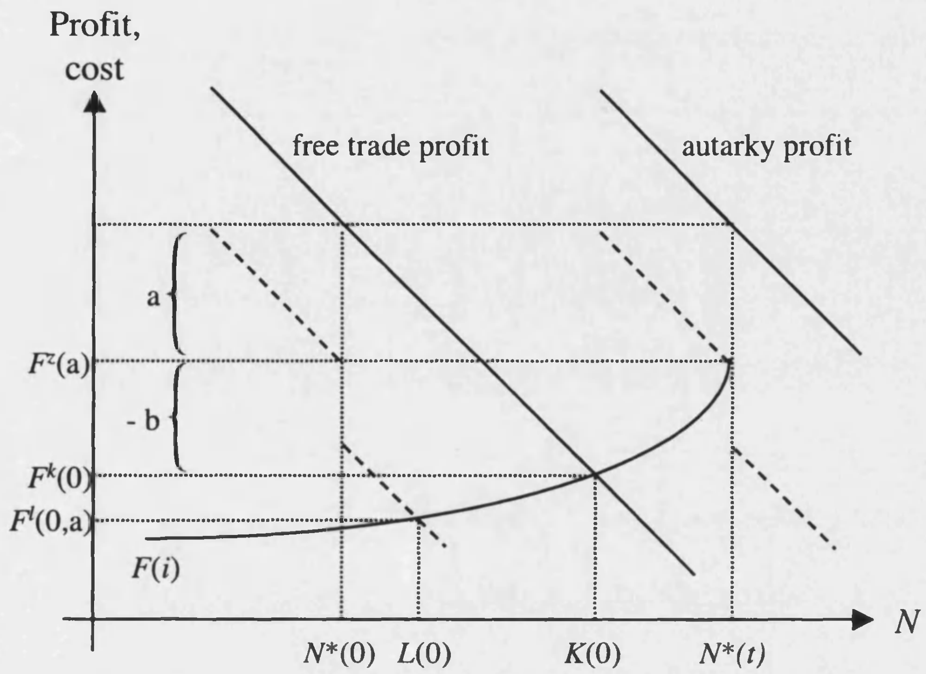


Figure II.4: Moving from autarky to free trade

The solid straight lines give profit as a function of N for both autarky and free trade approximating an underlying convex function. The intersection of the profit function and the upper dotted line giving a measure of entry cost determines the number of firms N^* in the initial equilibrium. The broken lines give merger costs as lost profit minus the cost saving a and minus potential market power effects b. The broken lines have a discontinuity at N^* because below that level market power effects are zero.

The initial equilibrium with trade cost t creates an equilibrium population of firms described by $F(i)$. The removal of trade barriers shifts the profit function to the left. Firms above $K(0)$ make losses and leave the industry. Firms between $L(0)$ and $K(0)$ merge. The values for $L(0)$ and $K(0)$ depend on the shape of $F(i)$ but are constrained by .

Figure II.5

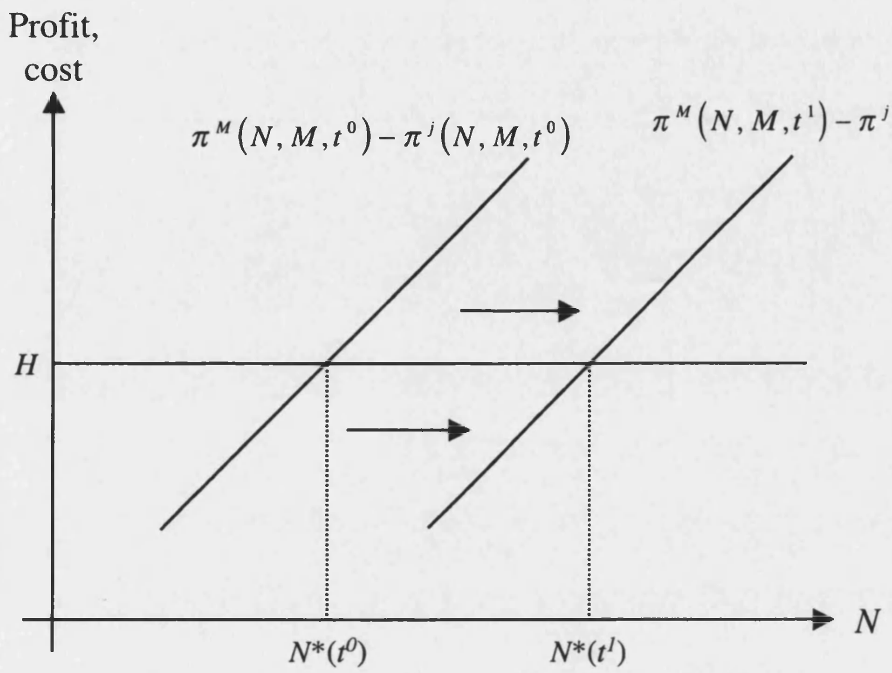


Figure II.5:
Type choice between domestic and multinational firms

For a given trade cost t we keep the total number of firms $N + M$ constant. The positive slope of the profit difference is proved in appendix II.C. Trade liberalisation implies a reduction of trade costs from t^0 to t^1.

Figure II.6

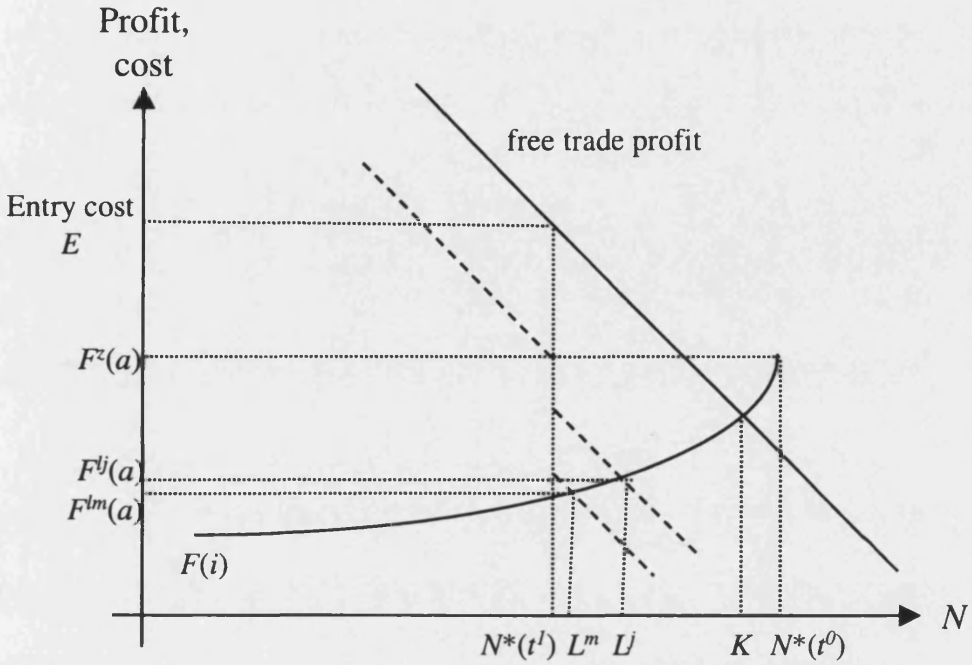


Figure II.6:
Fixed cost of the marginal firm after trade liberalisation

To the right of the discontinuity the merger conditions for multinationals and domestic firms differ. In particular, the merger condition for multinational firms is below the one for domestic firms indicating higher market power effects for a merger between multinational firms.

Appendix II.A
Mergers in the European Community

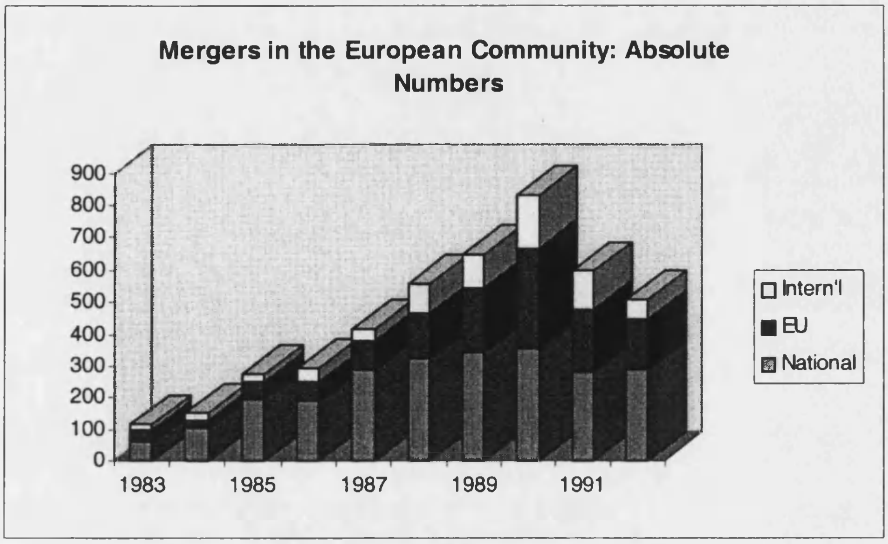


Table 1: Number of Mergers in the EU,

Source: European Commission, Report on Competition Policy, var. issues

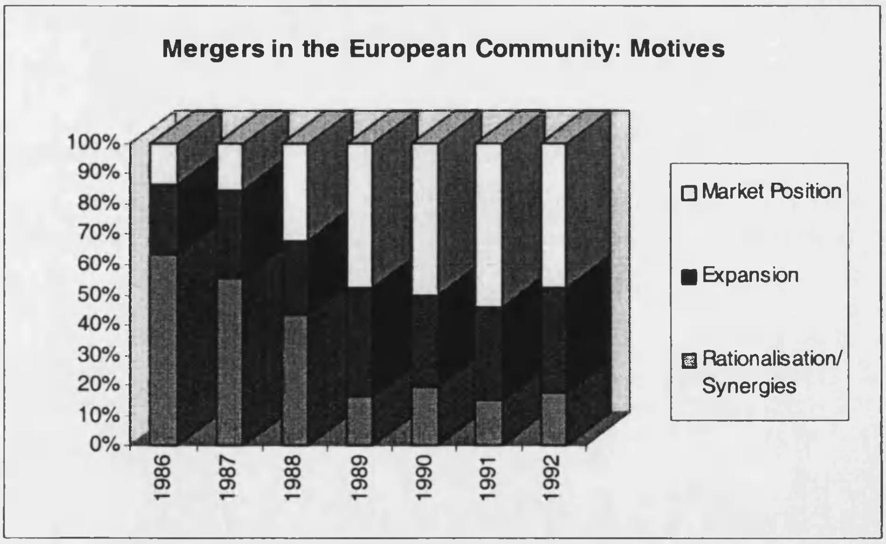


Table 2: Motives for Mergers in the EU,

Source: European Commission, Report on Competition Policy, var. issues

Appendix II.B

Convexity of the profit function in N

Here we prove the convexity of profit in the number of firms N.

(A1) $$\frac{d\pi}{dN} = \left[P^k - t - c\right]\frac{dq^{jk}}{dN} + q^{jk}\frac{dP^{jk}}{dN} < 0$$

$$\frac{d^2\pi}{dN^2} = 2\frac{dP^k}{dN}\frac{dq^{jk}}{dN} + \left[P^k - t - c\right]\frac{d^2q^{jk}}{dN^2} + q^{jk}\frac{d^2P^k}{dN^2} > 0$$

Using the first-order condition to the firm's problem we first show that output is decreasing and convex in the number of firms.

(A2) $$\frac{dq}{dN} = -\frac{\left[q + \sum dq/dN\right]\left[D'+qD''\right]}{2D'+qD''} = -qX^{-1} < 0$$

$$\frac{d^2q}{dN^2} = -\frac{dq}{dN}X^{-1} + q\frac{dX}{dN}X^{-2} > 0$$

where $X \equiv \left[\frac{2D'+qD''}{D'+qD''} + N\right] > 0;\ \frac{dX}{dN} > 0$

Using the above result we show second that the price level is also decreasing and convex in the number of firms.

(A3) $$\frac{dP}{dN} = \left[q + N\frac{dq}{dN}\right]D' = qD'Y < 0$$

$$\frac{d^2P}{dN^2} = \left[\frac{dq}{dN}D'+qD''\left\{q + N\frac{dq}{dN}\right\}\right]Y + qD'\frac{dY}{dN} > 0$$

where $Y \equiv \left[1 - \frac{N}{N + \left[2D'+qD''\right]/\left[D'+qD''\right]}\right] > 1; \frac{dY}{dN} < 0$

Plugging (A2-3) in (A1) proves the convexity of the profit function in N.

Appendix II.C

Proof of proposition 3

(a) Post-liberalisation equilibrium

At the pair described by (20) all three equilibrium conditions hold: no entry occurs because $L \geq N^*$; no merger is profitable because the left hand side of (20) is the merger condition; finally, by rewriting (20) we find that all firms generate a positive profit and hence no exit occurs.

(b) Comparison of the initial and the post-liberalisation equilibrium

The first part of (21) is implied by expression (20). All firms generate a non-negative profit and hence the number of firms never falls below $N^*(0)$.

For the second part of (21) to hold either exit or merger has to have occurred after liberalisation. Immediately after liberalisation profit levels fall from (16) and the entry condition is no longer binding. Hence the merger condition is shifted to the left and some mergers become profitable.

The first three parts of (21) relate to the three stages the industry moves through on F(i) from autarky to free trade. From $F^z(\infty, a)$ to $F^k(0)$ firms with a high fixed cost level exit the industry; from $F^k(0)$ to $F^z(0, a)$ additional firms disappear through merger. By construction of F(i) both weak inequalities apply.

The final equality is an application of proposition 1: the equilibrium number of firms adjusts the effect of different trade costs such that firms' equilibrium profit is independent of trade cost. The equality in (22) then follows from (11).

Appendix II.D

Excessive merger and the threat of entry

This appendix analyses the welfare effects of mergers after trade liberalisation if the number of firms is not constrained by the entry condition. The private and social objective functions are written as (A4) and (A5).

(A4) $\sum \Pi^i = 2\pi(N,t) - \sum F^i$ private

(A5) $W = U(qN) - cqN - \sum F^i$ social

Differentiating both expressions with respect to the number of firms N and accounting for the possible cost reduction the decision criterion for mergers is

(A6) $-\pi(N,t) + F^n + a - d\pi(N,t)/dN \geq 0$ private

(A7) $-(p-c)(q^i + q'N) + F^n + a \geq 0$ social

For a given number of firms the private incentive to merge are weakly smaller than the social returns if (A8) holds. Inequality (A8) can be written as (A9).

(A8) $-d\pi(N,t)/dN \leq -[p-c]q'N$

(A9) $\frac{dp}{dN}q \geq [p-c]\frac{dq}{dN}[N-1]$

For linear inverse demand with unit slope (A8) reduces to (A10) and further to (A11).

(A10) $\frac{dp}{dq}\left[\frac{dq}{dN}N + q\right] \geq \frac{dq}{dN}[N-1]$

(A11) $1 \leq \frac{2N-1}{N+1}$

The inequality (A11) holds for all $N \geq 2$. The inequality implies that in the absence of entry the social gains from a merger are higher than the private gains unless the two merging firms are the only firms on the market.

Appendix II.E

An interior solution for the type choice condition

Step 1: show $\pi^{ij}(N,M,t)-\pi^{jk}(N,M,t)>0$

The difference in profit between a multinational and a domestic exporter is due to the difference in the own cost parameter: exporters pay an additional trade cost *t*. To prove the above we show that profit is decreasing in own cost.

(A12) $$\frac{d\pi^i}{dc^i}=-q^i+[N-1]\frac{d\pi^i}{dq^j}\frac{dq^j}{dq^i}\frac{dq^i}{dc^i}=-q^i-[N-1]\frac{D'q}{D'+qD''}<0$$

from $\frac{d\pi^i}{dq^j}=D'q<0$; $\frac{dq^i}{dq^j}=\frac{1}{2D'+qD''}<0$; $\frac{dq^i}{dc^i}=-\frac{2D'+qD''}{D'+qD''}<0$

Step 2: show $\frac{d[\pi^{ij}(N,M,t)-\pi^{jk}(N,M,t)]}{dN}-\frac{d[\pi^{ij}(N,M,t)-\pi^{jk}(N,M,t)]}{dM}>0$

The profit difference between multinationals and domestic exporters is affected when other multinationals close plants to become domestic firms and thus increase their marginal production cost. The sign of the expression is essentially driven by the cross-product of profit differentiated by own and a competitor's marginal cost. We show that this cross-product is positive if the convexity of the inverse demand function is not too large: $[D''^2-D'D''']<0$.

(A13) $$\frac{d^2\pi^i}{dc^i dc^j}=-\frac{dq^i}{dc^j}-[N-1]\frac{dq^j}{dc^j}\frac{q^2[D''^2-D'D''']+D'^2\,dq^i/dq^j}{[D'+qD'']^2}<0$$

from $\frac{dq^i}{dc^j}=-\frac{[D'+qD'']dq^j/dc^j}{2D'+qD''}>0$ and the explanation to (A12)

Appendix II.F

Proof of proposition 4

(1) and **(2)** follow from the shift of the *type choice condition* (29).

Differentiating (29) from the main text with respect to trade cost t and keeping the number of firms constant we get

(F1) $$\frac{d\pi^{ij}\left(N^f, N^h, M, t\right)}{dt} - \frac{d\pi^{jk}\left(N^f, N^h, M, t\right)}{dt} > H$$

To re-establish equilibrium the relative number of firms has to be adjusted. From (30) in the main text the left hand side of (F1) is decreased if domestic firms extend their operations to become multinational firms. A reduction of trade costs has the opposite effect thus proving (2) and the second part of (1).

To prove the first part of (1) we have to further establish that there is no entry by additional multinationals. This is an application of proposition 3 (a).

(3) follows from the discussion of the *exit condition* in (32).

(4) follows from the discussion of the *merger conditions* (34-36) and (38-39)

Deducting (34) from (35) we get (F2) to show that the multinational firm outbids a home firm for a merger with a home firm.

(F2) $$-\frac{d\pi^{ff}}{dN^h} > -\frac{d\pi^{hf}}{dN^h}$$

Deducting (36) from (35) we get (F3) to show that the multinational firm outbids a foreign firm for the merger with a home firm.

(F3) $$-\frac{d\pi^{hh}}{dN^h} > -\frac{d\pi^{ff}}{dN^h}$$

Deducting (38) from (39) we get (F4) to show that the multinational firm outbids a domestic firm for the merger with a multinational firm.

$$\text{(F4)} \qquad -\frac{d\pi^{hh}}{dN^h} > -\frac{d\pi^{ff}}{dN^h}$$

(5) follows from the comparison of the *merger conditions* evaluated at the equilibrium (41-42):

$$\text{(F5)} \qquad F^{Lj} - F^{Lm} = \underbrace{\pi^j - \pi^m + H}_{=0} + \underbrace{\frac{d\pi^{kk}}{dN^j} - \frac{d\pi^{kk}}{dN^k}}_{\geq 0} \geq 0$$

Chapter III

A Note on the effect of trade policy on the speed of Cost-cutting

1. INTRODUCTION

In this chapter we analyse how the interaction of market structure and owners' control of management affects firms' incentives to invest in performance improving activities (i.e., restructuring) over time. What are the conditions under which protection helps an industry to improve its competitiveness through speedier cost-cutting? In the literature owners are assumed to have full control over their management's actions to secure profit-maximising behaviour. Under this assumption we find that trade policy designed to increase profit *increases* the incentives of firms to invest in restructuring and initial differences in firm performance *increase* over time.

We also investigate the effects of trade policy on firms' incentives to invest under a different assumption where owners have only limited control of their management's activities and set a dividend target below the maximum level. Managers react by choosing a restructuring strategy that allows them to satisfy the dividend target but delay the next restructuring as long as possible. Managers want to delay restructuring because any restructuring requires them to put in additional effort (i.e., they incur an additional private cost) for which they are not compensated. Additionally, managers want their firms to survive because they derive control rents from their jobs. Under our set of assumptions trade policy induced increases in profit *reduce* the incentives of firms to invest in restructuring and *reduce* initial differences in firm performance.

We use a small open economy model with two home firms facing a given world market price. Firm owners hire a manager with the responsibility to run operations and make dividend payments. At each date, the firm sells on the home market and generates a profit that can be used to either finance dividend payments to the owner or to accumulate for a later investment in a cost-reducing restructuring. We make the assumption that a restructuring can only be financed internally and not through borrowing from the capital market.

If the owner controls the management he maximises the discounted value of the dividend stream. By choosing the dividend level the owner implicitly also chooses a sequence of restructuring dates at which the firm reduces cost. If the owner does not control the management he sets a dividend target for the firm. The manager satisfies this dividend target but uses all additional profit to delay restructuring as long as possible to avoid the private cost attached to restructuring. The level of protection determines the level of profit and thus the amount of resources available for restructuring and dividend payments. We undertake a trade policy experiments to study the effects of trade liberalisation on the timing of restructuring under the two managerial objectives.

Our model is motivated by an interest in the interactions between internal firm structures and international competition. A specific example of this interaction is the discussion on the productivity performance of German manufacturing firms in the late 80s/early 90s. BAILEY/GERSBACH (1995) claim that trade liberalisation played a role in the delay of performance improving investments by German firms. Their argument involves two steps: first, EU trade policies created a windfall profit for German firms with their initially favourable cost position. Second, the windfall profit was not re-invested but used as a cushion to delay otherwise necessary performance improvements. We analyse the consistency of this argument.

The specific German example draws attention to broader questions: how does trade liberalisation, for example in the context of a free trade area, affect heterogeneous firms? Are high-cost firms able to catch up after trade barriers are removed, or do they fall further behind their low-cost competitors now competing in an open market? These questions are raised in the context of NAFTA and the enlargement of the EU. The answers to these questions depend on both general-equilibrium and competition effects. We concentrate on the latter and demonstrate the importance of assumptions on owners' control of management in assessing the likelihood of either catch-up or further fall-back of firms with an initial disadvantage.

Our work draws on the trade literature as well as on the literature on competition and efficiency. MIYAGIWA/OHNO (1995) present a partial equilibrium model with a positive link between (permanent) trade barriers and R&D investment. Their approach is similar in spirit to our full owner-control benchmark case but we add the case of management-control. The trade and growth literature (GROSSMAN/HELPMAN (1991)) analyses linkages between international trade and R&D but concentrates on general equilibrium effects as well as knowledge spill-overs. The growth enhancing role of trade stems from these knowledge spill-overs, not from changes in competitive pressure on the product market. As FEENSTRA (1996) points out these international knowledge spill-overs are also responsible for the convergence of growth rates after trade liberalisation across heterogeneous countries. BALDWIN/FORSKLID (1996) list at least six different channels through which trade liberalisation can enhance the growth rate of an economy. One of their experiments analyses the effects of trade liberalisation in the manufacturing sector and is thus comparable to our setting This experiment achieves an increase in the growth rate by making the final good an input to R&D because even though there are fewer resources available to spend on R&D the R&D cost is reduced due to increased competition in the input market. This result bears some resemblance to the lab equipment model in RIVERA-BATIZ/ROMER (1991).

The literature on competition and efficiency points out the importance of different managerial objectives for the effects of a change in competitive pressure. AGHION ET AL. (1997) and AGHION/HOWITT (1998, 1997) develop a general equilibrium model with knowledge spill-overs as an engine of growth. As in our model, they contrast profit maximisation by owners with full control over their management with an alternative scenario. In this alternative scenario managers have some leeway to pursue their own interests and delay the next restructuring as long as possible while securing the survival of the firm. We reduce their model of the economy to partial equilibrium but explore further the role of international competition in the absence of external effects. We broaden their model of the firm by allowing owners to require some dividend payments even when their control of the management is limited.

RADNER (1995) and SCHMIDT (1997) look at the importance of the survival constraint on management behaviour. In their models profit is entirely a cushion against the consequences of risky or bad behaviour. The first paper uses a dynamic Brownian-motion approach, where the management of a firm controls the volatility and drift of the profit function. It shows that profit maximisation leads to a behaviour quite different from a pure survival strategy. The second paper is static but links competition to management behaviour. Because stronger competition increases the likelihood of costly bankruptcy, managers react by increasing their level of effort.

The structure of the remainder of the chapter is as follows. Section 2 sets out the model and describes the properties of the optimal restructuring strategies depending on who controls the firm. Section 2.1. presents the general structure of firms' choice problems. Section 2.2. analyses optimal restructuring dates for owner control (2.2.1) and for manager control (2.2.2.). Section 3 analyses the effects of trade policy on these solutions. Section 3.1 examines the effect of changes in import protection. Section 3.2 applies these results to look at the effects of the creation of a custom union. Section 4 concludes.

2. THE MODEL OF INTERNATIONAL COMPETITION

2.1 The general set-up

We build upon a simple model of a small open economy in partial equilibrium. There are two home firms facing at date τ a world market price $p(\tau)$ and a tariff level t. The home firms each have a manager in charge of setting output in every period and an owner with the right to demand dividend payments.

The firms are assumed to have increasing marginal cost and a fixed cost element A in a simple cost function given by (1). At date 0 firm $i \in \{1;2\}$ starts with an initial value for the cost parameter c^i where we let $c^1 < c^2$.

(1) $$C^i\left(c^i(\tau), q^i(\tau)\right) = c^i(\tau)\left[q^i(\tau) + q^i(\tau)^2/2\right] + A \qquad \text{with } c^i(0) = c^i$$

Firm i's flow profit in period τ is given by

(2) $$\pi^i(\tau) = [p(\tau) + t]q^i(\tau) - C^i\left(c^i(\tau), q^i(\tau)\right)$$

At each date managers set the output volume in order to maximise the flow profit of the firm. Their optimal output choice in each period depends on the firm's cost parameter $c^i(\tau)$ as well as on the world price $p(\tau)$ and the level of protection t but not on the cost parameter of the other home firm.

$$(3) \qquad q^i\left(c^i(\tau), p(\tau), t\right) = \frac{p(\tau) + t - c^i(\tau)}{c^i(\tau)}$$

Having solved for the optimal output level we can now derive the equilibrium profit of firm i as a function of the time-dependent variables $c^i(\tau)$ and $p(\tau)$ as well as the trade cost t.

$$(4) \qquad \pi^i\left(c^i(\tau), p(\tau), t\right) = \frac{\left[p(\tau) + t - c^i(\tau)\right]^2}{2c^i(\tau)}$$

The flow profit can be used in two different ways: first, money can be paid to the firm owner in the form of dividends $v^i(\tau)$. Second, the profit can be added to the accumulated profit $\Pi^i(\tau)$ to be later invested in a cost-reducing restructuring of the firm. Firm i's accumulated profit at time T is called $\Pi^i(T)$ given by (5). The first term in this expression represents the integral over profit and dividend payments keeping track of cost parameter changes due to restructuring. The second term gives the restructuring cost R times the number of restructuring incidences s before date T.[1]

$$(5) \qquad \Pi^i(T) = \int_0^T \left[\pi^i\left(c^i(\tau), p(\tau), t\right) - v^i(\tau)\right] d\tau - Rs$$

[1] Note that for simplicity there is no discounting in this model, i.e., firms receive no interest for past profits. This assumption reflects the fact that there is no financial market in the model but is not essential for the results.

Each restructuring reduces the cost parameter of the firm according to the concave function $g(c^i)$.

(6) $c^i(\tau+1) = g\left(c^i(\tau)\right)$ at restructuring dates

where $0 < g(c) < c$ and $1 > \frac{dg(c)}{dc} \geq 0$

$c^i(\tau+1) = c^i(\tau)$ at all other dates

Like AGHION ET AL. (1997) we make the crucial assumption that a restructuring can only be financed through internal resources, i.e., the firm is not allowed to use the capital market in order to finance this investment.

Assumption 1: Firms are unable to obtain external credit.

The assumption is a strong version of credit models where borrowing is limited by the amount of available collateral and rules out models where borrowing is only limited by the present value of the investment.[2] Under the assumption about the absence of external finance restructuring at date T is only feasible if a firm has sufficient accumulated resources available to finance the restructuring cost R. Hence for the sequence of firm i's restructuring dates T^{is} the feasibility condition (7) has to hold.

[2] Without assumption 1, owners borrow and restructure immediately s times until any further restructuring is no longer profitable. The equivalent of restructuring in other models is the purchase of new blue-prints that become available over time. In our model, all future restructuring is already available. Hence assumption 1 is only another way to obtain an equivalent constraint on the speed of cost reduction.

(7) $\Pi^i(T) \geq R \; \forall T \in \{T^{is}\}$

To find the set of dates for which the feasibility condition (7) holds we establish the path of accumulated profit $\Pi^i(\tau)$ over time. At dates without restructuring $\Pi^i(\tau)$ changes by the level of the flow profit $\pi^i(\tau)$ reduced by dividend payments $v^i(\tau)$. At restructuring dates the additional restructuring cost R has to be deducted.

(8) $$\frac{d\Pi^i(\tau)}{d\tau} = \pi^i\left(c^i(\tau), p(\tau), t\right) - v^i(\tau) \qquad \text{if no restructuring}$$

$$\frac{d\Pi^i(\tau)}{d\tau} = \pi^i\left(c^i(\tau), p(\tau), t\right) - v^i(\tau) - R \qquad \text{at restructuring dates}$$

For any given dividend level $v^i(\tau)$ the sign of (8) depends on the evolution of flow profit over time. Flow profit is a function of the world market price which is assumed to follow a continuous downward trend over time.

(9) $$\frac{dp(\tau)}{d\tau} < 0$$

From the flow profit (4) we can establish the change in flow profit at dates without restructuring and thus a constant cost parameter c^i.

(10) $$\frac{d\pi^i\left(c^i(\tau),p(\tau),t\right)}{d\tau}=\frac{p(\tau)+t-c^i(\tau)}{c^i(\tau)}\frac{dp(\tau)}{d\tau}<0$$

From the dynamic evolution of flow profit (10) the firm might not be able to finance the dividend payment without using some accumulated profit from earlier periods: $\pi^i(\tau)-v^i(\tau)<0$. Firms are only active in the market if at date 0 they generate a profit $\pi^i(0)$ larger than the dividend level $v^i(0)$. At dates without restructuring accumulated profit is thus concave over time and has an inverted U-shaped form as drawn in figure III.1.

(11) $$\frac{d\Pi^i(0)}{d\tau}=\pi^i\left(c^i(0),p(0),t\right)-v^i(0)>0 \qquad \cap$$

$$\frac{d^2\Pi^i(\tau)}{d\tau^2}=\frac{d\pi^i\left(c^i(\tau),p(\tau),t\right)}{d\tau}<0$$

We are now in the position to describe the set of feasible restructuring dates defined above in (7). From the U-shaped form of $\Pi^i(T)$ we find that for a given dividend profile $v^i(\tau)$ there are two dates at which the constraint defined in (7) holds as an equality.

The lower bound $\underline{T}$ and upper bound $\overline{T}$ of the set of feasibility restructuring dates (7) are defined by

(12) $$\Pi^i(\underline{T})=R \text{ and } \pi^i\left(c^i(\underline{T}),p(\underline{T})\right)-v^i(\underline{T})\geq 0 \qquad \text{lower bound}$$

$$\Pi^i(\overline{T})=R \text{ and } \pi^i\left(c^i(\overline{T}),p(\overline{T})\right)-v^i(\overline{T})\leq 0 \qquad \text{upper bound}$$

In figure III.1 we show the feasibility set as the intersection between the horizontal line representing the restructuring cost R and the area underneath the accumulated profit function $\Pi^i(\tau)$.

2.2 Finding the optimal restructuring dates

So far we have established the evolution of profit over time and the resulting set of feasible restructuring dates. In this section we analyse the optimal sequence of restructuring dates under two different assumptions. Under the first assumption, the owner has complete control of the management and effectively sets dividend levels and restructuring dates on his own. This assumption corresponds to the traditional case of a profit maximising firm. Under the second assumption, the manager is faced with a fixed dividend target which he has to respect in order not to lose the job generating control rents. Given this constraint the manager is free to set the restructuring dates T^s as he decides. This assumption corresponds to the more critical view of managers being able to exploit their position to pursue private objectives other than profit maximisation.

2.2.1 The profit maximising firm

The owner faces a trade-off between consumption today, i.e., immediate dividend payments, and consumption tomorrow, i.e., investment in restructuring to generate a higher profit and thus dividend potential in the future. The optimal decision depends therefore on the owners' rate of time preference r. Reflecting the stickiness of dividend levels observed empirically, we restrict the owner to set a constant dividend level between restructuring dates, such that $v^i(T^s)$ indicates the dividend level of firm i between dates T^{s-1} and T^s.

We start by establishing the possible combinations of dividend levels v^i and feasible restructuring dates T^s. The feasibility set defined by the boundaries in (12) depends on the level of dividend payments v^i a firm has to make in every period. An increase in the level of dividends shifts the boundaries of the feasibility set according to

(13) $$\frac{d\underline{T}}{dv^i} = \frac{\underline{T}}{\pi^i\left(c^i(\underline{T}), p(\underline{T})\right) - v^i(\underline{T})} > 0 \qquad \text{lower bound}$$

$$\frac{d\overline{T}}{dv^i} = \frac{\overline{T}}{\pi^i\left(c^i(\overline{T}), p(\overline{T})\right) - v^i(\overline{T})} < 0 \qquad \text{upper bound}$$

Note that a rational owner only produces if he can generate a non-negative profit, i.e., $\pi^i\left(c^i(\tau), p(\tau), t\right) \geq 0 \forall \tau$. We use figure III.2 to present the relationship between the level of dividends and the set of feasible restructuring dates. Note that figure III.2 and figure III.1 differ in the vertical axis. Whereas figure III.1 concentrates on the level of accumulated profit, figure III.2 focuses on the level of dividend payments set by the firm owner. The set of feasible restructuring dates in figure III.2 is thus the sum of all feasible restructuring dates from figure III.1 for all dividend levels $v^i(\tau)$. In figure III.2 we make use of the second derivatives with respect to the dividend level.

(14) $$\frac{d^2\underline{T}}{dv^{i^2}} = \frac{\underline{T}}{\left[\pi^i\left(c^i(\underline{T}), p(\underline{T})\right) - v^i(\underline{T})\right]^2} > 0 \qquad \text{lower bound}$$

$$\frac{d^2\overline{T}}{dv^{i^2}} = \frac{\overline{T}}{\left[\pi^i\left(c^i(\overline{T}), p(\overline{T})\right) - v^i(\overline{T})\right]^2} > 0 \qquad \text{upper bound}$$

There exists a maximum $\hat{v}^i$ such that only one feasible restructuring date $\hat{T}^i$ remains. Note that at this date the flow profit is equal to the dividend level and (13) has a discontinuity. In figure III.2 the function of flow profit over time intersects the frontier of the feasibility set at this maximum.

Apart from the level of dividends it is also the level of the cost parameter $c^i(\tau)$ which influences the shape of the flow profit function $\pi^i(\tau)$ and thus of the accumulated profit function $\Pi^i(\tau)$. In particular, a firm with a lower cost parameter is able to generate a higher flow profit.

(15) $$-\frac{d\pi^i(\tau)}{dc^i(\tau)} = \frac{p(\tau) + t - c^i(\tau)}{2c^i(\tau)^2}\left[p(\tau) + t + c^i(\tau)\right] > 0$$

The advantage of operating with a lower cost parameter depends on the level of the world market price $p(\tau)$. A higher price level increases the advantage of having lower cost.

(16) $$-\frac{d^2\pi^i(\tau)}{dp(\tau)dc^i(\tau)} = \frac{p(\tau) + t}{c^i(\tau)^2} > 0$$

Using these results the effect of different cost parameters on the level (15) and the price responsiveness (16) of flow profit, we establish the change in the feasibility set in reaction to a lower cost parameter with the help of figure III.3. Suppose we compare the two firms 1 and 2 with $c^1 < c^2$. Starting from the maximum of the feasibility set for firm 2 at date $\hat{T}^2$ from (15) firm 1 can afford to increase its dividend level by the additional profit it generates at that date. But from the effect of the cost parameter on the price responsiveness of flow profit (16) this policy has not the exploited the full level of additional resources generated in earlier periods with a higher world market price level. Some flow profit remains available to be divided up between higher dividends and earlier restructuring dates.

$$(17) \quad -\int_0^{\hat{T}^2} \frac{\left[\pi^1\left(c^1(\tau), p(\tau), t\right) - \pi^2\left(c^2(\tau), p(\tau), t\right)\right]}{dc^i(\tau)} d\tau > -\hat{T}^2 \left[\frac{d\pi^1\left(c^1\left(\hat{T}^2\right), p\left(\hat{T}^2\right), t\right) - d\pi^2\left(c^2\left(\hat{T}^2\right), p\left(\hat{T}^2\right), t\right)}{dc^i(\tau)}\right]$$

It follows that the frontier of the feasibility set is pushed up even further. The maximum for firm 1's feasibility set is on its decreasing flow profit function such this maximum in comparison to firm 2 is characterised by both an earlier restructuring date $\hat{T}^1 < \hat{T}^2$ and a higher dividend level $\hat{v}^1 > \hat{v}^2$.

After establishing the set of combinations between feasible restructuring dates and dividend levels for different levels of the cost parameter $c^i(\tau)$ we can now formulate owner i's optimisation problem for the discounted sum of dividends V using the discount factor r.

$$(18) \quad \underset{\{T^{is}\},\{v^i\}}{Max} V^i = \int_0^{T^{i1}} v^i(T^{i1})e^{-r\tau}d\tau + \int_{T^{i1}}^{T^{i2}} v^i(T^{i2})e^{-r\tau}d\tau + .. + \int_{T^{is-1}}^{T^{is}} v^i(T^{is})e^{-r\tau}d\tau$$

such that $\quad \Pi^i(T) \geq R \;\; \forall T \in \{T^{is}\}$

The exact sequence of restructuring dates $\{T^s\}$ depends on all exogenous parameters including the discount factor r, the cost-cutting function $g(c)$ and the time path of $p(\tau)$. To understand the effect of trade liberalisation it is sufficient to show that the optimal combinations of restructuring dates and dividend levels are all on the lower bound of the feasibility set defined in (12).

Proposition 1

(a) A firm owner with full control over dividend levels and restructuring dates chooses an optimal combination of $T^{is}*$ and $v*(T^{is})$ satisfying

$$(19) \quad \Pi^i(T) = R \quad \cap \quad \pi^i(c^i(\tau), p(\tau)) \geq v^i(T) \quad \forall T \in \{T^{is}*\}$$

(b) A firm owner with full control facing a lower initial cost parameter $c^i(0) < c^j(0)$ receives both a higher dividend level and restructures earlier.

$$(20) \quad v^i(T^s) \geq v^j(T^s) \quad \cap \quad T^{is} < T^{js} \quad \text{if} \quad c^i(0) < c^j(0)$$

Proof:

(a) Suppose the owner chooses a combination of v' and T' within the feasibility set but not at its lower bound. Then the owner could move the restructuring date forward to the lower bound keeping the dividend level constant. Noting the flow profit is decreasing in the cost parameter (15) the firm enjoys an additional profit between the new restructuring date T'' and the planned restructuring date T' given by

$$\text{(21)} \quad \int_{T''}^{T'} \left[\pi\left(g\left(c(T'')\right), p(\tau)\right) - \pi\left(c(T'), p(\tau)\right) \right] d\tau > 0$$

This additional profit can be used for an extra dividend or earlier restructuring dates in the future. Hence a combination of v and T away from the lower bound of the feasibility set can not be optimal.

(b) Using the effect of the cost parameter on the level (15) and price responsiveness (16) of the flow profit we established that the maximum of the feasibility set shifts upwards and to the left with a lower cost parameter. The argument applies analogously to all points on the lower bound of the set. This proves (20) where the weak inequality only applies for an extremely patient owner ($r = 0$) with a policy of zero dividends and restructuring at dates $\underline{T}$.

Proposition 1 has a number of interesting features: first, firms with full owner control do not delay activities to reduce their cost level until flow profit drops below the dividend level. If actual firm behaviour deviates from this prediction we have to determine which critical assumption of the model does not correspond to empirical facts. Second, firms with a lower cost level both generate a higher dividend level and improve their performance faster than other firms. Over time, proposition 1 thus implies increasing differences in firms' cost levels

(22); firms with an initial advantage extend their lead further and further until finally weaker competitors exit the market.

(22) $$\frac{d\left[c^{j}(\tau)-c^{i}(\tau)\right]}{d\tau}\geq 0$$

2.2.2 Manager control over restructuring dates

In this section we compare the profit maximising firm with a firm where the manager has some leeway to pursue his own private objectives. The manager has two interests: first, he wants to keep his job in order to continue to enjoy control rents. Second, he wants to delay restructuring as long as possible in order to avoid the attached private cost of new learning and reorganising the firm.

The owner requires the payment of a constant dividend v^{**} where we assume that at this dividend level there exists a non-empty set of feasible restructuring dates as defined in (7). The manager has not to respect a non-negativity constraint on flow profit such that we get the adjusted feasibility set in figure III.4. But if the manager is unable to pay the dividend v^{**}, be it out of the flow profit or the accumulated profit, he loses his job and the attached per-period control rent of b.[3]

[3] HOLMSTRÖM (1982) assumes that the cost to the manager comes in terms of lost reputation resulting in a lower future wage, where profit instead of survival is the signal of effort.

With every restructuring the manager incurs a private cost of k. Because the manager has a rate of time preference $0<\rho\leq\infty$ he aims to delay restructuring dates as much as possible without losing the job. The managers optimisation problem for his private utility B can thus be written as

$$\text{(23)} \qquad \underset{\{T^s\}}{Max}\, B = \int_{\tau=0} be^{-\rho\tau}d\tau - \sum_{\{T^s\}} ke^{-\rho T}$$

$$\text{s.t.} \qquad \Pi(T)\geq R \;\; \forall T\in\{T^s\}$$

$$v(\tau)\geq v^{**}$$

As in AGHION ET AL. (1997) and AGHION/HOWITT (1998) we assume that the manager's discount rate ρ and the private control rent b are both high enough such that the manager acts as if he has lexicographic preferences over restructuring dates, i.e., he first tries to delay the first restructuring as far as possible then the second restructuring and so on. Under this assumption we can in proposition 2 describe the properties of the optimal combination of restructuring dates and dividend levels for management control of restructuring dates. An equivalent assumption concentrates on the frequency of feasible restructurings: if the restructuring cost R is high relative to the flow profit π the distance between restructuring dates is large such that even for a lower discount rate the manager's behaviour approaches the one implied by lexicographic preferences.

Proposition 2

(a) A firm manager with control over restructuring dates and an obligation to pay a constant dividend v^{**} chooses an optimal sequence $\{T^{s**}\}$ satisfying

(24) $$\Pi(T) = R \quad \text{and} \quad \pi(c(\tau), p(\tau)) \le v^{**} \quad \forall T \in \{T^{s}{**}\}$$

(b) If firm owners set an equal dividend target for all firms independently of their initial cost situation then cost parameters converge to a common level.

(25) $\exists \tau^{**}$ such that $c^i(\tau) = c^j(\tau)\,|\tau \ge \tau^{**}$

Proof:

(a) The manager has no reason to pay a dividend higher than v^{**} because that would reduce his ability to finance restructuring without giving any private gain. The manager also has no incentive to choose an earlier restructuring date $T<T^{s**}$ because from the assumption about his time preference the additional private cost from restructuring earlier outweighs any gain from restructuring later in future periods.

(b) Because the flow profit is decreasing in the cost parameter (15) the firm with an initially lower cost generates a higher flow profit. Applying the implicit function theorem on the definition of the feasibility set (7) we get (26): a higher flow profit shifts the upper bound of the feasibility set to the right.

(26) $$-\frac{d\overline{T}}{dc^i(\overline{T})} = -\frac{\int_o^{\overline{T}} d\pi^i(\tau)/dc^i(\tau)\,d\tau}{\pi^i(c^i(\overline{T}), p(\overline{T})) - v^{**}} > 0$$

Hence with an equal target dividend of v^{**} the firm with a lower initial cost parameter $c^i(0)$ can wait longer until it invests in the first restructuring. This process of later restructuring dates continues until at date τ^{**} both firms have reached the same cost level, hence the same flow profit and restructuring dates.

From the comparison of proposition 1 and 2 we can establish the effect of different assumptions on owner control over management on firm behaviour. In figure III.5 we have drawn firm *i*'s combinations of restructuring date and dividend level for these two assumptions about internal control. While the relative level of the dividend depends on the time preference of the owner the restructuring dates occur always later for the case of manager control compared to the case of a profit-maximising firm with owner control.

A second implication of the model concerns the evolution over time: while owner control implies an increase in firm differences culminating in the exit of high-cost firms from the industry, with manager control all firms with equal dividend levels reach an identical cost level independently of their initial cost situation. The absence of owner control thus eliminates to a large extent the pressure of product competition on firms and their managers.

3. THE TRADE POLICY EXPERIMENT

We analyse two different trade policy experiments: in the first section, we look at the effect of an increase of import protection on firm restructuring behaviour as a function of control within the firm. In the second section, we use these results to look at the effects of creating a custom union when the participating countries previously had different rates of import protection and the firms located in these countries have a different initial cost levels.

3.1 The effect of import protection

In the first trade policy experiment we analyse the effect of a change in import protection (a production subsidy has equivalent effects) on firm behaviour depending on the two different assumptions about control within the firm. We find that import protection has radically different implications for the timing of restructuring dates and thus the evolution of the firm's cost level over time if manager control instead of owner control is the correct description of the internal structure of the firm.

Our experiment involves a permanent shift in the level of import protection t. Higher protection increases the level of flow profit.

$$(27)\qquad \frac{d\pi^i\left(c^i(\tau), p(\tau), t\right)}{dt} = \frac{p(\tau) + t - c^i(\tau)}{c^i(\tau)} > 0$$

The upward shift of flow profit affects the evolution of accumulated profit through the dynamic equation (8). The set of feasible restructuring dates is extended because more resources are available. The maximum dividend for which restructuring is still feasible is increased and the corresponding restructuring date is shifted forward. To prove this result first note that the increase in profit due to higher protection is increasing in the world price level.

$$(28)\qquad \frac{d^2\pi\left(c(\tau), p(\tau), t\right)}{dt\,dp(\tau)} = \frac{1}{c(\tau)} > 0$$

Because the world price level is decreasing over time (9) the stronger effect of protection on flow profit for higher price levels (28) implies a higher flow profit gain in earlier periods. Now from an argument parallel to the one made above in the analysis of the effect of different cost parameters we can establish that higher protection implies both a higher dividend level and earlier restructuring dates at the maximum of the set of feasible restructuring dates. For the graphic argument we can again use figure III.3.

3.1.1. The effect of protection on a profit-maximising firm

For the profit maximising firm, i.e., a firm owner with full control over restructuring dates and dividend levels, the extended feasibility set is used to increase both current and future consumption.

The effect of higher import protection on a firm's profit also depends on the initial cost level of that firm. In particular, we find that low cost firms have a bigger advantage from protection than high cost firms.

(29) $$\frac{d^2\pi^i\left(c^i(\tau),p(\tau),t\right)}{dtdc^i(\tau)}=-\frac{p(\tau)+t}{c^{i^2}(\tau)}<0$$

In proposition 3 we collect these results both for the individual firm and for the differential impact depending on the initial cost level.

Proposition 3

(a) An increase in tariff protection allows a profit maximising firm to increase the dividend level while at the same time shifting forward the restructuring dates.

$$(30) \qquad \frac{dT}{dt} < 0 \, ; \, \frac{dv(T)}{dt} > 0 \qquad \forall T \in \{T^s *\}$$

(b) An increase in tariff protection increases the rate at which the cost differential between firms of different initial cost levels increases.

$$(31) \qquad \frac{d^2[c^j(\tau) - c^i(\tau)]}{d\tau dt} > 0 \qquad \text{if} \qquad c^j(0) > c^i(0)$$

Proof:

(a) Because high protection increases both the level (27) and the price responsiveness (28) of the flow profit we can by the same argument as used in the proof for proposition 1 (b) show that the maximum of the feasibility set is shifted upwards and to the left. This argument applies, analogous to the proof of proposition 1, to all points on the lower bound of the feasibility set.

(b) This is an application of (22) noting the differential impact of trade protection depending on initial cost levels (29).

Proposition 3(a) shows the infant-industry characteristics of the model: trade protection generates transfers from consumers to home firms in the form of higher prices which are used by home firms to make investments in cost reduction. This implication holds both for individual firms, i.e., each firm restructures faster from proposition 3 (a), and for the distribution of firms, i.e., low-cost firms gain more and thus eliminate high-cost competitors quicker from proposition 3 (b). Over time protection might become unnecessary because firms catch up with their world market competitors.

3.1.2. The effect of protection on a manager-controlled firm

For the firm with manager control over restructuring dates the effect of higher import protection gives the management an opportunity to delay future investments in cost reduction: the additional resources are used as a cushion to survive the effects of slower cost-cutting.

Initial cost differences have no long-term effect on the reaction of the manager controlled firm. Firms with an lower initial cost level enjoy a higher windfall gain from an increase in protection and are thus able to delay restructuring dates by more. After the adjustment period, however, proposition 2 (b) still applies and all firms converge towards a common cost level.

Proposition 4

(a) An increase in tariff protection allows a manager-controlled firm to delay all future restructuring dates.

(32) $$\frac{dT}{dt} > 0 \qquad \forall T \in \{T^s *\}$$

(b) An increase in tariff protection has no long term effect on the cost differential between firms with initially heterogeneous cost parameters.

(33) $$\exists \bar{\tau} \text{ such that } c^i(\tau) = c^j(\tau) \forall \tau \geq \bar{\tau}$$

(c) Higher protection increases the long term cost level of all firms.

(34) $$\exists \tilde{\tau} \text{ such that } \frac{dc^i(\tau)}{dt} > 0 \forall \tau \geq \tilde{\tau}$$

Proof:

(a) Flow profit is increasing in protection (27) at any point in time. This implies a higher level of accumulated profit at any point in time and thus a later date at which the accumulated profit function reaches the level of restructuring cost R from above.

$$(35)\quad \frac{d\bar{T}}{dt} = -\frac{\int_{o}^{\bar{T}} d\pi^i(\tau)/dt\, d\tau}{\pi^i\left(c^i(\bar{T}), p(\bar{T})\right) - v^{**}} > 0$$

(b) Higher protection increases the initial flow profit difference between firms with heterogeneous cost parameters (29) but proposition 2 (b) still applies.

(c) For higher protection levels firms can generate sufficient resources, i.e., an equal level of flow profit, to satisfy the dividend target with a higher cost level. Using the implicit function theorem on flow profit (4) we get

$$(36)\quad \frac{dc^i(\tau)}{dt} = \frac{2c^i(\tau)}{p(\tau) + t + c^i(\tau)} > 0$$

Proposition 4 has implications close to the public perception on the effect of trade protection: firms use an additional profit to relax in their cost cutting efforts. Infant-industry effects are absent and the burden of a higher home market price on consumers results in a direct transfer to firms without achieving an improvement in the industry's long term prospectives. The opposite is true as from proposition 4 (c) the cost level of the home industry is even increased compared to a policy with lower import tariffs. Comparing proposition 3 and 4 the model draws attention on the critical importance of the assumption made on the control situation within a firm when evaluating trade policies.

3.2 An application to the creation of a free trade area

Suppose that countries home h and foreign f initially run different trade policies where home sets a lower external tariff than foreign: $t^h < t^f$. Now let the two countries create a custom union with a common external tariff t somewhere between the two individual levels: $t^h < t < t^f$. How does this policy affect the evolution of firm cost levels over time when we assume firms to be manager-controlled and international shareholders demand equal dividend payments in all countries?

For the pre-custom union situation, i.e., all dates before enacting the common external tariff t at date τ^{CU}, we can apply proposition 4(c) to establish that the firm in the more protected country operates with a higher cost parameter. Due to the higher rate of protection this firm is still able to generate sufficient flow profits to satisfy the dividend demands and finance a future restructuring.

(37) $c^h(\tau) \leq c^f(\tau) \forall \tau \leq \tau^{CU}$

The common external tariff t^{CU} affects the firms in two countries differently: firms in the home country experience an increase in protection while firms in the foreign country face a tougher trade policy environment. Applying proposition 4(b) we conclude that the home country firms relax in their cost-cutting efforts while the foreign country firms speed up the cost-cutting. Eventually all firms converge to a common cost level.

(38) $\exists \tau ** > \tau^{CU}$ such that $c^h(\tau) = c^f(\tau) | \tau \geq \tau **$

We are interested in this case because the German experience is claimed to be a result of such a sequence of events: first, Germany chose a low rate of protection such that the exposure to strong foreign competition required German managers to restructure quickly while satisfying the dividend demands by the owners. Second, easier access to other European markets after the 1992 Single Market initiative as well as the reunification of Germany created windfall profits for German firms. These profits were used to delay restructuring programs and thus gave competitors in other European countries an opportunity to catch up.

Unfortunately, our model is not fully equipped to investigate this hypothesis. In an oligopoly model we can easily construct a situation where the elimination of trade barriers between two countries creates a windfall gain for low-cost firms in one country and windfall losses for high-cost firms in the other countries. In a small open economy model without exports this is not possible. These additional results of an oligopoly model come at the cost of a significant complication of the model: firms compete on all stages, i.e., on the product market, in setting restructuring dates, and when announcing the dividend level, with a largely increased strategy space. In this paper we have decided to develop the small open economy case instead which already allows us to draw out many of these results.

4. CONCLUSIONS

This chapter develops a dynamic model to analyse how the exposure of a national market to international pressure and owners' control of management behaviour affect a firm's incentive to invest in cost reducing restructuring. Our model is applied to investigate the claim that low-cost firms slow down restructuring when faced with windfall profit. We show how a change in trade policy designed to increase profit *increases* the incentives of firms to speed up restructuring when firm owners fully control their management and thus are able maximise the firm's dividend payment. When, however, owners only have limited control of their management through a dividend target the same trade policy *decreases* the incentives of firms to speed up restructuring. This latter prediction seems to be much more in line with empirical observations. The model has also implications for the evolution of cost differences over time: for owner-control these cost differences *increase* over time while for manager-control they *decrease* until they finally disappear.

Protection translates into a specific level of profit accruing to a firm. The way profit affects restructuring depends on the ability of owners to appropriate the profit. Under the assumption of full owner control of the management, as standard in the trade literature, accumulated profit is used as a resource to finance restructuring and dividends. Under the alternative assumption of limited owner control via a profit target, however, accumulated profit is used as a cushion to ensure firm survival in the absence of cost reductions.

The model does not allow for strategic interaction between firms and relies on the exogenously assumed movement of the world price. These strategic effects would give interesting additional insights but complicate the model considerably. Especially for the case of heterogeneous firms and full owner control the results threaten to look more drastic in a full oligopoly model: lagging firms not only fall further behind their stronger competitors, but the performance of those low-cost firms speeds up this process until the laggards have to exit the industry. A second worry is the assumption on the complete absence of capital markets. AGHION ET AL. (1997) show that debt can be used as a commitment device to force the management to restructure at earlier dates. This is an effect of debt known from the finance literature. If, however, uncertainty about the level of flow profit is introduced the effect of this instrument is restricted and managers regain some leeway in setting the firm's restructuring dates.[4] Despite the restrictions of the model outlined above the results are robust to different market structures. More specifically, the results obtained from our model hold for both price and quantity competition for differentiated products.

In the context of our model we look at the argument that has been made by BAILEY/GERSBACH (1995) in the context of the further integration of European markets as part of the 1992 Single Market. They claim that the Single Market gave German firms with their initial cost advantage that opportunity to slow down in their cost-cutting efforts because they enjoyed windfall profits. From our model we conjecture that their argument is logically consistent, if owners have only limited control about the management's activities.

[4] See Aghion/Howitt (1998), p. 215.

Figure III.1

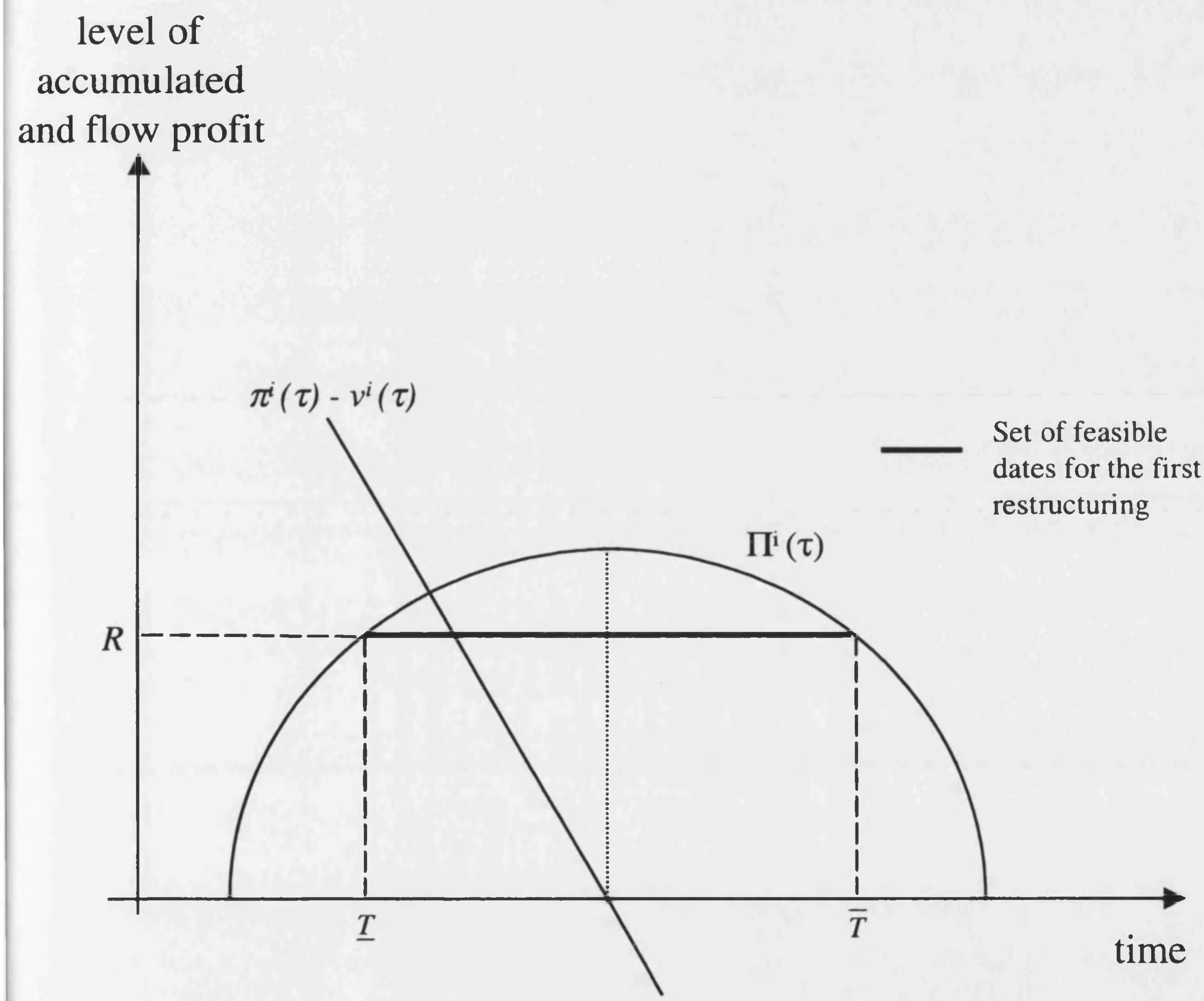


Figure III.1: Feasible dates for the first restructuring given positive dividend level v^i

Figure III.2

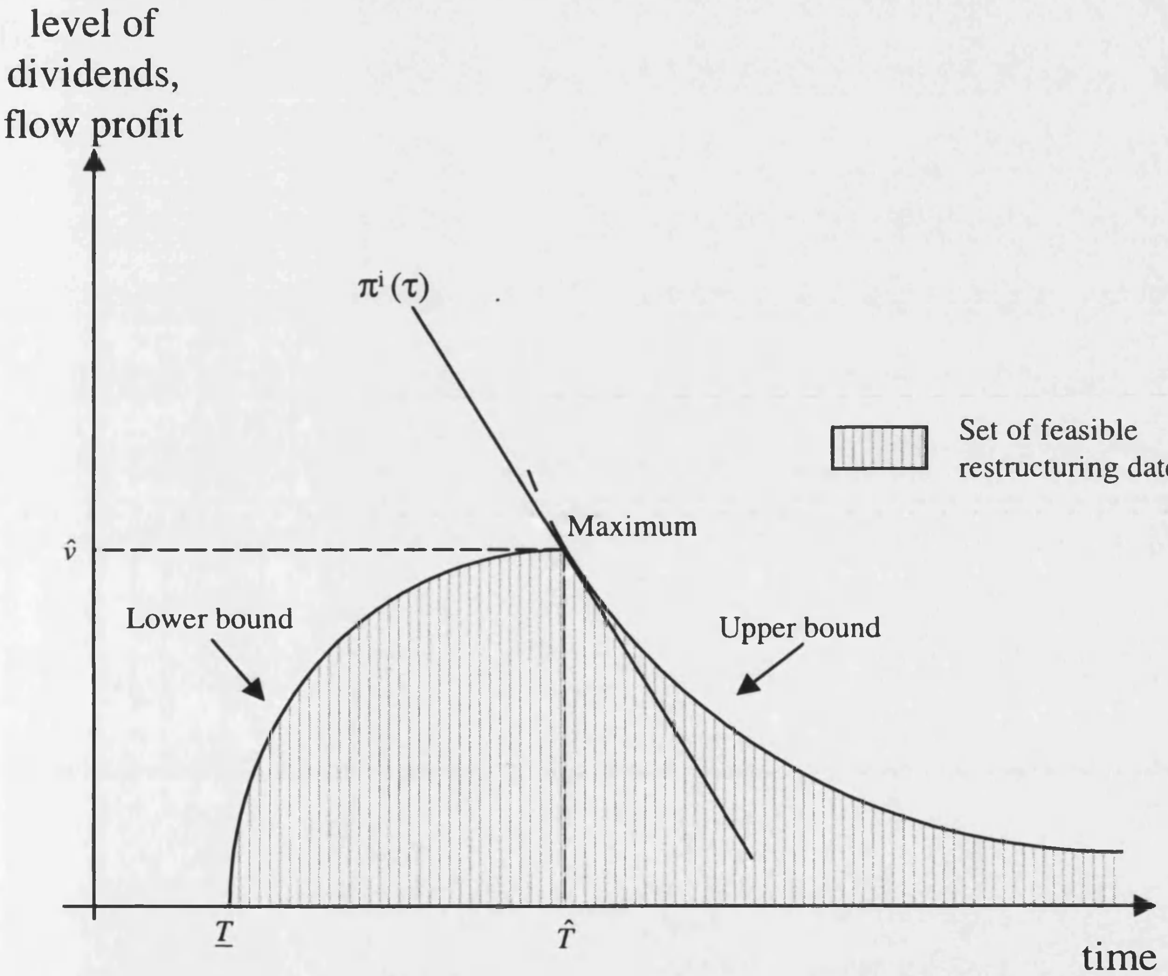


Figure III.2: The set of feasible restructuring dates for an owner-controlled firm

Figure III.3

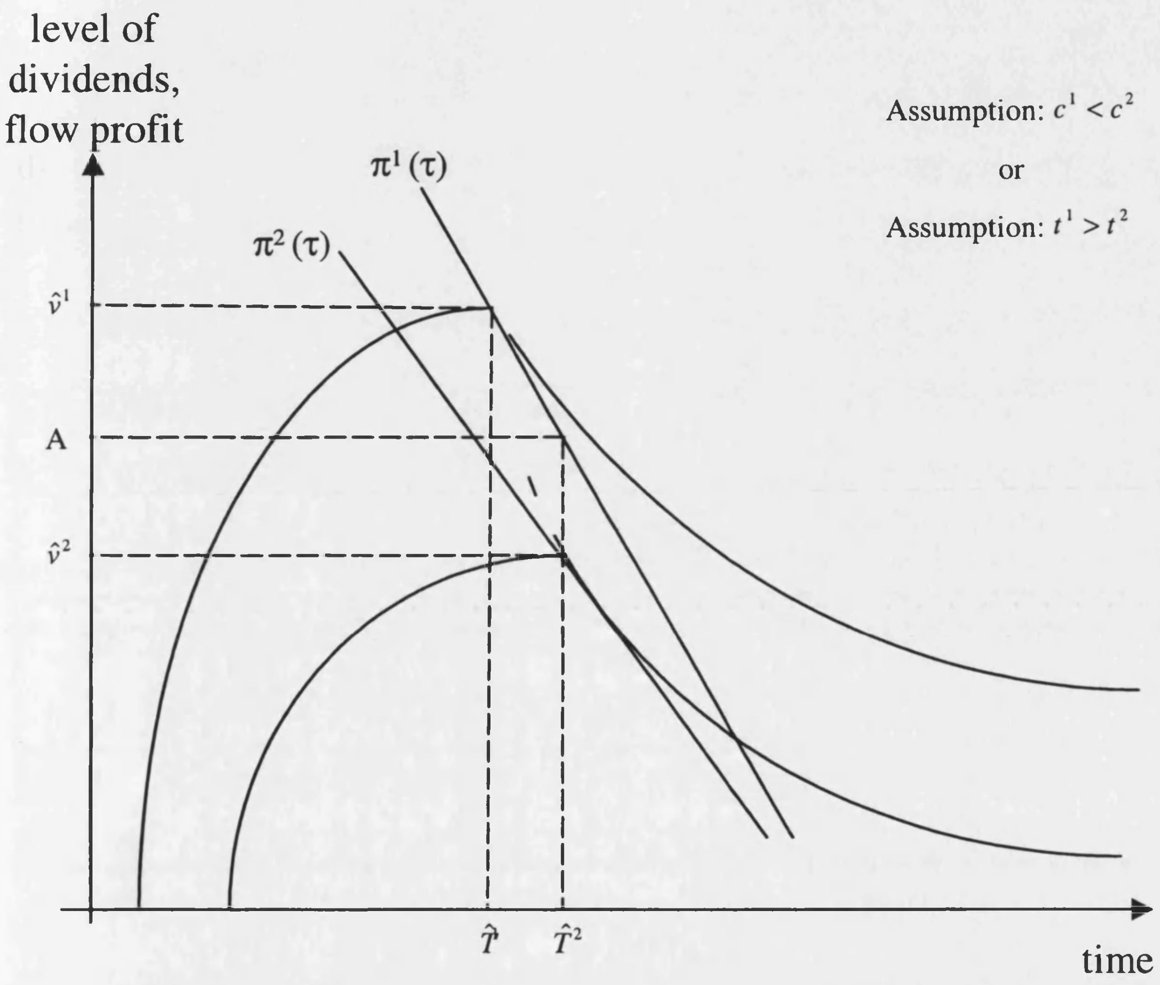


Figure III.3: The feasibility set as a function of the cost parameter

The area between A and the dividend level v^1 over the time between 0 and T^2 is from (17) smaller than the area between the flow profit functions bewteen 0 and T^2. Therefor, (A,T^2) is not the maximum of the feasibility set for a lower cost parametere or a higher tariff level.

Figure III.4

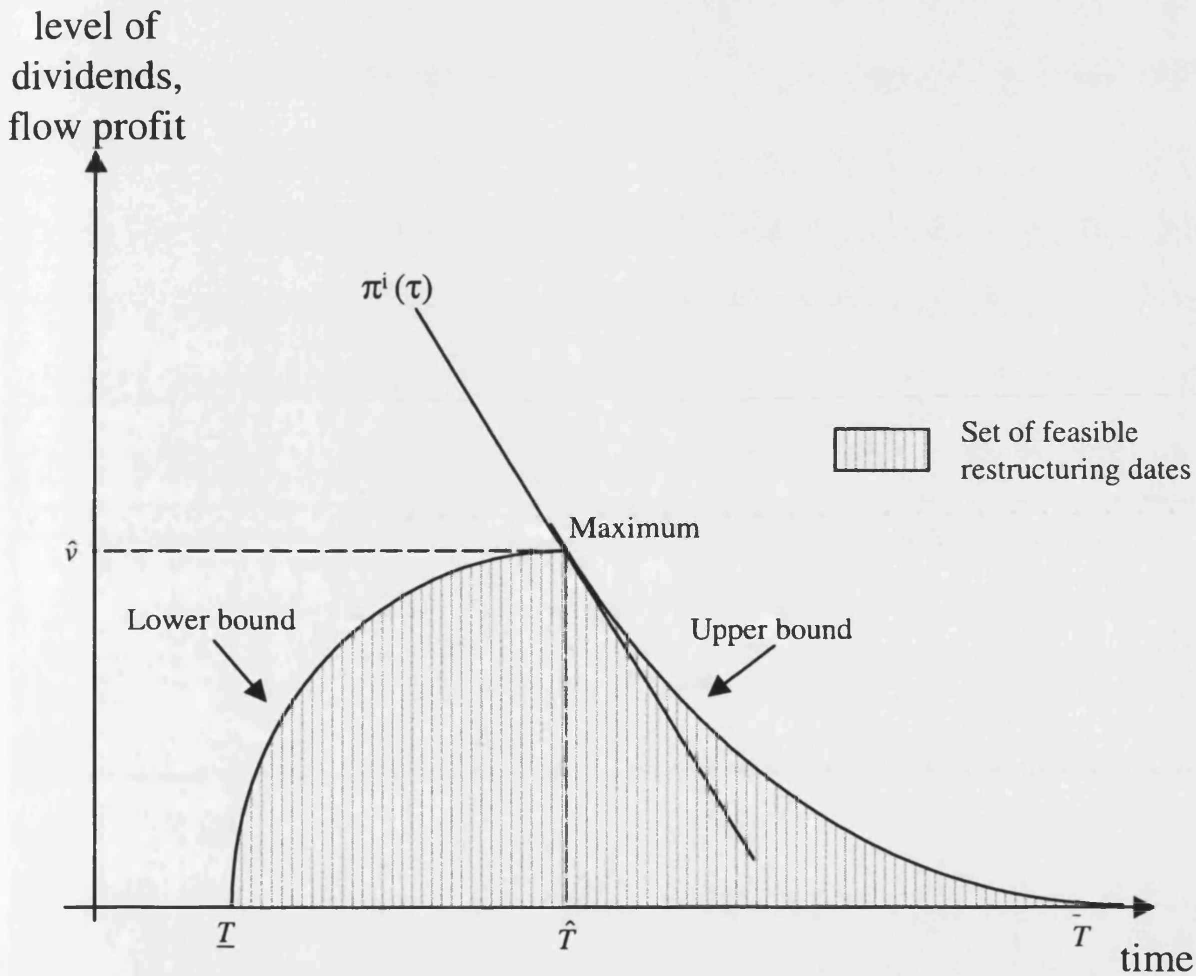


Figure III.4: The set of feasible restructuring dates for a manager-controlled firm

Figure III.5

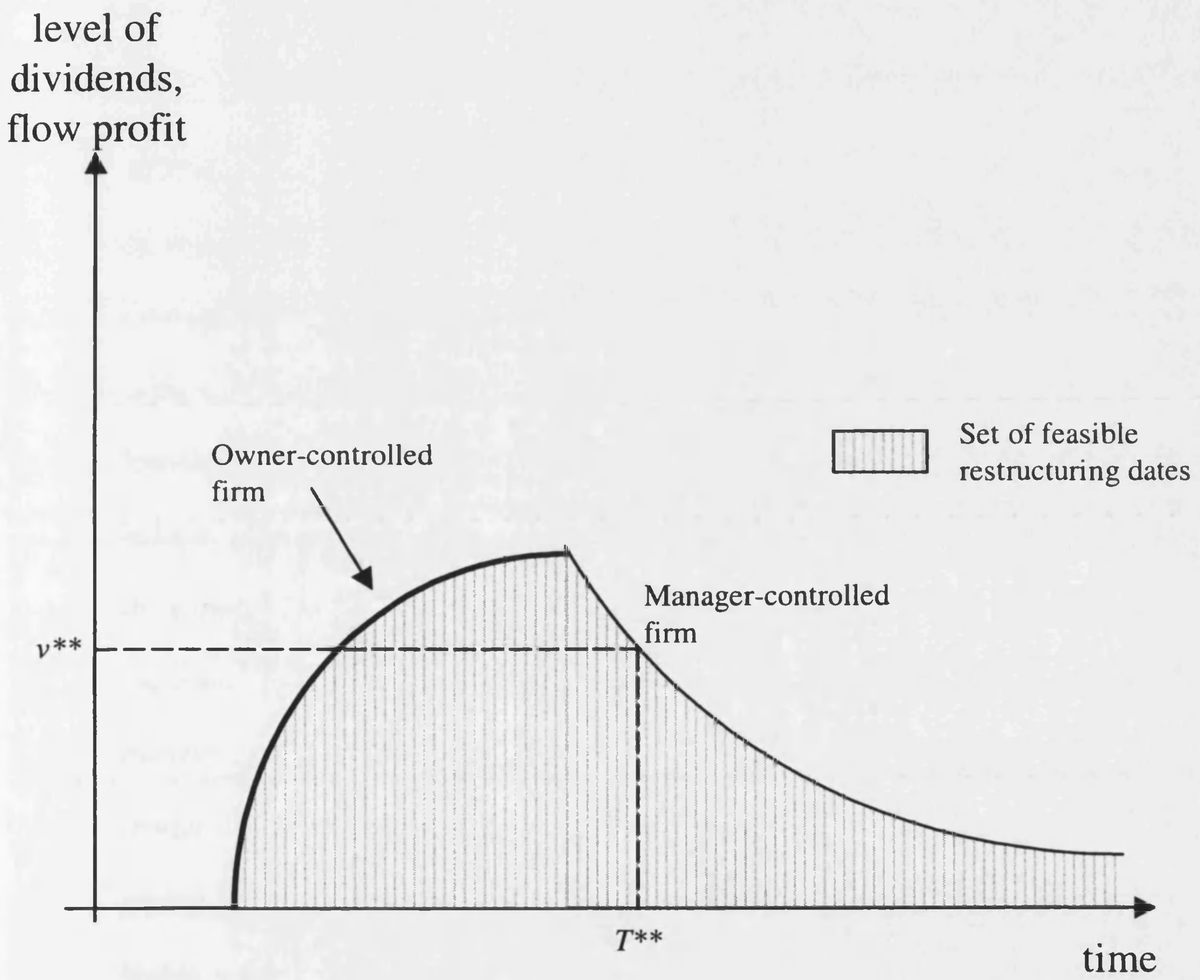


Figure III.5: Optimal restructuring dates and dividend levels

Chapter IV

Trade liberalisation and within-firm incentive contracts: An application to the labour market

1. INTRODUCTION

In this chapter we analyse how trade liberalisation affects wage differentials between skill groups through the impact of international competition on within-firm incentive contracts for high-skill labour. We develop a free entry international trade model where trade liberalisation increases the incentives for firms to invest in performance bonuses to their high-skill managers to reduce the low-skill per-unit labour input requirement. The reduction of trade barriers reduces market power and price cost margins such that firms have to push up their output in order to be able to finance a fixed cost of production. With an expansion of firm size it becomes more valuable to switch to a technology where managers can be induced with an appropriate incentive contract to cut the marginal cost of production. Trade liberalisation increases the number of firms paying incentive bonuses and thus the number of high-skill managers receiving a higher wage: the wage differential between skill groups rises as a response to the reduction of trade barriers. Our model thus develops an argument based on competition effects while the previous literature focuses on general-equilibrium effects of trade. Both perspectives are complementary steps towards a better understanding of the link between trade and wages.

An increase in the relative wage of high-skill labour is observed in many OECD countries (see the OECD *Jobs Study* (1994) and appendix IV.1). The increase is particularly noticeable in the U.S. and the U. K. whereas for continental European countries like Germany[1] the evidence is less clear. Concurrent to the increase in wage differentials the OECD countries experienced an increase in the role of foreign trade, especially in the manufacturing sector. Because the increase in wage differentials and the increase in trade shares occurred at the same time the two phenomena could be causally linked.

In general, the increase in the relative wage of high-skill labour can be the result of a shift in either demand or supply. Because the relative supply of skilled labour appears to have gone up (even though there is some discussion in the U.S. about the impact of migration[2]) labour demand is the main candidate for explaining the increase in wage differentials. One possible explanation for the increase in relative demand for high-skill labour is the emergence of new high-skill intensive technologies. Another explanation is that production has shifted towards high-skill intensive sectors as the result of trade liberalisation driving countries with an abundant supply of high-skill labour, such as the OECD members, to concentrate on the high-skill intensive sectors where they enjoy a comparative advantage.[3] This possible linkage is behind much of the public concern about "globalisation".

---

[1] In its *Jobs Study* (1994) the OECD reports for Germany a falling relative wage of high-skill labour referring to work using the German Socio-economic Panel. MÖLLER (1996) uses the Labour Market Statistic and finds contrary evidence. KRUGMAN (1995) argues that with labour market rigidities these countries might experience an increase in relative unemployment rates for low-skill labour instead.

[2] See BORJAS/FREEMAN/KATZ (1997).

[3] AGÉNOR/AIZENMAN (1997) mention a third hypothesis: a decline in the real cost of capital might have induced firms to substitute low-skill labour with capital.

The empirical work tries to test these - non-mutually exclusive - hypothesis. Most studies applying the HECKSCHER-OHLIN framework to analyse the quantitative impact of the change in trade flows on the change in wage differentials conclude that trade accounts for less than twenty percent of the observed changes in the wage structure.[4] There are a number of reasons why trade turns out to be either of small importance or no candidate at all to explain the wage movements when working within the HECKSCHER-OHLIN framework. First, labour economists argue that the change in trade flows has been too small to explain the large movements in relative wages if usual estimates of labour market elasticities are applied. Through the factors of production incorporated in traded goods the change in trade flows changes the effective labour supply. But because trade accounts only for a fraction of total production changes in trade volumes tend to have a limited effect on wages. Second, LAWRENCE/SLAUGHTER (1993) find that high-skill labour demand increased not only because high-skill intensive sectors gained importance but also because the demand for high-skill labour rose across all sectors. This observation is in contrast to the predictions of the HECKSCHER-OHLIN model. Finally, ROBBINS (1996) reports an increase in the relative wage of high-skill labour for some Latin-American countries. This observation again is in contrast to the predictions of the HECKSCHER-OHLIN model if these countries are low-skill labour abundant.

We argue that this perspective neglects the importance of trade and international competition on the decision to adopt a new technology and thus

[4] See for example SLAUGHTER/SWAGEL (1997).

underestimates the effect of trade on wage differentials.[5] Our model provides a framework to measure the effect of trade on wages not only by the prices of traded goods or the production factors incorporated in trade flows[6] but also by the change in management structure and technology induced from international competition. Because a change in competition is the source of changes in management structure and compensation, in our model trade liberalisation even towards a country with identical relative factor endowments has an impact on relative wages.

We allow for the choice of technologies with attached compensation schemes for high-skill managers and imperfect competition on the product market. We make one critical assumption about the role of skill that differs from the existing literature: high-skill labour has a fixed cost property, i.e., a given number of k high-skill managers is able to run a firm independent of its output size. Low-skill labour is variable, i.e., the number of low-skill workers varies directly with output size. This assumption is responsible for the asymmetric impact of international competition on different skill groups. Differences in relative productivity or specificity to an industry - both assumptions that have been studied in the literature - are not critical in our model.

In the model, firms face decisions in three stages. In the *first stage*, firms decide to enter either a perfectly competitive sector X or an imperfectly competitive sector Y. In the *second stage*, firms in the imperfectly competitive

[5] KAPSTEIN (1996) makes an informal argument along the same lines.

[6] There is some discussion about prices or quantities being the appropriate indicator of the effect of trade on the labour market. While trade economists generally prefer the prior labour economists often use the latter.

sector Y choose between two technologies: one technology has given per-unit labour input requirements beyond the control of high-skill managers; the other technology allows high-skill managers to reduce per-unit labour input requirements when they are paid a bonus. Firms in the perfectly competitive sector X face exogenously given labour input requirements. In the *final stage*, firms compete in the international product markets.

Our model draws on the industrial organisation and the new trade literature. The model of simultaneous technology choice in the *second stage* builds on LAI (1995) and LEWIS (1996). BEATH ET AL. (1995) reviews the literature on competition in R&D expenditure that analyses conceptually very similar issues. FRIEDMAN/FUNG (1995) analyse the effect of trade liberalisation on technology (in their terminology: type) choice in the presence of several externalities. REITZES (1991) and CABRAL ET AL. (1996) compare the incentives to invest in R&D under tariff and quota protection. We add to this literature by introducing free entry and by linking competition in the product market to the labour market. The linkage between international competition and the labour market in the *third stage* builds on the vast literature on trade and wages. Overviews are given by SLAUGHTER/SWAGEL (1997), THYGESEN ET AL. (1996), BURTLESS (1995), WES (1995), and in a recent symposium of the *Journal of Economic Perspectives* (1995). GARCIA-PENALOSA (1996) extends the HECKSCHER-OHLIN framework by introducing endogenous factor supplies. We add to this literature by introducing imperfect competition in the product market and by allowing the endogenous choice of technology and management compensation.

The remainder of the chapter is structured as follows. In section 2 we analyse the three-stage model of competition. Section 2.1 solves for the product market equilibrium in both sectors. Section 2.2 examines the technology choice and thus compensation policy decision for firms in the imperfectly competitive sector. Section 2.3 studies firms' entry decisions. In section 3 we add the labour markets for both high-skill and low-skill labour. Section 4 analyses the effect of multilateral trade liberalisation in the imperfectly competitive sector. Section 4.1 solves for the change in the number of firms and in firms' technology choices. Section 4.2 examines the impact of the change in technologies and management compensation on wage differentials between skill groups. Section 5 concludes.

2. THE MODEL OF INTERNATIONAL COMPETITION

Firms compete in a three-stage set-up in two countries called home h and foreign f. They employ low-skill and high-skill labour in production. In the *first stage*, analysed in section 2.3, firms enter either sector X or sector Y. Firms in the Y sector use a production technology with increasing returns to scale (IRS) due to the existence of fixed management costs. Both types of labour have the same productivity. [7] Firms in the X sector use a production function with constant returns to scale (CRS). Again, both types of labour have the same productivity.

In the *second stage*, analysed in section 2.2, firms in the Y sector can invest a fixed amount kb to decrease their marginal production cost. We think of

[7] The assumption on identical labour productivity in production independently of skill simplifies the analysis but is not essential for our results. With a COBB-DOUGLAS production function the outside wage level for high-skill labour falls if competition decreases the number of total management jobs. With a fixed number of firms this effect is zero. With an endogenous number of firms this effect tends to reduce the average compensation for high-skill labour.

b as a bonus on top of the base wage paid to k managers in order to provide them with the appropriate incentives for cost reduction in the sense of per-unit labour input requirements. Alternatively, b can be interpreted as an investment in R&D, the purchase of a new patent, or the acquisition of a new production technology. We assume that the levels of both k and b are exogenously given and only high-skill labour can work in management.

In the *final stage*, analysed in section 2.1, firms compete in the product market in both sectors and countries by setting quantities as their strategic instruments. In the perfectly competitive labour markets firms hire production workers and high-skill managers. As usual, the sub-game perfect equilibrium of the game is established by solving backwards.

2.1 The product markets

In this section we analyse the final stage competition in the product market first in the CRS X sector and second in the IRS Y sector. At this stage the number of firms and their technologies are given in both sectors. In the CRS X sector trade costs are zero, and the per-unit labour requirement is normalised to unity and is equal in both countries independently of the type of labour employed. With constant marginal and average cost in production competition in the X market is perfect. Firms set the price q equal to marginal cost given by the wage level w_L of low-skill labour.

(1) $$w_L = q$$

The Y sector drives the results in our model. The market structure in the sector follows an established imperfect competition trade model by BRANDER/KRUGMAN (1983) as extended by free entry in VENABLES (1985). The total number of firms in sector Y is determined by a *zero profit condition* and given by n. Superscripts h and f indicate the locations home and foreign with $n = n^h + n^f$. Firms can be one of two types, 1 or 0, where the per-unit labour input requirement for the two types differs according to $c^1 < c^0$. The number of type 1 firms in country j is determined by a *technology choice condition* and is given by a^j such that we have $a = a^h + a^f$.

The total cost of production for a type i firm depends on the technology parameter c^i, the wage levels w_L for low-skill and w_H for high skill labour, the fixed number k of managers per firm, and the size b of the bonus payment. The cost function in the Y sector is given by (2) where y is firm output.

(2) $$C^i(y) = c^i w_L y + k w_H + kbi\,;\ i = \{0;1\}$$

The fixed expenditure on management together with the constant marginal cost of production result in increasing returns to scale (IRS) and thus imperfect competition in the Y sector. Market demand for the output y is given by (3) where we assume linear demand functions to get tractable explicit solutions for the equilibrium levels of output and profit. We ignore income and assume preferences to be quasi-linear with respect to the output of industry X.

(3) $$p^j = A^j - \sum y \qquad A \text{ is market size; } j = h,f$$

Firms compete by setting output as their strategic instrument. Both the total number of firms and the number of type 1 firms at each location are given when output decisions are made. Firms pay a per-unit trade cost t when serving their export market and zero trade costs when serving their domestic market. Firms solve problem (4) separately for each market.[8]

$$\text{(4)} \qquad \max_{y^i}\left\{\left(p\left(\sum y^i\right)-t-c^i w_L\right)y^i - kw_H\right\}$$

Because marginal cost is constant and markets are segmented firms choose the output in each market separately. The first-order condition to the optimisation problem in (4) is given by (5).

$$\text{(5)} \qquad p\left(\sum y\right)-t-c^i w_L + y^i \frac{dp\left(\sum y\right)}{dy^i}=0$$

The equilibrium of the market game is defined by the vector of individual firms' output choices y^i that simultaneously satisfy the maximisation problems (4) for all firms and by prices that satisfy the demand functions (3). It is useful to define as z^i the average marginal cost of all active competitors of a type i firm. The value of z depends both on the total number of firms (competitors) n and their types as given by the number of type 1 firms a^j.

$$\text{(6)} \qquad z^i = \frac{\left[a^h c^1 + \left[n^h - a^h\right]c^0\right]+\left[a^f c^1 + \left[n^f - a^f\right]c^0\right]-c^i}{n-1} w_L$$

$$= \frac{a\left[c^1 - c^0\right]+nc^0 - c^i}{n-1} w_L$$

[8] In appendix IV.2 we analyse the effect of a binding non-negativity constraint on output.

The expression for competitors' costs includes a component c^i depending on the firm's own type. With a large number of competitors n this component matters increasingly less such that z^i converges to an own-type independent value z. From (6) competitors' costs z are decreasing in a^j, weakly increasing in n^j, and between the limits defined by the two types: $c^1 w_L \leq z \leq c^0 w_L$.

We solve explicitly for the equilibrium home firm output (7) in the home market and the foreign market where the superscript ij indicates the sales of a type i firm on market j and z^i is the average marginal cost of all its competitors.

$$(7) \qquad y^{ih} = \frac{A^h + [n-1]z^i + n^f t - nc^i w_L}{n+1} \qquad \text{Home market}$$

$$y^{if} = \frac{A^f + [n-1]z^i + [n^h - 1]t - n[c^i w_L + t]}{n+1} \qquad \text{Export market}$$

We can now write down the equilibrium profit of a home firm[9] as a function of the own type given by superscript i and the number of type 1 firms a^j determining competitors' costs z. The maximised type-dependent profit Π^i evaluated at the product market equilibrium before additional bonus payments kb is given by

$$(8) \; \Pi^i\left(a^h, a^f\right) = \left[\frac{A^h + [n-1]z + n^f t - nw_L c^i}{n+1}\right]^2 + \left[\frac{A^f + [n-1]z + [n^h - 1]t - n[w_L c^i + t]}{n+1}\right]^2 - kw_H$$

[9] We continue to concentrate on the solutions from the perspective of the home firm. Foreign firms' solutions are mirror images.

Due to the linearity of the marginal cost and demand functions profit is given by the sum of squared output in each market minus the fixed management cost. At this final stage of the market game both firms' types and the number of firms in the market are taken as given. In the next two sections we analyse first firms' *technology choice decisions*, i.e., the number of type 1 firms a, and second firms' *entry decisions*, i.e., the total number of firms n.

2.2 Technology choice: Investment in high-skill management incentives

In this section we analyse firms' choices of technology type in the second stage if they produce in the Y sector. In the X sector the technology is exogenously given and thus no such choice exists.

Firms in the Y sector choose between two types of technology: if firms choose type 0, their per-unit input labour requirement is given by c^0 and k managers are paid a wage w_H each. If firms choose type 1, their per-unit input requirement is given by $c^1 < c^0$ and k managers each get a bonus b on top of the wage w_H. In other settings this bonus payment could be an investment in R&D or new production technologies. Here we treat b as a reduced form solution to give managers an incentive to reduce marginal cost to c^1 in the presence of some informational friction between managers and firm owners like in chapter I.

At this second stage of the game trade costs t and the total number of firms n are fixed. From (7) and (8) the maximised type-dependent profit Π^i can be written as a function of the endogenous number of type 1 firms $a \equiv a^h + a^f$ only. Firms choose their technologies and compensation policies simultaneously. Each firm assumes other firms not to be influenced by its own choice (COURNOT assumption). For simplicity, we look at symmetric countries ($A^i = A^j$) such that the country superscript j can be dropped.

In equilibrium no firm gains from changing its type. A pure-strategy equilibrium satisfies condition (9a) for type 1 and condition (9b) for type 0 simultaneously.

(9a) $\Pi^1(a) - kb \geq \Pi^0(a-1)$

(9b) $\Pi^0(a) \geq \Pi^1(a+1) - kb$

With a large number of firms n the two equilibrium conditions (9a,b) converge to the *technology choice condition* (10).

(10) $\Pi^1(a) - kb = \Pi^0(a)$

The equilibrium condition (10) also applies for the mixed-strategy equilibrium where firms choose type 1 with probability *a/n*. We assume that the market conditions are such that the equilibrium n is large and we can use (10) as the equilibrium condition and an own-type independent z from (7).

To analyse the characteristics of the equilibrium we rewrite (10) in explicit form. The left and the middle parts of (11) give the difference in profit between the two types. This profit difference is a function of the number of type 1 firms a through competitors' costs z. The right hand part of (11) gives the additional management cost of a type 1 firm. This additional cost kb is constant.

(11) $$\Pi^1(a) - \Pi^0(a) = \frac{2nw_L}{[n+1]^2}\left[\left[c^0 - c^1\right]\left[A + 2[n-1]z(a) - t\right] + nw_L\left[c^{1^2} - c^{0^2}\right]\right] = kb$$

From (11) we can show that the profit differential is decreasing in *a*. Hence with a larger number of low marginal cost, i.e., type 1, competitors the advantage of adopting the type 1 technology shrinks.

$$\text{(12)} \quad \frac{d[\Pi^1(a)-\Pi^0(a)]}{da} = [n-1][c^0 - c^1]\frac{4nw_L}{[n+1]^2}\frac{dz}{da} = -\frac{4nw_L^2}{[n+1]^2}[c^1 - c^0]^2 < 0$$

In figure IV.1 we graph the profit difference and the management cost *kb*. At the intersection of the two lines we can read off the equilibrium a^*. From the figure we see that this equilibrium is stable: the profit difference intersects the management cost line from above, hence only for $a < a^*$ firms find it profitable to switch to type 1. For $a > a^*$ it is profitable to switch to type 0. At $a = a^*$ deviations to either side are unprofitable.

From figure IV.1 we can also see that the value of a^* depends on the exogenous size of *kb*. Three different scenarios are possible but we concentrate on the interior solution for *a* in case 2.

Case 1.) $\quad kb \geq \max_a\{\Pi^1(a) - \Pi^0(a)\} \rightarrow a^* = 0$

Case 2.) $\quad \max_a\{\Pi^1(a) - \Pi^0(a)\} > kb > \min_a\{\Pi^1(a) - \Pi^0(a)\} \rightarrow 0 < a^* < n$

Case 3.) $\quad kb \leq \min_a\{\Pi^1(a) - \Pi^0(a)\} \rightarrow a^* = n$

The equilibrium of this subgame is described by the unique a^* solving the technology choice condition (11).

2.3 Free entry in both sectors

In this section we analyse firms' entry decisions in both sectors at the first stage of the game and endogenously derive the number of firms *n* in the *Y* industry. In the *X* sector firms always make a zero profit because in section 2.1 we have shown that firms in this sector set price equal to marginal cost (1). In our model the *X* sector acts only as a fallback option.

In the *Y* sector firms enjoy market power and price with a mark-up over marginal cost (5). They have, however, to cover the fixed cost of the management compensation. Maximised profit for each type is a function of both the total number of firms *n* and the number of type 1 firms *a*. In the previous section we have solved for a^* given *n*. Here we look for simultaneous solutions for both a^* and n^*. In equilibrium, the profit of a type 1 firm is just sufficient to compensate for the additional fixed management cost *kb*. The profit of a type 0 firm is equal to zero. The *free entry conditions* are given by

$$\text{(13)} \quad \begin{aligned} &\Pi^{1j}\left(a^h, a^f, n^h, n^f\right) = kb \\ &\Pi^{0j}\left(a^h, a^f, n^h, n^f\right) = 0 \end{aligned}$$

Because of the assumptions that all firms export and countries are symmetric we can collapse the four dimensions of the profit function to two for the sum of all firms *n* and the sum of type 1 firms *a*. Symmetry implies $n/2 = n^h = n^f$ as well as $a/2 = a^h = a^f$.

$$\text{(14)} \quad \begin{aligned} &\Pi^{1}(a,n) = kb \\ &\Pi^{0}(a,n) = 0 \end{aligned}$$

The free entry conditions (14) describe the zero profit contours in (a,n)-space. Applying the implicit function theorem on (14) the slope of these profit contours is given by

$$\text{(15)} \quad \frac{da}{dn} = -\frac{d\Pi^i/dn}{d\Pi^i/da} = -\frac{\sum_{j=h,f} 2y^{ij}\, dy^{ij}/dn}{\sum_{j=h,f} 2y^{ij}\, dy^{ij}/da} < 0$$

where the negative sign of (15) follows from

$$\text{(16)} \quad \frac{dy^{ij}}{da} = -\frac{w_L}{n+1}\left[c^0 - c^1\right] < 0$$

$$\text{hence } 0 > \frac{dy^{1j}}{da} = \frac{dy^{0j}}{da}$$

$$\text{(17)} \quad \frac{dy^{ih}}{dn} = -\frac{A^h + w_L c^i - 2z - tn/2 - [n+1][n-1]\,dz/dn}{[n+1]^2} < 0$$

$$\frac{dy^{if}}{dn} = -\frac{A^f + w_L c^i - 2z + tn/2 - [n+1][n-1]\,dz/dn}{[n+1]^2} < 0$$

$$\text{hence } 0 > \frac{dy^{1j}}{dn} > \frac{dy^{0j}}{dn}$$

The reaction of output to a change in the number of type 1 firms is type-independent (16). The reaction of output to a change in the total number of firms, however, depends on the firm's own type (17). Hence even though the profit contours are downward sloping for both types they have different slopes. In particular, it follows from (17) that the slope of the profit contour for a type 0 firm is steeper.

$$\text{(18)} \quad 0 > -\frac{d\Pi^1/dn}{d\Pi^1/da} > -\frac{d\Pi^0/dn}{d\Pi^0/da}$$

In figure IV.2 we draw the profit contours at the *free entry conditions* in (a,n)-space as solid lines. At the intersection of the profit contours for type 0 and type 1 firms are both indifferent between types and entry/exit. Depending on the level of *kb* the intersection can be in different regions corresponding to the three cases discussed earlier. An intersection above the 45^0 line is technically infeasible (by definition $a \leq n$) and thus all firms choose type 1. This corresponds to case 3 and occurs for low values of *kb*. An intersection below $a = 0$ is equally infeasible and thus all firms choose type 0. This corresponds to case 1 and occurs for high values of *kb*. Finally all other intersections give an interior solution with $a < n$, correspond to case 2, and occur for medium values of *kb*. This is the situation drawn in figure IV.2.

Figure IV.2 also includes the *technology choice condition* from the previous section 2.2 drawn as a dotted line. The technology choice condition runs through the intersection of the free entry conditions because at that point both type of firms generate an identical profit of zero. Moving from this intersection at (a^*, n^*) to the left holding a constant we get $\Pi^1(a^*,n)-\Pi^0(a^*,n)<kb \ \forall n<n^*$. Type 0 firms profit more from a reduction in the total number of firms because using (15) and (17) we get

$$\textbf{(19)} \qquad -\frac{d\Pi^0}{dn} > -\frac{d\Pi^1}{dn} > 0$$

From (19) the *technology choice* condition is below the horizontal line through a^* for $n < n^*$. Moving from the intersection (a^*, n^*) downwards holding n constant we get $\Pi^1(a,n)-\Pi^0(a,n)>kb \ \forall a<a^*$ because in (12) we have

shown that type 1 firms gain more profit from a reduction in low cost type 1 competitors than type 0 firms. Pulling these two observations together we conclude that the *technology choice condition* runs through (a^*, n^*) and is upward sloping.

3. THE LABOUR MARKET

We now turn to the labour markets for high and low-skill labour. The structure of the labour markets is held very simple in order to concentrate on the interaction between technology and compensation policy choice and the wage differential between skill groups. In particular we assume perfect competition in both labour markets.

Low-skill labour can work in production in both sectors. If production in the X sector is positive (which can always be assured by an appropriate demand structure) the fixed per-unit labour input requirement in this sector determines the wage level for low-skill labour at the price of the x good.

(20) $w_L^j = q \;\; ; j = h, f$

High-skill labour can work in production in both sectors at the same productivity as low-skill labour. In addition, high-skill labour can also work in the management of Y sector firms. Let the total high-skill labour force in home be given by H^h. Of the total high-skill labour force kn^h work as managers while the rest H^{hp} works in production.

(21) $H^h = kn^h + H^{hp}$

The level of the high-skill wage w_H assures that $kn^j \leq H^j$. The lower bound of the wage for high-skill labour is given by the price q of the x good.

(22) $w_H^j \geq q \quad ; j = h, f$

We assume that some high-skill labour work in production such that (22) holds as an equality.[10] Because we assume perfect competition on the labour market, the wage in (22) is also the wage paid to high-skill management in type 0 firms. High-skill managers in type 1 firms, however, receive the additional bonus payment b. The bonus payment is assumed to be the reaction to an underlying (not modelled) informational friction between the management and firm owners and thus competition can not drive down the size of the total payment $b + w_H^j$ without violating an underlying incentive constraint. It is critical to our results that in contrast to chapter I we assume b not to depend on competition.[11] The average wage W_H of high-skill labour is therefor

(23) $W_H^j = w_L^j + a^j kb / H^j \; ; j = h, f$

[10] If no high-skill labour works in production the number of firms is limited by the number of potential managers. The assumption above implies that this restriction is not binding. Otherwise entry would be limited and managers would share a fraction of the non-negative profits in the Y industry.

[11] In particular, if competition decreases the incentive payment b that would introduce a countervailing effect to our model such that the overall effect would be ambiguous.

With the wage level fixed from the X sector technology the labour market equilibrium for low-skill labour determines the allocation of labour to the two sectors X and Y.

Equating labour demand with labour supply we get

$$(24) \qquad x + a^j c^0 \left[y^{jh}(c^0) + y^{jf}(c^0) \right] + \left[n^j - a^j \right] \left[y^{jh}(c^1) + y^{jf}(c^1) \right] = L^j + H^{jp}$$

Equation (24) traces out the production possibility frontier of the economy. With a fully specified demand system this allows us to determine the absolute level of output in each sector.

4. MULTILATERAL TRADE LIBERALISATION

In the trade policy experiment we analyse the effects of multilateral trade liberalisation. Examples for such a concerted change in trade policy are the GATT Uruguay Round and the EU Common Market Programme. Multilateral trade liberalisation affects firms on two sides: firms enjoy easier access to their export market but they face more intense competition in their domestic market.

We proceed in two steps: first, in section 4.1 we analyse the effect of a reduction in trade costs t on the number of firms and the technology choice of firms in the Y sector. We find that the absolute (and relative) number of type 1 firms increases. The free-entry condition magnifies this effect as the absolute number of firms falls in response to trade liberalisation.

Second, in section 4.2 we highlight the implications for the labour market. The increase in the number of type 1 firms increases the number of high-skill managers that receive an additional bonus payment *b*. Other high-skill managers lose their jobs because their firms exit the industry but they are re-employed in production at the same wage level. The average high-skill wage increases while the low-skill wage is unchanged: the change in technology choice in response to trade liberalisation increases wage differential between skill groups.

4.1 Firms' exit and technology change

To analyse the effect of a fall in protection *t* we use both the mathematical equilibrium conditions and the figures. In the initial equilibrium both the *technology choice condition* (11) and the *zero profit conditions* (14) are satisfied. Profit depends on the number of all firms *n*, the number of type 1 firms *a*, and the level of trade cost *t*. We refer only to the home country because the foreign country is a mirror image by the symmetry assumption.

The fall in the trade cost *t* affects both the zero profit and the *technology choice* condition. First, we analyse the impact on the *technology choice condition* (11) by applying the implicit function theorem. We find that a reduction in trade costs *t* increases the profit difference between types and thus pushes up the number of type 1 firms *a*. Intuitively, the larger market increases equilibrium firm output and thus raises the advantage of operating with low marginal cost.

$$(25) \qquad -\frac{da}{dt} = \frac{d\left(\Pi^{1j} - \Pi^{0j}\right)/dt}{d\left(\Pi^{1j} - \Pi^{0j}\right)/da} = w_L\left[c^0 - c^1\right] > 0;\ j = \{h, f\}$$

Above in (12) we have already shown that the profit difference between types is decreasing in the number of type 1 firms a. The profit difference between types is also decreasing in trade costs t because profit increases more for type 0 firms than for type 1 firms in response to an increase in t.

(26) $$\frac{d\left(\Pi^1 - \Pi^0\right)}{dt} = -\frac{2nw_L}{[n+1]^2}\left[c^0 - c^1\right] < 0$$

In figure IV.2 the sign of (25) implies an upward shift of the technology choice condition: for a given number of firms n a lower trade cost t implies a larger number of type 1 firms a in the technology choice equilibrium defined by (11).

Second, we analyse the impact on the *zero profit conditions* (14). The effect of trade liberalisation on profit levels depends on the initial level of trade costs. We assume initial trade costs to be sufficiently high such that profit is increasing in trade costs.

Assumption (27) $$d\Pi^j/dt = 2y^{ih}\frac{dy^{ih}}{dt} + 2y^{if}\frac{dy^{if}}{dt} > 0$$

We establish the movement of the *zero-profit conditions* (14) by applying the implicit function theorem. Assumption (27) assures that exports are small enough such that (28) has a negative sign. Intuitively, lower protection decreases the level of profit and firms only break even if their competitors at the same time operate at higher marginal costs, i.e., more of them are of type 0.

(28) $$-\frac{da}{dt}=\frac{d\Pi^i/dt}{d\Pi^i/da}=\frac{1}{w_L[c^1-c^0]}\left[\frac{n^f}{n+1}-\frac{y^{if}}{y^{if}+y^{ih}}\right]<0;\ i=\{0,1\}$$

Expression (28) implies a south-west shift of the two zero profit lines in figures IV.2. The type 1 zero profit line shifts less because type 1 firms export a larger share of their output and thus the term in brackets is smaller for them.

In figure IV.3 we can now clearly identify the forces linking trade liberalisation, the number of firms, and firms' technology choice. The pre-liberalisation equilibrium is given at the intersection of the two pre-liberalisation *free entry conditions* at A. The post-liberalisation equilibrium is given at the new intersection of the post-liberalisation *free entry conditions* at B. Through B also runs the post-liberalisation *technology choice condition.*

Proposition 1

Let a be the equilibrium number of type 1 firms. A fall in protection increases the share and the absolute number of type 1 firms.*

(29) $$-\frac{da^*}{dt}>0 \qquad\qquad -\frac{d(a^*/n^*)}{dt}>0$$

Proof: See appendix IV.3

4.2 The effect of technology change on the labour market

Multilateral trade liberalisation affects the labour market in two ways. First, from proposition 1 a larger number of firms in the Y sector use the type 1 technology. This will change the average wage of high-skill labour. Second, the fall in protection reduces the price level p and increases total output in the Y sector. The increase in Y sector output changes the sectoral allocation of labour but because we have tied the wage level by the CRS technology in the X sector the change in the allocation of labour has no effect on the wage level.

First, we analyse effect of trade liberalisation on the average wage of high-skill labour. Managers are affected through the change in their compensation if their employer changes his technology type. Using (23) the change in the average wage of high-skill labour is given by

$$(30) \qquad -\frac{dW_H^j}{dt} = -\frac{da^j}{dt}\frac{kb}{H^j} > 0$$

The increase in the average high-skill wage is directly proportional to the change in the number of type 1 firms. There is no countervailing effect from high-skill managers losing their jobs to work in production because wages in management and production in type 0 firms is equal given perfect competition in the labour market. The low-skill labour wage is fixed from the X sector technology at the level given by (23). The real value of their wage, however, goes up because the price level p in the Y sector is falling. If consumption patterns are independent of skill the fall in p does not counteract the increase in the nominal wage differential.

Second, we look at the sectoral allocation of low-skill labour. On the one hand, sector Y output increases. This increase in Y output increases production labour demand. On the other hand, firms with lower per-unit labour input requirement increase their output and capture a larger share of the total market.

This decreases the average per-unit labour requirement in the Y sector. The net effect of these countervailing forces depends on parameters of supply and demand in the sector.

Proposition 2

(a) Trade liberalisation increases the wage differential between unskilled labour and skilled managers because a higher share of managers receives bonus payments.

(b) Trade liberalisation increases the output in the Y-sector. Due to the change in technology the impact on the allocation of unskilled labour is ambiguous.

Proof:

(a) follows from (30) in conjunction with proposition 1.

(b) The pricing rules given by firms' first-order conditions on output choice (5) imply a positive relationship between the price p and trade costs t. From the inverse demand function (3) lower prices imply higher total output in the Y sector but the per-unit labour demand falls, so the total effect on labour demand from the Y sector is ambiguous.

5. CONCLUSIONS

This chapter contributes to the discussion on the link between Globalisation and changes on the labour markets of the industrialised countries. We present a model in which trade liberalisation increases the relative wage of high-skill labour through the impact on technology choice from increased international competition.

In contrast to the existing literature this result does not rely on differences in factor endowments across countries. It therefore also applies to trade liberalisation between similar countries such as the member states of the European Union and to trade liberalisation by low-skill labour abundant countries.

Empirical studies that evaluate the effect of trade on wage differentials in might underestimate the impact of international competition. In the HECKSCHER-OHLIN framework, to give an example, a decrease in the price of a high-skill product in a high-skill abundant country is evidence for an exogenous change in technology. In our model, the same price decrease is evidence for an increase in international competition that triggers a change towards a more high-skill intensive technology. Hence even though the observations are identical the two models imply different assessments of the role of trade in the change of wage differentials.

Our model is wider in scope than suggested in the present application and hence the robustness problem of many imperfectly competitive trade models is less severe. Both multilateral trade liberalisation in a COURNOT oligopoly and the form of cost cutting assumed are special cases of a general problem structure. The conditions for our results to hold are much less restrictive: in terms of the market structure and policy experiment in the model any combination of government policies and market structure that induce an increase in individual firm output have the described effect on technology choice, e.g., favour the technology with an active role for the high-skill manager. In terms of the cost-cutting process all investments that substitute the marginal cost of production with the fixed cost of more high-skill intensive activities like R&D, training, or managerial incentive structures feature the described link between technology choice and relative wages, e.g., increase the relative wage of high-skill labour.

The model extends the literature on trade and wages, and the literature on technology choice. First, the model gives a role for the degree of competition in goods markets in the link to the labour market. We show that the degree of competition is a force independent of factor price considerations on the relative demand for different skill groups. Second, the model allows for free entry and links technology choice to the labour market. Free entry magnifies the effects of trade liberalisation on technology choice and relative wages.

Figure IV.1

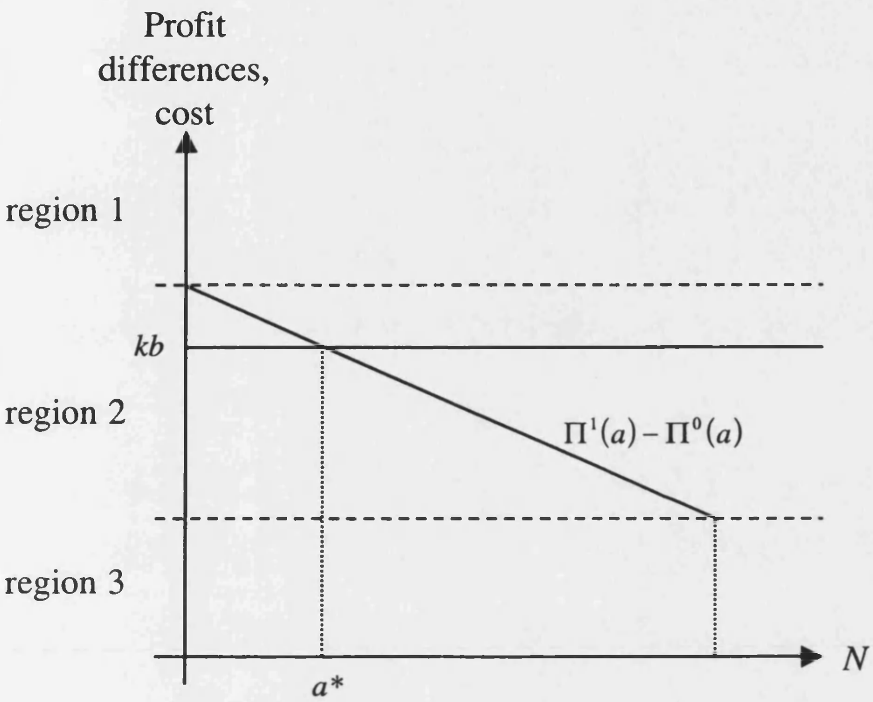


Figure IV.1: Technology choice condition

The equilibrium level of a^* is determined by the intersection of the profit difference with the level of bonus payments b to all k managers in a type 1 firm.

- If kb is in region 1, it is independently of competitors' decisisons never optimal to become a type 1 firm. The only stable equilibrium is at $a^* = 0$.
- If kb is in region 2 as shown, it is optimal to switch to type 1 as long as the number of type 1 competitors is below a^*-1. The stable equilibrium is defined by the interior value of $0 < a^* < n$.
- If kb is in region 3, it is independently of competitiors' decisions always optimal to become a type 1 firm. The only stable equilibrium is at $a^* = n$.

Figure IV.2

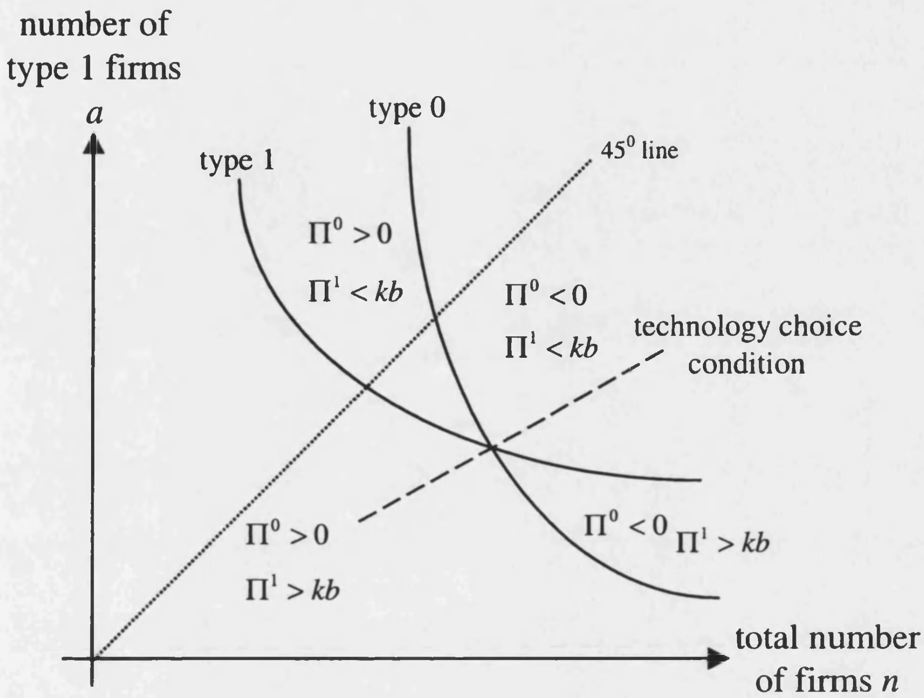


Figure IV.2: Free entry condition

Thetwo solid lines give the zero profit conditons for both firm types. At the intersection of the zero profit lines they are crossed by the upward sloping technology choice condition.

As drawn the equilibrium is interior, i.e., in region 2 defined in figure IV.1.

Figure IV.3

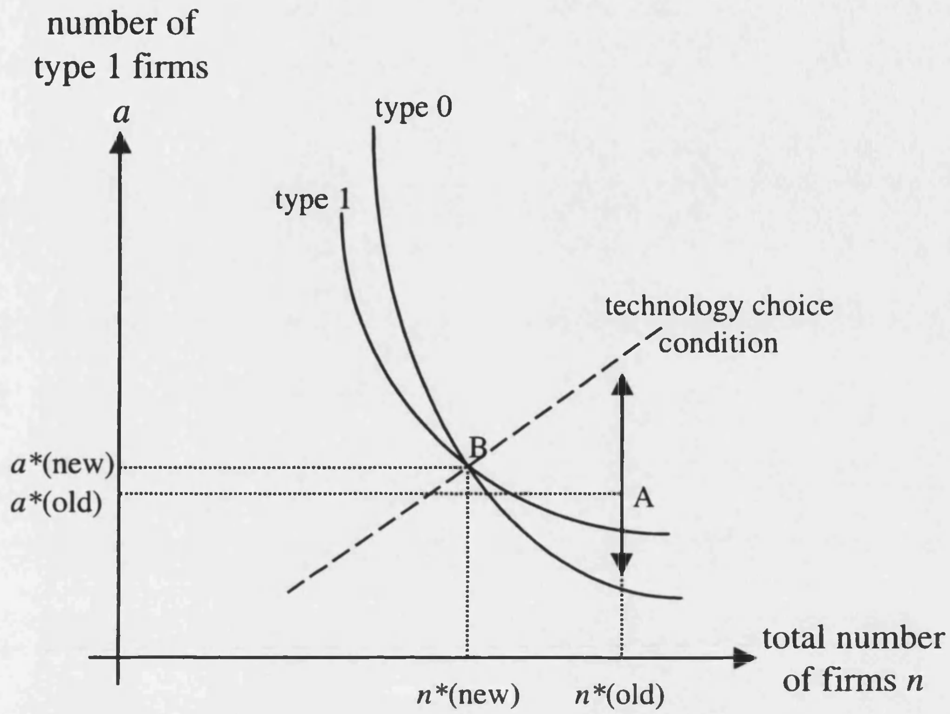


Figure IV.3: Equilibrium after trade liberalisation

A: pre-liberalisation equilibrium

B: post-liberalisation equilibrium

Figures IV.4-5

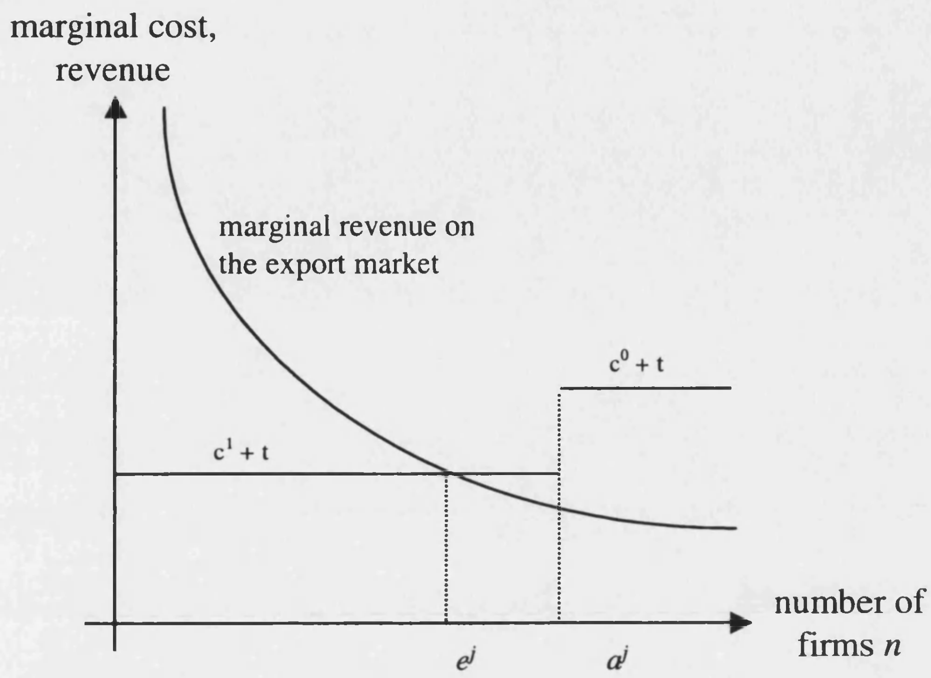


Figure IV.4:Type and number of exporters

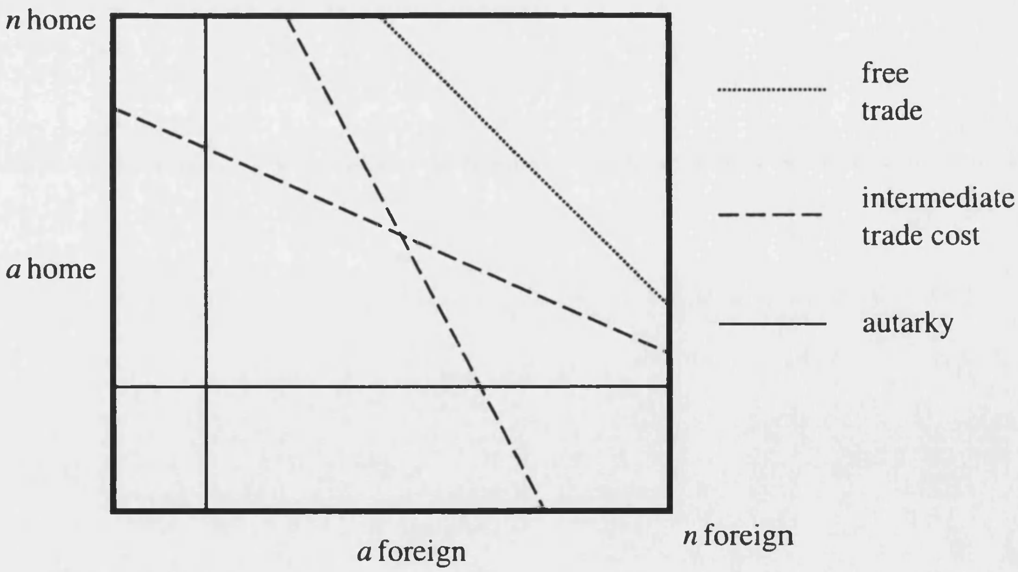


Figure IV.5:
Technology choice for different levels of trade cost

Appendix IV.1

Wage developments in the U.S. and Germany

U.S.A.

Year	rel. wage [b]		rel. unempl. [c]		Trade/ BIP	% Intra-Ind.
	Male	Female	Male	Female		
1980	1.94[a]	1.78[a]	8.95[a]	8.26[a]	14.47	38
1990	2.47	2.32	16.6	14.83	16.64	47
d%	+27	+30	+86	+80		

Source: OECD, a - 1972, b - average wage highest skill group/average wage lowest skill group, c - share of unemployed from lowest skill group/share of unemployed from highest skill group.

Germany

Year	rel. wage [b]		rel. unempl. [C]		Trade/ BIP	% Intra-Ind.
	Male	Female	Male	Female		
1980	2.00	1.77	18.83	30.06	45.8	59
1990	1.94	2.01	19.45	47.77	47.5	68
d%	-3	+14	+3	+59		

Source: OECD, notes: see above

Appendix IV.2
The effect of a binding non-negativity constraint on output

In this appendix we discuss the effect of a binding non-negativity constraint $y \geq 0$ on output. We find that the results of the main text all continue to apply even if the constraint binds. The non-negativity constraint on output in the optimisation problem (4) gives an additional KUHN-TUCKER condition.

(A1) $$y^i\left[p\left(\sum y\right) - t - c^i + y^i p'\left(\sum y\right)\right] = 0$$

For positive trade costs the non-negativity constraint is more likely to bind on the export market. If the non-negativity constraint is violated for some firms on the export market, a number of them will stop to serve that market and the marginal exporter is indifferent between exporting or not. For this firm both parts of the KUHN-TUCKER condition (A1) are zero. In figure IV.4 we draw the marginal revenue and the marginal cost firm as a function of the number of firms. The intersection of the two curves gives the number of exporters e^j and the type of the marginal exporter. We can use the KUHN-TUCKER condition (A1) to determine the number of home market exporters e^j such that condition (A1) is satisfied.

(A2) $$p\left(\sum_i^{n^k + e^j} y^i\right) = c^e + t$$ where c^e is given by the marginal home exporter

The expression for equilibrium sales (7) is modified to

$$\text{(A3)} \quad y^{ih} = \frac{A^h + [n^h + e^f - 1]z^i + e^f t - [n^h + e^f]c^i}{n^h + e^f + 1} \qquad \text{Home market}$$

$$y^{if} = \frac{A^f + [n^f + e^h - 1]z^i + [e^h - 1]t - [n^f + e^f][c^i + t]}{n^f + e^f + 1} \qquad \text{Export market}$$

where the average competitors' cost z (6) may differ between the home and the export market.

$$\text{(A4)} \qquad z^{ih} = \frac{[a^h c^1 + [n^h - a^h]c^0] + [a^f c^1 + X] - c^i}{n^h + e^f - 1} w_L$$

$$z^{if} = \frac{[a^h c^1 + X] + [a^f c^1 + [n^f - a^f]c^0] - c^i}{n^f + e^h - 1} w_L$$

$$\text{and } X = \begin{matrix} [e^j - a^j]c^0 & for & e^j \geq a^j \\ [e^j - a^j]c^1 & for & e^j < a^j \end{matrix}$$

In the technology choice part of the model (section 2.2) we distinguish between three regions defined by the number of exporters e^j. The autarky region is defined by $e^h = e^f = 0$. The intermediate trade cost region is defined by $0 < e^h = e^f < a^j$. The low trade cost region is defined by $e^h = e^f \geq a^j$. Note that the number of exporters is decreasing in trade costs t.

For the grapic analysis we introduce in figure IV.5 a box of size $n^h \times n^f$ instead of the line of length n used in figure IV.1. box introduced in figure IV.2. In this box we draw the equilibrium combinations of the total number of firms n and the number of type 1 firms a from the perspectives of home and foreign as a function of the level of the trade cost t.

Applying the implicit function theorem on the technology choice condition (11) we first establish the slope of $a^h(a^f)$ for the *autarky region* as zero (infinity) for the home (foreign).

(A5) $$\frac{da^h}{da^f} = 0(=\infty) \qquad \text{for home (foreign) technology choice condition}$$

In the autarky region no trade takes place and the number of type 1 foreign firms has no influence on home firm profit and technology choice (13). There is only one point in the box drawn in figure IV.5 where both countries are simultaneously in equilbrium.

Applying the same procedure for the *intermediate trade cost region* we find that the slope of $a^h(a^f)$ is negative but larger (smaller) than minus unity for the home (foreign) technology choice condition.

(A6) $$\frac{da^h}{da^f} = -\frac{y^{1j}\, dz^j/da^j}{\{y^{1i} - y^{0i}\}dz^i/da^i} > -1(< -1)$$

with $i = h, j = f$ $(i = f, j = h)$ for the home (foreign) technology choice condition

In the intermediate trade cost region only some of the type 1 firms export. A marginal change in the number of foreign type 1 firms thus has no effect on the home market. It does, however, affect the cost level on the foreign market. The same argument applies to a change in the number of home type 1 firms. The difference between the output of firms of type 0 and 1 on both markets is equal only if both firm types serve all markets. In the intermediate region this is by definition not the case. It follows that the slope of (A6) is larger (smaller) than minus unity for the home (foreign) technology choice condition. In figure IV.5 there again exists only one point at the intersection of the two lines with negative slope where both countries are simultaneously in equilibrium.

Finally applying the implicit function theorem for the *low trade cost region* the different effects cancel out and the slope is given by minus unity for both countries. This is the result used in the main text.

(A7) $$\frac{da^h}{da^f} = -1$$

Undertaking the trade policy experiment of a reduction in trade costs t three different reactions have to be discerned. First, the equilibrium schedule of technology choices in figure IV.5 is shifted up. Second, exit of firms is reducing the size of the box and shifting the technology choice schedule further up. Third, the slope of the technology choice schedules might change if the economy moves from one trade cost region to the other. The two first movements correspond to the effects analysed in section 4.1 of the main text. The adjusted analysis is not repeated here but is available upon request. The final movement does not affect the results presented in proposition 1 of the main text.

Appendix IV.3

Proof of Proposition 1

a. $\frac{da^*}{dt} < 0$

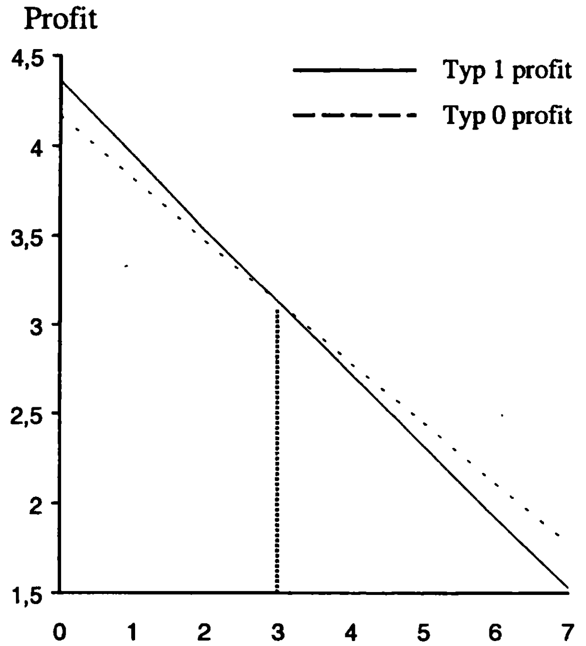
The negative relationship between t and a^* can be shown from the technology choice condition. A reduction in trade cost shifts this condition upwards (25). The technology choice condition thusintersects the two free downward sloping free entry conditions at a higher value for a and a lower value for n.

b. $\frac{d(a^*/n^*)}{dt} < 0$

With a^* increaing and n falling the share of a^* is trivially rising.

Appendix IV.4

Worked example to illustrate the existence of an interior solution



Number of type 1 firms a

Assumptions

- total number of firms: $n = 15$
- Market size: $A = 50$
- trade cost: $t = 4$

- low marginal cost: $c^1 = 2{,}0$
- high marginal cost: $c^0 = 2{,}5$

- fixed cost: $F = 20$
- Bonus payment: $b = 6$

Conclusions

The chapters collected in this thesis highlight different aspects of the link between international competition and the efficiency of firms. In the first chapter, we show how the internal efficiency of firms increases in response to different types of trade liberalisation. In the second chapter, we analyse the elimination of underperforming firms by exit and merger as a consequence of multilateral trade liberalisation. The third chapter investigates how the owners' control of a firm's management can shape the dynamic effects of initial firm heterogeneity in the context of trade liberalisation. The final chapter uses the previous results to present a technology choice link between liberalisation of intra-industry trade and the observed increase in wage differentials between skill groups. The picture that emerges clarifies the positive impact of competition on the efficiency of firms and puts ambiguities in the literature into perspective, and this should help both to devise better empirical tests of the impact of international competition and select policies that avoid potential problems.

International competition and the internal efficiency of firms

The first chapter "International competition and the internal efficiency of firms" looks at the precise links between trade liberalisation and the performance incentives given to managers.

The policy results of the paper are clear cut: Any policy reducing the level of profit favours the choice of a socially beneficial technology by a private owner. The set of policies resulting in these extra welfare gains on top of the standard allocational benefits includes the reduction in import tariffs and export subsidies, the relaxation of quotas, and the integration of segmented markets. The direction of technology choice is, in addition to the profit level, driven by the cost responsiveness of profit. Any policy increasing firm output also increases the cost responsiveness and favours the sophisticated technology. Policies fitting this description are the multilateral reduction of trade costs and the move from quota to tariff protection. That higher import tariffs and larger export subsidies have the same output increasing effect could explain some ambiguities in the theoretical as well as in the empirical literature that often picks up a positive correlation between output and total factor productivity growth (Verdoorn's law).

The chapter relates both to the contract and the trade literature. The contract model is an application of ideas by SCHMIDT (1997) and others to a set up of technology choice. First, it endogenises the profit level effect in an adverse selection model. Second, it demonstrates spill-over effects of informational asymmetries to stages of the game with full information. By identifying two separate channels of interaction between the product market and the internal structure of the firm the model clarifies some ambiguities in the theoretical literature. First, the profit level effect, which is new to the trade literature, is shown to be solely responsible for the additional welfare effects. This conclusion is derived using as a more appropriate benchmark a social planner suffering from the same informational limitations as the private owner. Through its impact on the informational rent the profit level effect acts directly on the inefficiency in the model. Second, the cost responsiveness of profit used in the previous trade literature is shown to be directly related to the change in output due to trade policy. Because the output response to trade policy depends very much on the individual setting, the ambiguity in the literature is no surprise. This ambiguity, however, relates only to the direction of technology choice, not the welfare implications as suggested elsewhere.

Trade liberalisation as facilitating merger

The second chapter "Trade liberalisation as facilitating merger" analyses merger and exit as part of an industry restructuring process in response to trade liberalisation.

The theoretical set-up is new to the trade literature because it checks the private incentives to merge before taking the social welfare perspective. This different set-up accounts for the surprisingly clear cut welfare result that depends only on the free entry assumption. The model sheds some light on the dynamics of an industry adjusting to trade liberalisation. Previous contributions have looked at the comparative statics but not at the transition to the new equilibrium. The sunk entry costs both introduce path dependency and provide a more balanced view than models treating all fixed costs either as sunk or recoverable. Sunk entry costs imply a larger number of firms in the post-liberalisation equilibrium but the merger process ensures that these firms all have low fixed costs. The welfare results of trade liberalisation are thus still unambiguously positive.

The policy results are more in line with political opinion than with the classical merger literature focusing on detrimental market power effects. All privately profitable mergers are welfare increasing. Mergers are an important tool in the restructuring of an industry, and trade liberalisation can initiate and support this process. The characteristics of mergers in the European Union between 1987 and 1992 are broadly in line with the predictions made from the model: over the course of the merger wave market power overtakes cost synergies as the most important stated motive for a merger. Cross-border and domestic mergers occur in parallel, and cross-border mergers rise in importance at the peak of the merger wave.

A note on the effect of trade policy on the speed of cost-cutting

The third chapter "A note on the effect of trade policy on the speed of cost-cutting" analyses how trade policy affects firms' incentives to cut cost depending on the control firm owners exercise over a firm's management..

The theoretical results concern the distinction of two different roles of profit depending on owners' control of management. First, profit is a resource for later investments in new technology, products or the like, if managers are perfectly controlled by owners. Second, profit is a cushion to shelter against the consequences of slacking if managers have some freedom to pursue their own interest. The result of any change in the market environment, like trade policy, through profit levels on management behaviour critically depends on which of these two motives dominates. The chapter contributes to the work on trade liberalisation between heterogeneous countries. It points at the potential divergence of countries as a consequence of initial differences when firm owners have full control of firms' management.

The policy results relate to a discussion in Germany that motivated the chapter: windfall profit as a result of joining a free trade area slows down cost-cutting efforts if owners have limited control over managers with a private interest in delaying restructuring. Hence we provide a theoretical basis for the claim that trade liberalisation lead to a slow down of cost-cutting activities by German companies. We also show, however, that joining a free trade area leads to the divergence of firm performance if firms are initially heterogeneous and owners have complete control over management. These results stress the ambiguous effects of trade policies that increase profit levels and the important role of firms' governance structures.

Trade liberalisation and within-firm incentive contracts:

An application to the labour market

The final chapter "Trade liberalisation and within-firm incentive contracts: An application to the labour market" builds on the previous chapters to address the effects of a trade induced change in technology on the labour market.

The policy result of the chapter relates to the trade and wages debate. We show that even in the absence of relative factor endowment differences trade liberalisation can push up wage differentials. Most trade flows are still of an intra-industry type between countries of similar factor proportions, so this result appears to be highly relevant to countries like the OECD members. The model implies that trade barriers against imports from developing countries not only reduce total welfare, they do not even succeed in protecting the rents of low-skilled labour as intended.

Empirical studies that evaluate the effect of trade on wage differentials in the context of the HECKSCHER-OHLIN framework might underestimate the importance of international competition. The present literature takes contrary price movements of high-skill intensive goods and high-skill labour as evidence for an exogenous shock unlinked to international trade. In our model, however, an increase in international competition reduces the high-skill intensive good's price while at the same time driving up the demand and thus the price of the high-skill input. The factor price increase is a result of trade and should be treated accordingly in the empirical analysis of the data.

The chapter adds to the theoretical literature because it treats technology as endogenous instead of exogenous in addition to trade policy. Trade liberalisation leads to an increase in firm output and thus encourages firms to invest in order to reduce marginal costs. If high-skilled labour not only has a higher productivity but is also predominant in activities like R&D or general management, trade liberalisation has obvious implications for the wage structure. The chapter finally allows for free entry of firms. This mechanism reinforces the initial reaction and increases the share of firms switching to the technology using more high-skilled labour even further.

The four chapters add to the understanding of the link between trade liberalisation and the efficiency of firms. The first two papers look at the response within firms and industries to trade liberalisation: within firms, we identify the forces driving technology choice in response to more intense international competition. Within industries, we characterise the selection of surviving firms in an exit and merger process on the adjustment path to the post-liberalisation equilibrium. Both the adjustments within firms and the selection within industries are welfare improving. The final two papers point out potential pitfalls: trade liberalisation can wipe-out industries or allow for periods of slack; and trade liberalisation can drive up the wage differentials between skill groups. Even though the overall welfare consequences are positive, these reactions can raise distributional issues with implications for the political economy of trade reform. A better understanding of the forces involved should help to devise rational policy responses to these challenges.

Bibliography

AGÉNOR, PIERRE-RICHARD, JOSHUA AIZENMAN (1997), Technological change, relative wages, and unemployment, *European Economic Review,* Vol. 41, pp. 187 - 205.

AGHION, PHILIPPE, MATHIAS DEWATRIPONT, PATRICK REY (1997), *Competition, Financial Discipline and Growth*, Oxford University, mimeo.

AGHION, PHILIPPE, PETER HOWITT (1998), *Endogenous Growth Theory,* Cambridge: MIT Press.

AGHION, PHILIPPE, PETER HOWITT (1997), *A Schumpeterian Perspective on Growth and Competition,* D. KREPS, K. WALLS (eds.), *Advances in Economics and Econometrics,* Cambridge: Cambridge University Press.

AGHION, PHILIPPE, PETER HOWITT (1992), A Model of Growth Through Creative Destruction, *Econometrica,* Vol. 60, No. 2, pp. 323 - 351.

BALDWIN, RICHARD E. (1992), *On the Growth Effects of Import Competition,* NBER Working Paper No. 4045.

BALDWIN, RICHARD E., RISKARD FORSKLID (1996), *Trade Liberalisation and Endogenous Growth,* Geneva Institute for International Studies, mimeo.

BALDWIN, RICHARD E., ANTHONY J. VENABLES (1995), *Regional Economic Integration,* in: GENE GROSSMAN, KENNETH ROGOFF (eds.), *Handbook of International Economics,* Vol. III, Amsterdam: North-Holland.

BAILEY, MARTIN NEIL, HANS GERSBACH (1995), Efficiency in Manufacturing and the Need for Global Competition, *Brookings Papers on Economic Activity,* pp. 307 - 358.

BARON, DAVID P., ROBERT B. MYERSON (1982), Regulating a Monopolist with Unknown Costs, *Econometrica,* Vol. 50, No. 4, pp. 911 - 930.

BARROS, PEDRO P., LUIS CABRAL (1994), Merger policy in open economies, *European Economic Review,* Vol. 38, pp. 1041 - 1055.

BEATH, JOHN, YANNIS KATSOULACOS, DAVID ULPH (1995), Game-Theoretic Approaches to the Modelling of Technological Change, in: P. STONEMAN (ed.), *Handbook of the Economics of Innovation and Technological Change,* Oxford: Basil Blackwell, pp. 132 - 181.

BERTOLETTI, PAOLO, CARLA POLETTI (1997), X-Inefficiency, Competition and Market Information, *Journal of Industrial Economics,* Vol. 45, No. 4, pp. 359 - 375.

BERTOLETTI, PAOLO, CARLA POLETTI (1995), A Note on Endogenous Firm Efficiency in Cournot Models of Incomplete Information, *Journal of Economic Theory,* forthcoming.

BERTSCHEK, IRENE (1995), Product and Process Innovation as a Response to Increasing Imports and Foreign Direct Investment, *Journal of Industrial Economics,* Vol. 43, No. 4, pp. 341 - 358.

BHAGWATI, JAGDISH N. (1965), On the equivalence of tariffs and quotas, in: ROBERT E. BALDWIN (ed.), *Trade, Growth and the Balance of Payments,* Chicago: McNally.

BORJAS, GEORGE J., RICHARD B. FREEMAN, LAWRENCE F. KATZ (1997), How much do Immigration and Trade affect Labor Market Outcomes, *Brookings Papers on Economic Activity - Microeconomics.*

BRAINARD, S. LAEL., D. MARTIMORT (1996), Strategic Trade Policy Design with Asymmetric Information and Public Contracts, *Review of Economic Studies,* Vol. 63, No. 1, pp. 81 - 106.

BRAINARD, S. LAEL (1993), *An Empirical Assessment of the Factor Proportions Explanation of Multinational Sales,* NBER Working Paper No. 4583.

BRANDER, JAMES R., PAUL R. KRUGMAN (1983), A "Reciprocal Dumping" Model of International Trade, *Journal of International Economics,* Vol. 15, pp. 313 - 323.

BURTLESS, GARY (1995), International Trade and the Rise in Earnings Inequality, *Journal of Economic Literature,* Vol. 33, No. 2, pp. 800 - 815.

CABALLERO, RICARDO J., MOHAMAD L. HAMMOUR (1994), The Cleansing Effect of Recessions, *American Economic Review,* Vol. 84, No. 5, pp. 1350 - 1368.

CABRAL, CÉLIA COSTA, PRAVEEN KUJAL, EMMANUEL PETRAKIS (1996), *Incentives for Cost reducing Innovations under Quantitative Import Restraints,* Universidad Carlos III de Madrid, WP 96-59.

COMBES, PIERRE-PHILIPPE, BERNARD CAILLAUD, BRUNO JULLIEN (1995), *Common Market with Regulated Firms,* CREST-Laboratoire d'Economie Industrielle, mimeo.

CORDEN, W. MAX (1974, 2nd revised edition 1997), *Trade Policy and Economic Welfare,* Oxford: Clarendon Press.

DAS, SATYA P. (1996), Incentive Pay, Worker Effort, and Trade Protection, *Review of International Economics,* Vol. 4, No. 2, pp. 141 - 151.

DAVIDSON, CARL, RAYMOND DENECKERE (1985), Incentives to form coalitions with Bertrand competition, *Rand Journal of Economics,* Vol. 16, No. 4, pp. 473 - 486.

DINOPOULUS, ELIAS, TRACY R. LEWIS, DAVID SAPPINGTON (1995), Industrial targeting with unknown learning-by-doing, *Journal of International Economics,* Vol. 38, pp. 275 - 295.

DUTZ, MARK A. (1989), Horizontal Mergers in Declining Industries, *International Journal of Industrial Organization,* Vol. 7, pp. 11 - 33.

ECONOMIC PLANNING ADVISORY COMMISSION (1996), *Tariff reform and economic growth,* Commission paper no. 10, Canberra: Australian Government Publishing.

EUROPEAN COMMISSION (1994), Competition and Integration. Community merger control policy, *European Economy,* Vol. 57.

EUROPEAN COMMISSION (1988), The economics of 1992: An assessment of the potential economic effects of completing the internal market of the European Community, *European Economy,* Vol. 35.

EUROPEAN COMMISSION, *Report on Competition Policy,* various issues.

ESFAHANI, HADI SALEHI, DILIP MOOKHERJEE (1995), Productivity, contracting modes, and development, *Journal of Development Economics,* Vol. 46, pp. 203 - 231.

FARRELL, JOSEPH, CARL SHAPIRO (1990), Horizontal Mergers: An Equilibrium Analysis, *American Economic Review,* Vol. 80, No. 1, pp. 107 - 126.

FAULÍ-OLLER, RAMON (1997), On merger profitability in a Cournot setting, *Economics Letters,* Vol. 54, pp. 75 -79.

FEENSTRA, ROBERT C. (1996), Trade and uneven growth, *Journal of Development Economics,* Vol. 49, pp. 229 - 256.

FINANCIAL TIMES, Shake-out likely for chemicals industry, 22nd April 1997.

FRIEDMAN, DANIEL, K.C. FUNG (1994), *International Trade and the Internal Organization of Firms: An Evolutionary Approach,* mimeo., University of California, Santa Cruz.

FUDENBERG, DREW, JEAN TIROLE (1991), *Game Theory,* Cambridge: MIT Press

GAL-OR, ESTHER (1992), Job Security and Product Market Competition, *Journal of Economics & Management Strategy,* Vol. 1, No. 2, pp. 313 - 337.

GARCÍA-PENALOSA, CECILIA (1996), *A Theory of Growth and Wage Differentials,* Nuffield College, University Oxford, mimeo.

GHANI, EJAZ, CARL JAYARAJAH (1995), *Trade Reform, Efficiency, and Growth,* World Bank Policy Research Paper 1438.

GROSSMAN, GENE, ELHANAN HELPMAN (1991), *Growth in the World Economy,* Cambridge: MIT Press.

GROSSMAN, SANFORD J., OLIVER D. HART (1986), The Costs and Benefits of Ownership, *Journal of Political Economy,* Vol. 94, pp. 691 - 719.

HANDOUSSA, HEBA, MIEKO NISHIMIZU, JOHN M. PAGE (1986), Productivity Change in Egyptian Public Sector Industries after "The Opening", 1973-1979, *Journal of Development Economics,* Vol. 20, pp. 53 - 73.

HARRIS, M., A. RAVIV (1979), Optimal incentive contracts with imperfect information, *Journal of Economic Theory,* Vol. 20, pp. 231 - 259.

HARRISON, ANN (1994), Productivity, Imperfect Competition and Trade Reform: Theory and Evidence, *Journal of International Economics,* Vol. 36, pp. 53 - 73.

HART, OLIVER D. (1983), The market mechanism as an incentive scheme, *Bell Journal of Economics,* Vol. 14, pp. 366 - 382.

HART, OLIVER D., JOHN H. MOORE (1990), Property Rights and the Nature of the Firm, *Journal of Political Economy,* Vol. 98, No. 6, pp. 1119 - 1158.

HELPMAN, ELHANAN, PAUL R. KRUGMAN (1992), *Trade Policy and Market Structure,* MIT Press: Cambridge & London.

HERMALIN, BENJAMIN E. (1992), The effect of competition on executive behaviour, *RAND Journal of Economics,* Vol. 23, No. 3, pp. 350 - 365.

HOLMSTRÖM, BENGT (1979), Moral hazard and Observability, *RAND Journal of Economics,* Vol. 10, pp. 74 - 91.

HOLMSTRÖM, BENGT (1982), *Managerial Incentives - A Dynamic Perspective,* in: *Essays in Economics and Management in Honour of Lars Wahlbeck,* Helsinki: Swedish School of Economics.

HOLMSTRÖM, BENGT, ROGER B. MYERSON (1983), Efficient and Durable Decision Rules with Incomplete Information, *Econometrica,* Vol. 51, Vol. 6, pp. 1799 - 1819.

HORN, HENRIK, LARS PERSSON (1996), *Endogenous Merger in an International Oligopoly,* mimeo., Institute for International Economic Studies, Stockholm.

HORN, HENRIK, HARALD LANG, STEFAN LUNDGREN (1995), Managerial Effort Incentives, X-inefficiency and International Trade, *European Economic Review,* Vol. 39, pp. 117 - 138.

HORN, HENRIK, HARALD LANG, STEFAN LUNDGREN (1994), Competition, long run contracts and internal inefficiencies in firms, *European Economic Review,* Vol. 38, pp. 213 - 233.

HORN, HENRIK, HARALD LANG, STEFAN LUNDGREN (1990), *"X"-Inefficiency and International Competition,* Seminar Paper No. 480, IIES, Stockholm University.

HORSTMANN, IGNATIUS M., JAMES R. MARKUSEN (1996), Exploring New Markets: Direct Investments, Contractual Relations and the Multinational Enterprise, *International Economic Review,* Vol. 37, No. 1, pp. 1 - 20.

HORSTMANN, IGNATIUS J., JAMES R. MARKUSEN (1992), Endogenous Market Structures in International Trade, *Journal of International Economics,* Vol. 26, pp. 109 - 129.

HORSTMANN, IGNATIUS J., JAMES R. MARKUSEN (1986), Up the average cost curve: Inefficient entry and the new protectionism, *Journal of International Economics,* Vol. 20, pp. 225 - 247.

INNES, ROBERT D. (1990), Limited Liability and Incentive Contracting with Ex-ante Action Choice, *Journal of Economic Theory,* Vol. 52, pp. 45 - 67.

JOURNAL OF ECONOMIC PERSPECTIVES (1995), Symposium: Income Inequality and Trade, Vol. 9, No. 3, pp. 15 - 80.

KAMEKE, ULRICH (1993), The role of competition for an X-inefficiently organized firm, *International Journal of Industrial Organisation,* Vol. 11, pp. 391 - 405.

KAPSTEIN, ETHAN B. (1996), Workers and the World Economy, *Foreign Affairs,* Vol. 75, No. 3, pp. 16 - 37.

KRUGMAN, PAUL R. (1995), Growing World Trade: Causes and Consequences, *Brookings Papers on Economic Activity: Microeconomics,* pp. 327 - 377.

LAFFONT, JEAN-JACQUES, JEAN TIROLE (1986), Using Cost Observations to Regulate Firms, *Journal of Political Economy,* Vol. 94, No. 3, pp. 614 - 641.

LAI, EDWIN L.-C. (1995), Learning by Doing, Technology Choice, and Export Promotion, *Review of International Economics,* Vol. 3, No. 2, pp. 186 - 198.

LAWRENCE, R. Z., M. J. SLAUGHTER (1993), International Trade and American Wages in the 1980s, *Brookings Papers: Microeconomics,* pp. 161 - 210.

LEVINSHON, J. (1993), Testing the Imports-As-Market-Discipline Hypothesis, *Journal of International Economics,* Vol. 35, pp. 1 - 22.

LEWIS, ANDREW (1996), *On Technological Differences in Oligopolistic Industries,* mimeo., European University Institute.

LIPPMAN, S. A., R. P. RUMELT (1982), Uncertain imitability: an analysis of interfirm differences in efficiency under competition, *Bell Journal of Economics,* Vol. 13, pp. 418 - 438.

MACDONALD, JAMES M. (1994), Does import competition force efficient production?, *Review of Economics and Statistics,* Vol. 76, No. 4, pp. 721 - 727.

MANKIW, N. G., M. D. WHINSTON (1986), Free entry and social inefficiency, *RAND Journal of Economics*, Vol. 10, pp. 20 – 32.

MARKUSEN, JAMES R. (1995), The Boundaries of Multinational Enterprises and the Theory of International Trade, *Journal of Economic Perspectives,* Vol. 9, No. 2, pp. 169 -189.

MARKUSEN, JAMES R., ANTHONY J. VENABLES (1995*), Multinational Firms and the New Trade Theory,* LSE, mimeo.

MARKUSEN, JAMES R., ANTHONY J. VENABLES (1988), Trade Policy with increasing returns and imperfect competition, *Journal of International Economics,* Vol. 24, pp. 299 - 316.

MARTIN, JOHN P. (1978), X-inefficiency, managerial effort and protection, *Economica,* Vol. 45, pp. 273 - 286.

MARTIN, STEPHEN (1993), Endogenous Firm Efficiency in a Cournot Principal-Agent Model, *Journal of Economic Theory,* Vol. 50, pp. 445 - 450.

MCAFEE, R. P., M. A. WILLIAMS (1992), Horizontal Mergers and Antitrust Policy, *Journal of Industrial Economics,* Vol. 40, No. 2, pp. 181 - 187.

McKinsey Global Institute (1993), *Manufacturing Productivity,* McKinsey & Company, Inc.: Washington, D.C.

Mercenier, Jean, Nicolas Schmitt (1996), On Sunk Costs and Trade Liberalization in Applied General Equilibrium, *International Economic Review,* Vol. 37, No. 3, pp. 553 - 571.

Miyagiwa, Kaz, Yuka Ohno (1995), Closing the Technology Gap, *American Economic Review,* Vol. 85, No. 4, pp. 755 - 770.

Möller, Joachim (1996), *Technological Change, Unemployment, and Recent Trends in Human Capital Formation,* Regensburger Diskussionsbeiträge Nr. 280.

Neary, J. Peter (1994), Cost asymmetries in international subsidy games: Should governments help winners or losers?, *Journal of International Economics,* Vol. 37, pp. 197 - 218.

Nickell, Stephen (1995), *The Performance of Companies,* Oxford: Basil Blackwell.

Nishimizu, Mieko, John M. Page (1991), Trade Policy, Market Orientation, and Productivity Change in Industry, in: Jaime de Melo, André Sapir (eds.), *Trade Theory and Economic Reform: North, South, and East,* Oxford: Basil Blackwell, pp. 246 - 264.

Nishimizu, Mieko, S. Robinson (1984), Trade Policies and Productivity Change in Semi-Industrialized Countries, *Journal of Development Economics,* Vol. 16, pp. 177 - 206.

Organisation for Economic Co-operation and Development (1994), *The OECD Jobs Study, Evidence and Explanations,* OECD: Paris.

ORDOVER, JANIS A., ROBERT D. WILLIG (1986), Perspectives on Mergers and World Competition, in: RONALD E. GIROS (Ed.), *Antitrust and Regulation*, Lexington: Lexington Books, pp. 201- 218.

PANUNZI, FAUSTO (1994), Managerial Slack and the Efficiency of Organizations under Competitive Pressure, *Economic Notes,* Vol. 3, No. 2, pp. 338 - 352.

PERRY, MARTIN K., ROBERT H. PORTER (1985), Oligopoly and the Incentive for Horizontal Merger, *American Economic Review,* Vol. 75, No. 1, pp. 219 - 227.

PUGA, DIEGO, ANTHONY J. VENABLES (1997), Preferential Trading Arrangements and Industrial Location, *Journal of International Economics,* Vol. 43, No. 3/4, pp. 347 - 368.

RADNER, ROY (1995), *Economic Survival,* J.L. Kellogg School of Management, Northwestern University, Nancy L. Schwartz Lecture.

REITZES, JAMES D., DAVID T. LEVY (1995), Price discrimination and mergers, *Canadian Journal of Economics,* Vol. 28, No. 2, pp. 427 - 436.

REITZES, JAMES D. (1991), The Impact of Quotas and Tariffs on Strategic R&D Behavior, *International Economic Review*, Vol. 32, No. 4.

RIVERA-BATIZ, LUIS A, PAUL M. ROMER (1991), Economic Integration and Endogenous Growth, *Quarterly Journal of Economics,* pp. 531 - 555.

ROBBINS, DONALD (1996), *Evidence on Trade and Wages in the developing World,* OECD Development Centre, Technical Paper No. 119.

RODRIK, DANI (1995), *Trade and Industrial Policy Reform,* in: JERE BEHRMAN, T.N. SRINIVASAN (eds.), *Handbook of Development Economics,* Vol. IIIB, Amsterdam: Elsevier, pp. 2925 - 2982.

RODRIK, DANI (1992), *Closing the Productivity Gap: Does Trade Liberalization Really Help?,* in: GERALD K. HELLEINER (ed.), *Trade Policy, Industrialization and Development: New Perspectives,* Oxford: Clarendon Press.

ROSS, THOMAS W. (1988), On the price effects of mergers with freer trade, *International Journal of Industrial Organization,* Vol. 6, pp. 233 - 246.

SALANT, STEPHEN W., SHELDON SWATTER, ROBERT J. REYNOLDS (1983), Losses from Horizontal Merger: The Effects of an Exogenous Change in Market Structure on Cournot Nash Equilibrium, *Quarterly Journal of Economics,* Vol. 98, pp. 185 - 199.

SAPPINGTON, DAVID (1983), Limited Liability Contracts between Principal and Agent, *Journal of Economic Theory,* Vol. 29, pp. 1 - 21.

SCHARFSTEIN, DAVID (1988), Product-market competition and managerial slack, *RAND Journal of Economics,* Vol. 19, No. 1, pp. 147 - 155.

SCHMIDT, KLAUS M. (1997), Managerial Incentives and Product Market Competition, *Review of Economic Studies,* Vol. 64, pp. 191 - 213.

SJÖSTRÖM, TOMAS, MARTIN L. WEITZMAN (1996), Competition and the evolution of efficiency, *Journal of Economic Behavior & Organisation,* Vol. 30, pp. 25 - 43.

SLAUGHTER, MATTHEW J., PHILLIP SWAGEL (1997), *The Effect of Globalization on Wages in the Advanced Economies,* IMF WP/97/43.

STENNEK, JOHAN (1995), *Competition reduces X-inefficiency - A Note on a Limited Liability Mechanism,* Seminar Paper No. 599, Institute for International Economic Studies, Stockholm University.

STENNEK, JOHAN (1994), Does competition make firms more flexible?, *Journal of Economics & Management Strategy,* Vol. 3, No. 2, pp. 279 - 300.

SUTTON, JOHN (1991), *Sunk Costs and Market Structure,* Cambridge: MIT Press.

THYGESEN, NIELS, YUTAKA KOSAI, ROBERT Z. LAWRENCE (1996), *Globalization and Trilateral Labor Markets: Evidence and Implications,* Report to the Trilateral Commission, April.

TRACA, DANIEL A. (1996), *Imports as Dynamic Discipline,* Columbia University, mimeo.

TYBOUT, JAMES R., M. DANIEL WESTBROOK (1995), Trade liberalization and the dimensions of efficiency change in Mexican manufacturing, *Journal of International Economics,* Vol. 39, pp. 53 - 78.

TYBOUT, JAMES R., JAIME DE MELO, V. CORBO (1991), The Effects of Trade Reform on Scale and Technical Efficiency, *Journal of International Economics,* Vol. 31, pp. 231 - 250.

VAN LONG, NGO, NEIL VOUSDEN (1995), The Effects of Trade Liberalisation on Cost-Reducing Horizontal Mergers, *Review of International Economic Studies,* Vol. 3, No. 2, pp. 141 - 155.

VAN WEGBERG, MARC (1994), *Why do Mergers occur in Waves? Business Cycles, Bandwagons and the Merger for Market Power Paradox,* METEOR RM/0/94-022.

VARIAN, HAL R. (1995), *Entry and Cost Reduction,* University of Michigan, mimeo.

VENABLES, ANTHONY J. (1985), Trade and Trade Policy with Imperfect Competition: The Case of Identical Products and Free Entry, *Journal of International Economics,* Vol. 19, No. 1/2, pp. 1 - 19.

VICKERS, JOHN (1995), *Entry and competitive selection,* University Oxford, mimeo.

VOUSDEN, NEIL, NEIL CAMPELL (1994), The organizational cost of protection, *Journal of International Economics,* Vol. 37, pp. 219 - 238.

WES, MARINA (1995), *Globalisation and Wages: Recent International Trends and the Academic Response*, Centre for Economic Performance, LSE, mimeo.

WILLIG, ROBERT D. (1991), Merger Analysis, Industrial Organization, and Merger Guidelines, *Brookings Papers on Economic Activity,* Microeconomics, pp. 281 - 312.

WILLIG, ROBERT D. (1987), Corporate governance and market structure, in: A. RAZIN, E. SADKA (eds.), *Economic Policy in Theory and Practice,* London: Macmillan, pp. 481 - 503.

WONG, KAR-YIU (1995), *International Trade in Goods and Factor Mobility,* Cambridge & London: MIT Press.

WORLD TRADE ORGANIZATION (1996), *WTO Focus,* July 1996, Geneva: WTO.

Acknowledgements

The work for this thesis has benefited from the discussion with a number of colleagues and friends. I would especially like to thank my supervisor Professor Anthony J. Venables, Antoine Fraure-Grimaud, Estella Montado, and Pawan Patil for their comments. Professor Richard Layard and the CEP I wish to thank for the hospitality of the Centre for Economic Performance. I would also like to thank Professor Juergen B. Donges for getting me interested in international economics and the links between competition and efficiency.

This research has been supported by the European Commission through a Marie Curie-Fellowship (Nr. ERB400IGT956748) as part of the TMR-programme. The Konrad-Adenauer-Foundation has given valuable earlier support that encouraged me to start the PhD.

My parents I wish to thank for their continued support far beyond providing the necessary financial resources. My fiancee Cecilia Johansson has encouraged me along the way and kept up with the long distance for three years. I could not have finished this thesis without this support.