The interaction between explicit contracting and economic conditions in labour markets

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Abstract

The study of labour markets is often limited to labour market institutions themselves and the link to other areas in economics, in particular product markets, is scarce. The purpose of this thesis is to shed light on the interaction between economic conditions and explicit contracting in labour markets. Chapters One and Two investigate how wages change in the face of changes in product market competition and propose a hypothesis for recent increases in wage inequality.

In Chapter One I explain why firms competing in an oligopolistic market alter how much they are willing to pay to attract good workers and how wage inequality within industries (and observed skill groups) may arise from these changes in product market competition. I then look at the actual impact of product market competition using a panel of individuals for the U.K. and concentration measures and two natural experiments as measures of competition. The results point to the fact that increased competition raises the returns to skills and hence wage inequality.

Chapter Two takes investigates the impact of product market competition on performance related pay. I analyse compensation equations of US managers and obtain that increased competition implies increased steepness of the performance pay relationship that raises the variance of wages.

Chapter Three assesses whether there is a systematic relationship between the type of contract held and an aspect of workers welfare. I analyse whether the large difference between the work accident rates of fixed-term and permanent contract workers in Spain is not just the result of a compositional effect but that a pure contractual effect exists. The results indicate there is a pure contractual effect that increases the individual accident probability by 5 percentage points.

Finally Chapter Four is an analysis of the relative impact of household income and unemployment benefit on unemployment duration, with a particular focus on female behaviour.

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This thesis is dedicated to my parents, Humberto y Angeles, and my sisters Cristina and the little Julia and Clara. Muchisimas gracias a todos.

Contents

[1] This chapter is based on joint work with Vicente Cuñat from Universitat Pompeu Fabra.

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0.1 Introduction and main results

The study of labour markets is today at the centre of modern applied economics and it is still of great practical relevance given the subject of study has a direct bearing on individuals lives and economic productivity. However, the area of study is often limited to labour market institutions themselves and what as economists we typically perceive as labour market variables. The link to other areas in economics, in particular product markets, is scarce and there has typically been what I would argue is an artificial dichotomy between the behaviour of individuals as workers or employers and their behaviour as consumers or sellers. It is the purpose of this enquiry to relate explicitly those two worlds, namely the impact of changes in economic conditions that are outside what we traditionally think as being the labour market variables in a strict and restrictive sense and labour market outcomes.

The major effort in this investigation is devoted to explore the impact of changes in product market competition on the wage structure and by extension on wage inequality. This will be the subject of Chapters One and Two. I will argue that increased competition in goods and services markets feeds back into labour markets in the form of increased polarisation of wages. Chapters Three and Four take on a different perspective and are an analysis, respectively, of the effect of the type of contract on the probability of work accidents and an analysis of the effect of the relative impact of household income and unemployment benefit in determining unemployment duration.

Chapter One starts by illustrating the theoretical link between increased competition in product markets and the wage structure when workers are heterogeneous in skills and there is imperfect competition in product markets. What characterises product market competition in a number of parameterisations is that the sensitivity of profits to unit costs is higher as competition increases. If skilled workers are able to produce at lower costs then firms will be willing to pay relatively more for a skilled worker in a competitive product market than in a non competitive one. This implies that the sensitivity of wages to costs (given by the skill level) is also higher in more competitive sectors. Note that this is not a statement about average wages but about within sector wage differentials between high and low skilled workers. It is shown that the defining property of competition is true under a number of parameterisations of competition (also see Boone 2002). A maintained hypothesis throughout the chapter is that firms are homogeneous ex ante; they only differ ex post by the type of worker they hire.

The immediate implication of the model is that as product market competition increases returns to skill are larger. I test this empirically using a panel of UK workers (males in the manufacturing sector for the period 1982-1999). The identification exploits the within sector variation in competition to estimates wage equations based on an individual panel. As measures of skill at work I use education and tenure. I also use wages as direct proxy for skill in a part of the analysis. The first competition measures used are sectoral concentration ratios. Even in the fully saturated specification with individual fixed effects I obtain that as concentration falls the returns to skill increase, ceteris paribus. The problem with these concentration ratios is that they may be criticised as imperfect measures of competition and also that they may be correlated with an omitted variable. To address these issues I use two natural experiments that I argue imply exogenous changes in product market competition.

First, I use the introduction of the European Single Market Programme in 1992 that implied that competition increased more for sectors with high non-tariff barriers before 1992. Second I exploit the strong appreciation of the British pound that took place in 1996 and that meant a bigger increase in competition for sectors that were highly exposed to international trade. The difference in differences results of these specifications confirm again that as competition increases, the ratio of high to low skill wages becomes larger and the magnitudes of the effects are sizeable. I also provide instrumental variable estimates for the effect of concentration with similar results. I argue that this is strong evidence in favour of the type of mechanism outlined and provides an additional explanation of the large increase in wage inequality that took place in the UK over the past twenty years.

One of the difficulties of the exercise is to find a convincing measure of competition, the use of natural experiments overcomes that difficulty. The second difficulty lies in the fact that my hypothesis emerges in a field of literature within labour economics that has received enormous attention and where a number of hypothesis for the reasons of increased inequality have already been advanced and repeatedly tested, such as skill biased technical change, de-unionisation, trade liberalisation and workplace reorganisation. I argue that my hypothesis is distinct from all these, that it is able to answer why "within" inequality has increased and that in the empirical analysis I identify the direct causal effect of competition on changes in the returns to skill. However, it is possible that the alternative explanations of the increase in inequality such as de-unionisation and organisational change may be thought of as a response themselves to changes in product market competition. Competition may then have an indirect effect through these mechanisms, but this is beyond the scope of this chapter.

The analysis in chapter one mainly concerns workers and wages when we take skills as given at a point in time. It would be interesting in future research to endogeneise skill accumulation and effort (and allow firms to differ ex ante through technological innovation and workplace reorganisation) to assess to what extent an exogenous increase in product market competition leads firms to reorganise themselves to reduce costs just as we outline it occurs with wages. In other words, skills/effort and cost reduction abilities are not necessarily given but may be altered forcefully. A step in this direction is developed in Chapter Two where I allow for firms to alter the effort required from their workers in response to changes in product market competition.

Chapter Two is a study of the effect of product market competition on the structure of managerial compensation[2]. In a standard principal agent setting, part of the managers compensation is in the form of performance related pay. This type of compensation has

[2]It is based on joint work with Vicente Cuñat from Universitat Pompeu Fabra.

the purpose of generating effort in managers in the presence of asymmetric information. This Chapter is an empirical assessment of whether as product market competition increases, the sensitivity of pay to performance is increased. This would actually generate an additional source of increased wage inequality in response to increased competition since higher performance pay sensitivities imply a higher variance in total compensation for a given distribution of performance. From a theoretical point of view Schmidt (1997) outlines two effects of product market competition. On the one hand increased competition reduces profits and provides implicit incentives to managers that fear bankruptcy, implying a lower sensitivity of pay to performance. On the other hand, increased competition means that it is easier to capture market share and hence firms are going to incentivate managers through higher performance pay sensitivities to induce higher effort. As always, the story is that changes in product market competition later what firms and employers are willing to pay for workers/how much they want to incentivate them. The mechanism in this chapter is that competition changes the returns to effort, while it changed the returns to hiring a skilled worker in the previous chapter.

I investigate the relationship between competition and the sensitivity of performance related pay (PRP) using a panel of managers in the largest US firms. I estimate wage equations that include the PRP component using first concentration ratios as a measure of product market competition and measuring performance by both stock market returns to shareholders and accounting profits. Controls are included for a number of firm characteristics, in particular the risk of the firm (that carries a high bearing on the shape of the PRP contract) and rents accruing in the firm (that are closely related to competition and allow us to say something on rent extraction by managers). The results confirm that PRP sensitivities are higher in more competitive sectors. However the same criticisms to using concentration ratios apply. Hence to confirm the robustness of the results we exploit two deregulation episodes of the financial sector in the US in the 1990s (1994 and 1999) as quasi-natural experiments for an increase in competition.

Again the difference in differences estimates indicate that after the deregulation episode sensitivities were higher in the financial sector (even controlling for sector specific time trends and individual fixed effects).

Chapters One and Two explain and provide empirical support for the idea of a direct impact of product market competition on various forms of explicit contracting in labour markets. They also open the way for further research in the area, in particular with the view to relate these basic mechanisms to others already present in the literature and that seem closely tied to the one advocated here. They also provide a supplementary hypothesis that has not received attention previously in the literature, for the increase in wage inequality that has taken place in Anglo Saxon countries over the past decades.

After the analysis of the effect of product market competition on explicit contracting and the wage structure I turn on to a different aspect of the interaction between economic conditions and labour market outcomes.

Chapter Three investigates the effect of allowing for different types of contractual arrangements in an economy on an aspect of labour productivity and workers welfare, namely the probability of having an accident at the workplace. In particular I investigate whether the use of fixed term contracts in Spain increases accident rates with respect to permanent contracts. The unconditional probability of a workplace accident is three times higher for fixed term than for permanent contract workers. This may be due to a number of reasons that are controlled for in the econometric analysis, such as differences in tenure, demographic characteristics or riskiness of the sector. However I argue that the types of contract in existence in the economy alters incentives and behaviour beyond this. In particular human capital accumulation is likely to be lower for fixed term contracts, effort will be higher to increase reemployment probabilities and there may be some type of systematic reporting bias. In addition it is possible there is selection of workers on ability into the different types of contracts. If this is so, and less able workers are hired on fixed term contracts, this will be reflected in differential accident probabilities. To control for this I use accidents on the way to work. The maintained assumption is that accidents on the way to work are correlated with ability but independent of the type of contract at work. Once I control for all these effects I find that the effect of the type of contract is reduced but it is still the case that those on fixed term contracts are twice as likely to have an accident at the workplace.

Here again I find an important interaction between explicit contracting and labour market outcomes that is given by the contractual institutional setting and the incentives generated by the different types on contracts.

Finally, Chapter Four takes on a different perspective as it is an analysis of unemployment duration. I study the differential impact of household income and unemployment benefit in determining the probability that an unemployed person exits unemployment. Income and benefit variables are important in determining unemployment behaviour. In particular, household income is said to be a disincentive for job search in the Mediterranean countries. However, no paper has addressed this issue directly for the case of Spain because Spanish datasets with detailed unemployment information do not contain income or benefit variables. To solve this problem I use the Encuesta Continua de Presupuestos Familiares, a dataset with detailed income data but an imperfect measure of unemployment. To overcome the limitations of the data I develop a hazard model to estimate the determinants of spell durations when the full duration of the spell is not available (one only knows whether a change in unemployment status has occurred within a three month interval). I find that household structure is very important in understanding unemployment behaviour in Spain. Household income does have a negative effect on transitions to employment and its effect is larger for women than for men. However the impact is much smaller than that of unemployment benefit. I am able to compute the elasticity of duration to benefit conditional on being entitled as 0.47. The results thus point to the importance of household and economic conditions in determining labour market behaviour.

Each of the chapters is to a large extent self contained in the sense that they each ask and answer well defined questions. They complement each other to the extent that they provide a better picture as to how essential constituents of the economic environment that are often ignored in the study of labour markets do have an impact on the behaviour of workers and firms.

Chapter 1

Does product market competition increase wage inequality?

1.1 Introduction

In recent times we have witnessed a number of economic and institutional changes leading to an increase in competition in goods and services markets. From economic integration of different geographic blocs, to the fall in costs of transportation and information transmission these are all trends leading to more competition in product markets. And the liberalisation rethoric is very much present at all levels of the economic and political debate. At the same time there has been a very sharp increase in wage inequality and in the returns to skills, especially in the UK and the US, that has generated a vast literature trying to explain its causes. However there has been little attempt to link these very strong trends in the economy. The question addressed in this paper is precisely how do changes in product market competition alter the behaviour of labour market actors and the wage structure?

It has been argued before that changes in product market competition will have an impact on the labour market because of the changes in rents they imply since sectors with more rents will be able to pay higher wages (Krueger and Summers (1988)[1]). This leads to between sector differences in wages for workers with the same skills. Here I will make a more subtle point: the distribution of wages within sectors will change as product market competition increases. In particular, the returns to skills will change within sectors in response to competition. Product market competition will have an impact on the distribution of wages within the sector that goes beyond the between sector rent sharing argument. As I will show below, this only relies on two fundamental assumptions, namely that there is imperfect competition in the product market and that workers are heterogeneous.

A nascent literature links product markets to labour markets (employment, wage levels) beyond the inter-industry wage differentials argument (Blanchard and Giavazzi (2000), Bertrand and Kramarz (2001), Amable and Gatti (1997)) but none outlines the type of effect of the level of competition on the variance of wages outlined here[2].

The idea in this paper is that as markets become more competitive the sensitivity of profits to the type of worker hired increases and firms are willing to bid more in order to attract the most able workers. As will be shown in what follows, this appears as a very robust economic mechanism: in more competitive industries, the sensitivity of profits to costs is higher, Since high skill workers are able to produce at lower costs competition for workers will be higher and good workers will receive higher wages. It follows that wage dispersion will be higher in sectors with more product market competition. It is possible that at the same time mean wages in the sector are falling (because of the rent sharing argument), but within sector dispersion will increase.

[1]Evidence of this rent-sharing mechanism is provided in Card (1996) for airline industry deregulation in the US, Revenga (1992) for international competition from import prices, Borjas and Ramey (1995) for international competition in durable goods markets, Abowd and Lemieux (1993) instrument quasi-rents with imports prices in Canadian data ane Van Reenen (1996) uses innovations as an instrument.

[2]The OECD (2002) Employment Outlook actually note the lack of evidence on this subject and document a negative cross country relationship between the index of product market liberalization and wage inequality, but this can only be considered as exploratory evidence of the relationship. Card (1986) and (1996) shows some evidence of increased wage dispersion after airline deregulation. Fortin and Lemieux (1997) asses the impact of a number of institutional changes in the US on the wage distribution. Deregulation of major industries explains some of the effect.

This feature of product market competition is common to most parametrisations of competition as will be shown and as has been found in recent economic research (Boone (2002)). This paper draws the implications for wage dispersion in the labour market of changes in product market competition.

The paper then explores empirically how product market competition relates to the wage structure in the light of the mechanism outlined above using UK data for males in the manufacturing industry. Note that the explanation in this paper is also an explanation for within industry and skill wage inequality. What is rewarded are the skills of workers and these may be observed by the worker and the employer but not by the econometrician. Under my hypothesis there will be higher returns to both observed and unobserved skills within industries.

The hypothesis that product market competition leads to changes in wage dispersion, is first tested using direct measures of product market competition (concentration ratios) in a fully saturated model with individual fixed effects. However, these empirical measures can be criticised from a conceptual point of view on the grounds that they may not be perfect measures of competition and from an econometric point of view because they may be correlated with an omitted variable and hence the estimates do not capture the causal effect of competition on changes in the returns to skills. Therefore I turn to two additional identification strategies that are based on two quasi-natural experiments. One is the implementation of the European Single Market programme in 1992, the second is the strong appreciation of the British pound in 1996. These are used as exogenous sources of competition that yield instrumental variables estimates of the effect of competition on wage dispersion.

This paper should be thought of taking into account existing explanations that have been put forward for an increase in wage dispersion, in particular skill-biased technical change, organisational change (Caroli and Van Reenen (2001), Black et al. (2003)) and changes in unionisation (Machin (1997)). Pushing the argument in this paper to the extreme would lead us to argue that those features are to a large extent responses to competitive pressures and hence they may be capturing some of (and are endogenous to) the effect outlined in this paper.

A parallel effect of product market competition that is not dealt with here (but left to Chapter Two) is its impact on the use of performance related pay (PRP). Schmidt (1999) and Raith (forthcoming) show under which circumstances increased product market competition will lead to a heavier reliance on PRP as a mode of payment to increase effort exerted[3] and a heavier weight on the use of bonuses in managerial compensation packages. Increased PRP will lead to increased dispersion in wages and possibly in returns to skills (if skilled workers are those that perform systematically better).

The effects of changes in competition on labour markets are likely to be numerous and sizeable[4]. Here I will only focus on its impact on the variance of wages, leaving for future research other implications of such a link.

Next section lays out the basic theoretical mechanism for a link, section three describes the econometric specification and the identification strategies used in the empirical analysis and section four discusses the results. Section five concludes.

1.2 The link between product market competition and wages

The purpose of this section is to outline a stylised model that illustrates in a simple way why changes in product market competition may affect wage setting behaviour and the wage distribution. The argument is that as product market competition increases, and even in the presence of perfect labour markets, firms will be willing to pay more to attract good workers and hence wage dispersion will increase. The crucial ingredient for

[3]Nickell (1996) and Griffith (2001) find empirical evidence of increased product market competition leading to increased effort exertion/efficiency.

[4]Other consequences of competition that are beyond the domain of this paper are its impact on employment (Bertrand and Kramarz (2001)), on market value and innovation (Blundell et al. (1999), Aghion et al. (2002).

this to be true is that profits[5] are more sensitive to the ability of the worker hired, the higher is product market competition. Firms will be willing to bid more for their workers and increase the fraction of profits they share with them. This is a very robust economic mechanism, that follows exclusively from the two assumptions made throughout this paper: imperfect competition in product markets and heterogeneity of workers. The result is very general and does not depend on the particularities of functional forms assumed. I now turn to a very simple illustration that captures the thrust of the theory underlying the paper, then I develop a more general case with more economic structure (without assuming any particular competition model) and finally I check its validity for a number of standard product market competition models.

1.2.1 Simple illustration

To illustrate the fact that profits are more sensitive to costs the higher the degree of product market competition, consider the following simple calculation. Let profits of firm i be

$$\pi_i = (p_i - c_i)Y_i$$

where in standard notation p_i is the price set by firm i, Y_i is the firm's output given some exogenous production function and c_i are (exogenous) unit production costs that are assumed to be decreasing in the ability of the worker hired. Using the envelope theorem one can show that

$$d\pi_i/dc_i = -Y_i$$

and the elasticity of profits with respect to c_i is

$$\varepsilon = (c_i/\pi_i)(d\pi_i/dc_i) = -c_i/(p_i - c_i)$$

[5] In the model below the condition will be on what I will call gross profits (gross of bargained wages $w(d_i)$).

Note that $(p-c)/c$ is the markup (Lerner index) that in turn reflects the level of competition. Hence the sensitivity of profits to costs is higher the higher the competition level. If high skill workers are those who are able to produce a lower costs, then the sensitivity of profits to skill increases in competition. This is a necessary basic economic mechanism to support the link between competition and wage dispersion. In this situation high ability workers will extract more surplus in form of wages when product market competition increases.

1.2.2 Formal setting

In what follows I develop a formal setting to underpin that link. This remains a very simple and stylised model with few assumptions that is kept at a high level of generality so that one can see the basic conditions that generate a link between product market competition and wage dispersion. I then turn to standard Industrial Organisation models of product market competition (Cournot and Dixit Stiglitz monopolistic competition) and confirm that the basic link is present in them.

Consider N firms selling goods in a non-competitive product market. Each firm hires one worker such that the number of workers employed in the monopolistic sector is given by the number of firms in that sector, N[6] . Those that are not hired in the sector will be self employed and get some exogenous reservation wage b.

Workers are of different skill levels. This skill is innate or acquired but given at some point in time when the hiring decision emerges. A high skill level means that the worker is able to produce at lower costs, that he is more productive. A way of reflecting this is that the worker's job is to set up a machine. A worker of ability d_i (where d_i is an inverse index of the skill level) sets the machine so that when the machine produces Y_i units of output, the unit costs are affected by d_i. A high d means that the worker produces at high costs and hence is of low skill. d is distributed between d_1 (for the highest skill

[6] N is takne as exogenous for the moment. I will later show what happens when we endogeneise it. The qualitative results are identical.

worker that produces at lowest costs) and d_L, and no assumption is made on whether there are more or fewer workers than firms in the monopolistic sector (the maximum number of firms in the monopolistic sector is given by the condition that no firm makes negative profits). Firms have a gross profit function $\widetilde{\pi}(d_i, \theta)$[7], where θ summarises the level of product market competition. $\widetilde{\pi}$ is such that $\frac{d\widetilde{\pi}}{dd_i} < 0$ (not necessarily $\frac{d\widetilde{\pi}}{d\theta} < 0$)

Note that product markets are not competitive but labour markets are perfectly competitive in the sense that there are no restrictions on hiring, firing or mobility costs.

The stages of the game are as follows. In the first stage N identical firms compete for workers of different abilities. They post a wage associated to each skill level. Both firms and workers know perfectly the ability level of all workers. When they meet, firms will offer workers a given wage level and each worker can accept or reject those offers[8].

Once workers are allocated to firms production occurs and in the second stage firms compete in the product market where they sell their products and wages are paid. The level of competition in the product market is also known throughout.

The game is solved backwards. In the second stage firms chose prices and/or quantities (depending on the type of competition game played) that maximise gross profits $\widetilde{\pi}(d_i; \theta)$ given the level of competition θ. This is a function of the ability of the worker hired.

In the first stage firms take into account this gross profit function and post wages to compete for workers of different abilities. They bid for them through the wage offers. Firms maximise net profits $\pi(d_i; \theta)$[9] (net of wages) subject to the participation constraint of workers. This constraint says worker d_i will only accept a wage offer $w_i(d_i)$ if it is above the reservation wage b and the wage that any other firm may offer them $w_j(d_i)$.

[7] $\widetilde{\pi}(d_i, \theta)$ is "profit" prior to paying the worker's wages.

[8] We could extend the model to allow for workers to be compensated per unit produced and the effort exerted. This is straightforward when we assume constant disutility of effort where the disutility of effort is precisely d_i.

[9] Profits appear as a function of ability d_i and the competition level θ. Implicitly they are also a function of quantity produced $q(d_i, \theta)$ which is already optimised as $q^*(d_i, \theta)$ when we write the profit function: $\pi(d_i; \theta) = \pi(d_i, q^*(d_i, \theta); \theta)$

$$\begin{aligned}\max_{w_i} \pi(d_i;\theta) &= \widetilde{\pi}(d_i;\theta) - w_i(d_i) \\ s.t. w_i(d_i) &\geqslant \max\{w_j(d_i), b\} \text{ for all } j \in [1, N]\end{aligned} \tag{1.1}$$

where b is the exogenous reservation wage and w_j is the wage offered by the other firms.

For a given N, in equilibrium the N^{th} firm that hires the N^{th} ability worker (if we ranked workers by ability level, the one at the N^{th} position) and pay him a wage equal to the reservation wage. This yields profits for the N^{th} firm given by: $\pi(d_N, \theta) = \widetilde{\pi}_N(d_N) - b$.

The optimal strategy for firm i is to offer $w_i(d_i)$ to worker i such that in equilibrium it could not make higher profits by paying w_i and hiring a worker of different ability d_j, nor by paying that i^{th} worker a different wage.

$$\widetilde{\pi}(d_i) - w_i(d_i) \geq \widetilde{\pi}(d_j) - w_i(d_j), \text{ for all } i, j \tag{1.2}$$

$$\widetilde{\pi}(d_i) - w_i(d_i) \geq \widetilde{\pi}(d_i) - w_j(d_i), \text{ for all } i, j \tag{1.3}$$

Since firms are identical $w_i(d_i) = w_j(d_i) = w(d_i)$, the above conditions collapse to:

$$P(d_i) - w(d_i) \geq P(d_j) - w(d_j), \text{ for all } i, j \tag{1.4}$$

In equilibrium we will have that:

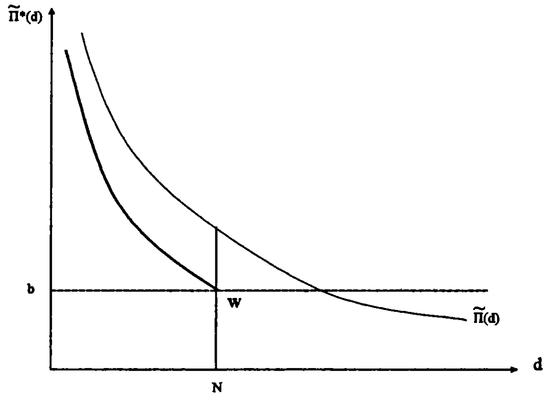
$$\widetilde{\pi}(d_i, \theta) - w(d_i, \theta) = \widetilde{\pi}(d_j, \theta) - w(d_j, \theta) = \widetilde{\pi}_N(d_N, \theta) - b \tag{1.5}$$

$$w(d_i, \theta) = \widetilde{\pi}(d_i, \theta) - \widetilde{\pi}_N(d_N, \theta) + b \tag{1.6}$$

This is an equilibrium because neither firms nor workers will have an incentive to deviate. The i^{th} firm paying wage $w(d_i)$ would like to pay a lower wage w' to worker i and make higher profits. But then the worker could threaten to go to another firm that would be willing to pay $w' + \varepsilon < w(d_i)$ and make higher profits. And this goes on until wages are again equal to $w(d_i)$. In equilibrium all firms are making equal profits and are indifferent as to which worker they hire. Now let's see if workers have an incentive to deviate. No firm will accept to raise wages because they can threaten workers with hiring the $N^{th} + 1$ worker and get almost the same profit. The alternative for the worker is then earning b that is lower. The only worker that is indifferent between working in the monopolistic sector or self employment is the N^{th} worker that gets a wage equal to the outside option b. So wages are distributed between b for the lowest ability worker employed in the monopolistic sector and $w(d_1, \theta)$ for the highest ability worker. The exact form of the wage schedule will depend on the form of $\widetilde{\pi}(d_i; \theta)$.

One can define two relevant schedules that are related as in equation (**??**). The gross profit schedule $\widetilde{\pi}(d_i, \theta)$ and the optimal wage schedule $w(d_i, \theta)$. These are pictured in figure (1.1) for an exogenous N. Note that $\frac{dw(d_i,\theta)}{dd_i} = \frac{d\widetilde{\pi}(d_i,\theta)}{dd_i}$. This was assumed to be negative, i.e. revenue is decreasing in costs or increasing in the ability of the worker hired. I will show below that different models of product market competition deliver the negative slope. So the wage schedule is decreasing in d and has the same slope as the revenue schedule but it is shifted down by $\widetilde{\pi}_N(d_N, \theta) + b$. It has a lower bound given by b.

Figure 1.1: Equilibrium revenue and wage schedules



So far I have not assumed any functional form for product market competition. All the assumptions required are that gross profits are increasing in the ability of the worker hired and that each firm hires one worker and the bidding process is as described above. I also took N as given. If instead we allowed free entry, firms would enter until the last firm makes zero profits such that:

$$\widetilde{\pi}_N(d_N, \theta) - b = 0 \tag{1.7}$$

All other firms will also be making zero profits and wages are such that $w(d_i, \theta) = \widetilde{\pi}(d_i, \theta)$.

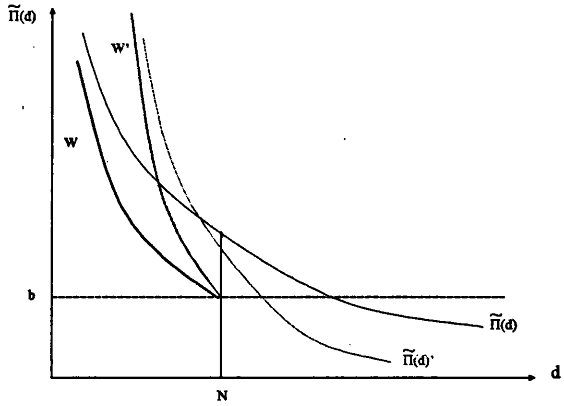
The next step is to see what is the sufficient condition in this general setting for an increase in competition triggering an increase in wage dispersion. This is:

$$\frac{d^2 w(d_i, \theta)}{dd_i d\theta} = \frac{d^2 \widetilde{\pi}(d_i, \theta)}{dd_i d\theta} < 0 \tag{1.8}$$

Which is a single crossing condition.

Figure 1.2 illustrates what happens when product market competition increases and the condition above is satisfied. The number of firms N is exogenously given. As θ changes, the gross profit function becomes steeper. The wage schedule also shifts so that the vertical distance between the two curves is constant, and the wage schedule is anchored at b for the N^{th} worker hired (assuming no free entry). The wage function becomes steeper and wage inequality increases. In the picture we hold N constant. If we assumed free entry and the number of firms increased until all of them where making zero profits, then the $\widetilde{\pi}$ function and the wage schedule would overlap and the same comparative statics would result.

Figure 1.2: Comparative statics of a change in product market competition



So far we have stated that if the type of competition generates a profit function with the properties outlined above, an increase in competition will trigger wage dispersion (nothing has been said though on whether wages will increase or fall for the different types, this was only a relative statement (they may actually increase for the most highly skilled workers). The question now is under which forms of competition in the labour market do we obtain the result that the profit function is more sensitive to the ability of the worker hired the more competitive is the sector. Since it can be argued that product market competition can take different forms in different markets we aim to check whether the classical forms of competition traditionally modelled satisfy the above property and what it implies for relative wages.

The general problem encountered when analysing the different models is that in my setting even though firms are homogeneous ex ante, once they have hired a worker they are heterogeneous (because they hire different types, they have different costs in production). The models no longer have symmetric firms. It is therefore convenient to work with relative profits and costs. To prove that the single crossing property is satisfied under most forms of product market competition it will prove more convenient to work with the following normalised version of equation (1.8):

$$\frac{d^2(\widetilde{\pi}(d_i,\theta)/\widetilde{\pi}(d_j,\theta))}{d\theta d(d_i/d_j)} < 0 \tag{1.9}$$

Where d_j can be any arbitrary chosen worker. In particular the worker with highest skill d_1. This is just a normalisation that exploits the fact that d_1 will always be the first to be employed and then, for given θ, $\widetilde{\pi}(d_1;\theta)/d_1$ can be treated as a constant. This normalisation will be useful when a functional form is attached to the revenue function. In what follows I investigate two standard models of product market competition (Dixit-Stiglitz and Cournot) and show they satisfy the properties required for an increase in product market competition leading to increased wage dispersion.

Competition à la Dixit-Stiglitz (1977)

In the previous section I showed that firms will decide how much to offer different workers according to their expectations of what will occur in the product market stage but no functional form was attached to the final revenue function. Let's assume now an explicit form of product market competition, namely horizontal product differentiation in the market, of the Dixit-Stiglitz type. Denote by Y_i the quantity that firms produce in the final stage and that they will sell at a price p_i. To produce they use the worker employed in the first stage that can produce at costs d_i (that indicates the level of (dis)ability). Monopolistic competition[10] (Dixit Stiglitz 1977) implies that

$$Y_i = (\frac{p_i}{p})^{-\theta} * \overline{Y} \tag{1.10}$$

where $\overline{Y}$ and p are index functions and $\theta > 1$ ($-\theta$ is the elasticity of substitution between products)

Firms maximise gross profits (gross of wages) that are a function of d_i

$\underset{p_i}{Max}\ \widetilde{\pi}(d_i) = (p_i - d_i) * Y_i$

$\widetilde{\pi}(d_i) = \overline{Y}p^{\theta}(p_i^{1-\theta} - d_i p_i^{-\theta})$

First order condition yields

$$p_i = \frac{\theta d_i}{\theta - 1} \tag{1.11}$$

Hence

$$\widetilde{\pi}(d_i) = \overline{Y}(p/\theta)^{\theta}(d_i/(\theta-1))^{1-\theta} \tag{1.12}$$

Which is decreasing in d_i. The next step is to show how revenues change with θ. The problem is that as θ changes the index functions $\overline{Y}$ and p also change and it is not simple to solve analytically for the comparative statics. Thus I focus on how the ratio of profits between firms hiring high and low skilled workers changes as competition changes. Take two workers i and j such that $d_i > d_j$ (take j to be the most able worker, for the purposes of the normalisation).

$$\frac{\widetilde{\pi}(d_i)}{\widetilde{\pi}(d_j)} = \frac{\overline{Y}(p/\theta)^{\theta}(d_i/(\theta-1))^{1-\theta}}{\overline{Y}(p/\theta)^{\theta}(d_j/(\theta-1))^{1-\theta}} = (\frac{d_i}{d_j})^{1-\theta} \tag{1.13}$$

Now we can easily prove the condition on the slope of the wage function for changes in θ :

[10] Where consumers have CES demand functions and there are N differentiated goods in the economy.

$$\frac{d(\widetilde{\pi}(d_i,\theta)/\widetilde{\pi}(d_j,\theta))}{d\theta d(d_i/d_j)} = (1-\theta)(\frac{d_i}{d_j})^{-\theta} < 0 \tag{1.14}$$

Which proves condition (1.9).

The result above applies for any given number of firms (one may not want to assume free entry).

With free entry we would have that

$$\frac{\widetilde{\pi}(d_i)}{\widetilde{\pi}(d_j)} = \frac{w(d_i)}{w(d_j)}$$

Hence one can see that relative log wages are

$$\ln w(d_i) - \ln w(d_j) = (1-\theta)[\ln d_i - \ln d_j] \tag{1.15}$$

which is clearly increasing in θ since $d_j < d_i$, and this for any i and j.

Competition à la Cournot

Now imagine that firms compete à la Cournot in a market with N firms. Firms take product price as given and price is a function of total production in the sector $P(\sum_{j=1}^{N} Y_j)$. Firms are profit maximisers, but since in the two stage framework wages are paid in the first stage and the two stages are separable, we can solve the maximisation:

$$\underset{Y_i}{Max}\widetilde{\pi}(d_i) = (P(\sum_{j=1}^{N} Y_j). - d_i) * Y_i \tag{1.16}$$

The first order condition yields:

$$Y_i = (1 - \frac{d_i}{P})\eta \sum_{j=1}^{N} Y_j \tag{1.17}$$

Where η is the elasticity of demand. Using the above one can rewrite revenues as:

$$\widetilde{\pi}(d_i) = (P(\sum_{j=1}^{N} Y_j). - d_i) * (1 - \frac{d_i}{P})\eta \sum_{j=1}^{N} Y_j \tag{1.18}$$

Take again two workers i and j such that $d_i > d_j$ (j is the first and most able worker employed).

$$\begin{aligned} \frac{\widetilde{\pi}(d_i)}{\widetilde{\pi}(d_j)} &= \frac{(P-d_i)^2}{(P-d_j)^2} \\ &= \frac{(P/d_j)^2 + (d_i/d_j)^2 - (2Pd_i/d_j{}^2)}{(P-d_j)^2/d_j^2} \end{aligned} \tag{1.19}$$

Note this is positive and increasing in the difference in ability between the two workers.

$$\begin{aligned} d(\frac{\widetilde{\pi}(d_i)}{\widetilde{\pi}(d_j)})/d(\frac{d_i}{d_j}) &= \frac{2(d_i/d_j) - (2P/d_j)}{(P/d_j)^2 + 1 - (2P/d_j)} \\ &= \frac{2d_j[d_i - P]}{(P-d_j)^2} \end{aligned} \tag{1.20}$$

Which is negative since $d_s < P$, for any worker s employed in the sector, which is the condition for firms making non-negative profits.

An increase in competition in this market is equivalent to an increase in N. One can prove that:

$$\frac{d(\widetilde{\pi}(d_j)/\widetilde{\pi}(d_i))}{dNd(d_j/d_i)} = \frac{d(\widetilde{\pi}(d_j)/\widetilde{\pi}(d_i))}{dPd(d_j/d_i)}\frac{dP}{dN} < 0 \tag{1.21}$$

The first term of the equation is positive and the second is negative (both proofs may be found in the appendix). So as N increases in the Cournot setting (price falls) the sensitivity of gross profits to ability will increase which proves condition (1.9).

Boone (2002) definition of competition

Boone (2002) is an interesting reference in relation to this analysis. In his paper he looks at different parametrisations (models) of product market competition and investigates what is common to all of them. It has been noted before (especially in relation to the empirical analysis of competition) that the competition measures traditionally used are non monotone in competition, and that their validity as measures of competition depends highly on the competitive framework assumed, in particular when firms are not symmetric. For example, it is different whether the number of competitors increases because entry costs fall (an increase in competition) or if it is because firms interact less aggressively (a fall in competition).

Boone finds that competition is higher if the mapping of relative marginal costs to relative profits is steeper. This is common to a number of parametrisations and becomes his "definition" of competition (it is a sufficient condition to say competition has increased).

This is very close to the analysis in this paper. When competition increases in my setting what is required for an increase in competition to deliver an increase in wage dispersion is precisely that relative gross profits from hiring two different workers (before wage bargaining) are higher the higher the degree of competition. Following Boone's analysis, this is exactly the characteristic of competition common to a number of competition models. If we add to this feature bargaining over the surplus in the way I have outlined we obtain the main prediction in this paper: that higher product market competition increases wage dispersion.

Rosen (1981): Superstars?

Rosen (1981) develops a theory of why small differences is skill can lead to large difference in wages as is seen with the development of the idea of superstars[11]. The argument is

[11] This is also closely related to the idea of winner-take-all markets.

that the production of some workers has the characteristics of a public good. This type of technology will imply that the Superstar gets a large part of the market and his earnings will increase relative to the person that is just below him in ability terms. Wage dispersion will be larger.

For this phenomenon to arise what is needed is that the market to which the individual has access is larger through a fall in transportation/communication costs.

Rosen's theory to explain increases in wage dispersion can be seen as a particular case of the more general case argued for in this paper. Rosen relies on a particular production technology (with public good features) and needs the increase in the market size (through fall in transport costs etc.). In my framework wage inequality increases without the need of the public good technology. What the public good technology (in my view, convincingly) delivers is the extreme polarisation of earnings. The fall in transportation costs can be assimilated to a fall in set up costs, and hence an increase in competition.

Rosen's paper is very compelling in his account of the extreme polarisation of earnings in the "superstar" phenomenon. I argue though that it is a particular case of the setting described here that sheds light more precisely on a particular aspect of labour markets.

I would like to stress that the link from product market competition to relative wages has been outlined in very general terms and relies only on the fact that as product market competition increases the sensitivity of profits to the ability of the worker hired increases. In this situation, that seems to be a very general and robust economic result independent of particular parametrisations of the production functions or of the type of product market competition, we obtain that changes in product market competition increase wage dispersion.

I now turn to the empirical analysis of this economic relationship to assess its significance and quantitative importance. The next section describes the econometric specification and identification strategy adopted.

1.3 Specification and identification strategy

The identification of the main effect in this paper exploits the effect of changes in product market competition on the relative returns to skill over time based on individual wage equations with UK data. Most of the analysis concerns returns to observed skilled level as proxied by occupational distribution and tenure. However I will also say something on the relationship between unobserved ability, competition and wage dispersion. The model in the previous section predicts that the difference in wages between high and low skill workers will be higher in more competitive sectors. Recall that this is independent of whether mean wages are higher or lower in more competitive sectors as it is just a statement about relative wages. So the parameter of interest is the difference in the returns to skill between the different skill groups as product market competition changes.

As has been documented widely elsewhere inequality has been increasing markedly in the UK over the past 20 to 30 years (Gosling et al. (2000)). Figure 1.3 shows the evolution of the ratio of mean log wages for the highest skill group to the lowest skill group in my data (males in the manufacturing sector), with my skill group definitions. Inequality between skill groups has increased by 0.16 log points.

Figure 1.4 draws the evolution of top5 concentration ratios measures by output and employment for the period 1982-1999 in the manufacturing sector in the UK. Note that employment concentration has fallen more than output concentration. I will use both measures in the analysis. Figures 1.8 and 1.9 show the evolution of the top 5 employment concentration ratio for two different manufacturing sectors: prepared animal feeds and printing. Note that for some sectors the measures of concentration have increased while for other sectors they fell. This is good for the identification since it provides useful variation in different directions to avoid spurious relationships.

Figures 1.5 to 1.7 bring theses two trends together and show the cross sectional and time series relationship between competition and inequality. Figure 1.5 plots the dispersion of log wages by sector between 82 and 99 against average concentration by sector for those years. We find that more concentrated sectors have lower dispersion than more competitive sectors. Figure 1.7 plots dispersion by year against average concentration by year, which again yields a negative relationship, i.e. over time concentration fell and inequality increased. So there is some preliminary evidence at the aggregate level of the existence of a cross sectional and time series relationship between wage dispersion and product market competition. The purpose of the remainder of the paper is to establish whether there exists a causal link between the two.

1.3.1 Basic model

Let's suppose that the equation determining the log wage of individual i working in sector j with skill level k at time t can be written as:

$$\ln(w_{ijkt}) = \alpha + \theta_k C_{jt} + \beta C_{jt} + X'_{ijkt}\gamma + d_t + d_k + d_j + v_{ijkt} \tag{1.22}$$

$$v_{ijkt} = d_{kt} + d_{kj} + \eta_i + \varepsilon_{ijkt} \tag{1.23}$$

Where C_{jt} is competition in sector j at time t, X_{ijkt} is a vector if individual characteristics, η_i is an unobserved permanent individual component, time, sector and skill dummies are given by d_t, d_j and d_k. d_{kt} represents fully interacted skill and time dummies and d_{kj} are fully interacted skill and sector dummies. ε_{ijkt} is a white noise.

The estimate of θ_k will reflect how returns to different skill levels (k) vary with product market concentration (one skill level*competition interaction is always dropped to avoid collinearity with C_{jt}). We are interested in the differential returns to skill in different competitive environments. In fact it is easier to see this as an interest in $(\theta_{k1} - \theta_{k2})$ where $k1$ and $k2$ are two different skill levels.

The basic model estimated in equation (1.22) controls for heterogeneity at sector level and for between sector differences in wages. It identifies θ_k out of the within sector variation in competition over time and will be unbiased provided sector specific trends in returns to skills are uncorrelated with competition.

However, the estimate of our parameter of interest will be biased if $Cov(C_{jt}, v_{ijkt}) \neq 0$. Equation 1.23 identifies the potential sources of bias.

The first major source of bias is individual unobserved heterogeneity. For this purpose I exploit the longitudinal character of my data and estimate an individual fixed effects model. This takes care of omitted variable bias that would result from $Cov(C_{jt}, \eta_i) \neq 0$, i.e. from the individual permanent unobserved component being correlated with competition levels. This could occur if more skilled workers selected themselves into sectors with more (less) competition implying that $Cov(C_{jt}, \eta_i) > 0 (< 0)$. Note that my data, the NES, is ideal for this exercise because it is a longer panel than most usually available providing considerable "within" variation to identify the main effects out of individual behaviour.

The second source of bias would arise from a correlation between C_{jt} and d_{kj}, that is between sector specific returns to skill and competition. I include skill*sector specific dummies in the regression to capture this. If we omitted this set of interactions, the results would be biased only if the wage differential between two skill groups varies by sector and this variation is correlated with competition. This could arise through a trade union effect if trade unions are stronger in sectors with less competition implying that wages are less compressed in those sectors. Note that a priori we would expect that unions are stronger in sectors with more competition (where employer's bargaining power is lower) and hence the bias would in any case underestimate the effect of competition.

I also introduce fully interacted skill*year dummies that account for the term d_{kt}, and capture any trend or time variation in returns to the different skills that might be correlated with competition. The most immediate example of this would be skill biased technical change. There is a large literature on this issue and skill biased technical change is thought to be one of the main culprits of the increase in wage inequality in the UK and the US[12]. If returns to skill are increasing over time (due to skill biased technical change or any other reason) and product market competition is increasing, we may capture a spurious relationship in our coefficient of interest. This is taken account of in the skill*year dummies interaction.

It is important to note that accounting for the terms in the error term equation in a fully unrestricted way leads to a fully saturated model of wages. The drawback is a loss in efficiency from the large number of dummy variables included in the regression and that the "within" variation will be lower.

Furthermore, if one wants to relate this research to previous existing literature on the determinants of wage inequality it is possible that some of the existing papers that measure returns to skills through skill biased technical change, de-unionisation, trade liberalisation or reorganisation are actually capturing to some extent the effect of changes in product market competition.

Although the variation exploited to assess the effect of product market competition on wage dispersion is at the level of sector and time, I exploit the individual panel for two main reasons. One is that in this way I can control for compositional changes in the sectors over time. If the tenure, skill or age structure of a particular sector varies over time this will be accounted for by using individual records. Second, some individuals will be changing jobs and sectors and this constitutes highly informative variation since the fact that we have movers allows us to compare the different returns to skills of same individual in sectors with different levels of competition. The standard errors will be adjusted to account for the fact that the correlation between the measures of competition of two different individuals in the same sector is non-zero (Moulton (1986)).

However, even in the fully saturated specification there are a number of objections to the results that one could come up with. The first and simplest is whether one believes the measure of product market competition used. There are numerous discussions in the

[12] Although see Card and DiNardo (2002).

Industrial Organisation literature on the nature of product market competition, how it should be measured and what different commonly used measures capture. In the main analysis I use the top5 concentration ratio measured by output and employment. This is a standard and commonly used measure of competition, however a number of criticisms can be raised against this measure. Since it may only be an imperfect measure of the true level of competition the next step in the analysis is to find some uncontroversial exogenous measures of changes in competition. These will be the natural experiments developed in what follows that will then also serve as instrumental variables for the concentration measures. Both concentration and the natural experiments can be thought of as imperfect measures of some true underlying degree of product market competition. Since the experiments reflect exogenous changes in competition they can be used as instruments for concentration to obtain the true effect of competition on wage dispersion.

The second objection is that the concentration measure used, in spite of having a fully saturated model may still be correlated with some variable W_{jt} that also determines the level of returns to skills. The natural candidate would be trade union presence and since this variable is omitted the estimates may be biased (note though that the saturated model will capture between industry differences in unionisation). In these circumstances, a natural way out is again provided by the use of natural experiments since these are exogenous changes in product market competition that do not affect directly union presence.

Finally, the use of natural experiments to deal with the two previous objections will also prove useful insofar as it allows us to instrument directly the measure of concentration. Given concentration measures are measures of competition with error and that differencing the data (through the fixed effects estimation) exacerbates the attenuation effect in the presence of measurement error, it is useful to have an instrument to deal with this.

1.3.2 A first natural experiment: the European Single Market Programme (SMP)

The European Single Market Programme was designed to allow for the free movement of goods, services, capital and labour in the European Union. The Commission devised in 1985 in a White Paper a number of measures (300) aimed at achieving this. The actual implementation of the measures was staged between 1988 and 1992.

The White paper designed measures to eliminate barriers to the development of a unique internal market arising from: physical controls at the frontiers, technical rules, regulations and standards, public procurement policies, differences in fiscal structures and restraints on the movement of labour and capital (Burridge and Mayes (1992)). The channels through which the SMP was expected to operate were the following: reducing transaction costs, lowering barriers which enabled firms to segment markets, removing the means through which national governments can discriminate in favour of its firms, reducing costs of capital and labour (increasing mobility), assisting the process of structural change by investing in infrastructure, technology and skills (Burridge and Mayes (1992)).

To exploit the exogenous variation in competition generated by the introduction of the SMP I use the fact that different industries had different levels of non-tariff barriers in place before the SMP implementation. I use the same classification as Griffith (2001). This is derived from Mayes and Hart (1994). They divide industries depending on wether they had low, medium or high non-tariff barriers prior to the SMP. It was expected that the introduction of the SMP would affect more those with medium of high barriers that would see these considerably reduced. The classification is at 3 digit SIC and as Griffith (2001) I will consider those with medium or high barriers previous to the development of the single market as the sectors for which competition increased more sharply. Given the measures were designed to be implemented between 1988 and 1992 I will consider two time periods -before and after 1992- and two groups of sectors -those most and least affected by the SMP.

Identification comes from the differential effect that the SMP had on affected and non affected industries depending on their level of non-tariff barriers. Since our interest is in the different returns to skill for different sectors $\theta_k * C_{jt}$, it does not require that the affected and non affected sectors have common time trends in wages, nor that they have common returns to skill ex ante. It only requires that the skill trends are constant within sectors (sector trends -common to all skills within a sector- can differ), in other words that any trend in the difference $(\theta_{k1} - \theta_{k2})$ is constant within sectors (it may differ across sectors).

Below, I test the validity of the SMP as an indicator of product market competition by looking at whether it affected differently what we call high and low sensitivity sectors before and after 1992.

I present the reduced forms for the experiment and then instrument the concentration variable in a two stage least squares regression.

The specification for the reduced form is:

$$\ln w_{ijkt} = \alpha + \gamma X_{ijkt} + \delta_k(SMPaffected_{jt}) + \tau SMPaffected_{jt} + d_t + d_j + \eta_i + \varepsilon_{ijkt}$$

where X_{ijkt} is a set of individual characteristics including age, age squared, tenure, tenure squared, the skill levels, $SMPaffected_{jt}$ is a dummy that takes value one for affected sectors after 1992, and the rest are defined as in section 4.

The IV specification is done in two stages and using the predicted instead of the actual value of competition in equation 1.22 (standard errors are appropriately corrected). Results for both stages are shown.

1.3.3 A second natural experiment: trade openness and exchange rates.

The second source of exogenous variation in competition I exploit is based on the UK being an open economy, small enough not to be able to influence international markets and the fact that fluctuations in the exchange rate are largely exogenous to the wage setting conditions within the country. Hence, sharp and sudden changes in the pound Sterling can be considered as a quasi-natural experiment.

In 1996 there was a sharp appreciation of the pound sterling. Since the UK is a small open country this increase in the exchange rate can be used as an exogenous shock that will affect differently different sectors depending on their trade openness. I use import penetration as my measure of openness (imports divided by the sum of imports and total sector product). Since openness itself may be endogenous to changes in the exchange rate, the measure of openness is defined as the average openness in the years before 1996 (1993 to 1995) which is kept constant for the whole sample. The identification assumes that the appreciation was strictly exogenous and could not be forecasted by firms in the UK.

The idea is that open sectors before 1996 will face increased competition after the appreciation of the pound and hence the wage differential of high to low skill workers should increase more in those sectors after 1996 than in the least open and non-traded sectors. Note that a priori there are no reasons to think that a sector that exports more is more or less competitive than others since this may depend on the production structure and other factors. However, a change in the exchange rate will affect more deeply those sectors with higher export openness within traded sectors but also traded sectors more than non traded sectors.

The identification assumption here is similar to the one in the SMP case, namely that there are no sector specific trends in returns to skill. Different sectors may have different trends in wages and different returns to skills, what is crucial is that there are no sector specific trends in returns to skill. A test of the experiment is also provided and both the reduced form and two stage least squares regressions are shown.

The reduced form is specified as:

$$\ln w_{ijkt} = \gamma X_{ijkt} + \delta_k(post96_t * impenetr_j) + \tau(post96_t * impenetr_j) + d_t + d_j + d_{kt} + \eta_i + \varepsilon_{ijkt}$$

where X_{ijkt} is a set of individual characteristics including age, age squared, tenure, tenure squared, the skill levels, $post96_t$ is a dummy variable that takes value one in the second period (post 96), $impenetr_j$ is import penetration (note it is computed as the mean import penetration measure over the years 1993 to 1995 (a period in which the exchange rate was stable) since openness may change endogenously with the exchange rate increase and therefore it only varies by j), and the rest are defined as in section 4.

And the IV regressions are also done in two stages as for the SMP experiment.

1.3.4 Returns to unobserved ability

In the basic specification I look estimates of the returns to observed skill interacted with competition. However it is also interesting to find out if there are also returns to unobserved ability that are higher in more competitive sectors. It is likely that the measure of observed skill used does not capture all the dimensions of individual ability, and this will be captured by the error term. An indirect way to assess this is to see wether the variance of the residual term of the wage equations is higher in more competitive sectors, i. e. if there is some type of heteroskedasticity along the competition dimension.

By regressing the variance of the residuals on the measure of competition one can assess if that variance is higher in more competitive sectors after removing the effect of all observables and the individual fixed effects. This will be evidence in favour of the main mechanism outlined here.

It also provides an explanation of within skill and sector changes in wage inequality. The existing literature points out that a large fraction of the increase in overall inequality cannot be explained by sector and skill differences. Product market competition may be a potential explanatory variable for that aspect of wage inequality.

One can also argue that the best measure of the ability of a worker is the wage he receives (Card (1996)). We can then potentially rank workers according to their predicted wages. Taking different percentiles as the skill groups, quantile regressions at different quantiles yield a measure of the degree of heteroskedasticity as a function of the measure of competition. I run the following quantile regressions for a number of quantiles q :

$$\ln(w_{ijkt}) = \delta^q C_{jt} + \gamma^q X_{ijkt} + d_k^q + d_j^q + d_t^q + v_{ijkt}$$

Where the variables are defined as before. If the dispersion of wages is increasing in competition conditional on all the covariates included we should obtain that $\widehat{\delta^q} > \widehat{\delta^{q'}}$ for $q > q'$[13]. This would indicate that high skilled workers (as measured by wages) are relatively more highly rewarded in competitive sectors.

1.4 Estimates of the impact of competition on the wage structure

1.4.1 The Data

To assess the link between product market competition and wage setting I use the New Earnings Survey (NES) and a number of different sources for the competition measures and the natural experiments.

The NES is a very large sample survey of 1% of all individuals employed in the U.K. All those individuals whose national insurance number ends in two given digits are included in the sample. It has a number of characteristics that make it ideal for this

[13]In the case C_{jt} measures concetration as in the data this would be $|\widehat{\delta^q}| > |\widehat{\delta^{q'}}|$ for $q > q'$.

study. Since NI numbers are issued randomly to individuals and are retained for life we have very long panel with complete employment histories. It contains very detailed data on earnings and hours worked. These data are provided directly by employers who are bound by law to give that information. The records correspond to a specific week in April for each year and are available from 1975 to 1999. The data contain information on weekly and hourly wages, on overtime hours worked and also on age, occupation, region, industry and wether or not the individual was in the same job on the previous year.

I restrict the sample to males working full time and whose pay has not been affected by absence in the reference week.

The advantage of using the NES over other datasets for this purpose is that it is a very long panel that follows individuals throughout their working lives so it provides enough individual variation for longitudinal analysis. It contains very accurate hourly measures of wages such that one can isolate the non-cyclical component of wages. Furthermore it is a very large sample that contains observations from all economic sectors which allows us to control for a large number of variables and effects.

To estimate the role played by competition in the wage equations I originally obtained a number of measures of competition from the UK Office of National Statistics (ONS) based on the ARD dataset[14]. This dataset has the advantage that it goes back to 1982 but only for the manufacturing sector (sic92 from 151 to 372). The results presented here are done for the top 5 employment and output concentration ratios.

To assess the effect of the single market programme (as an exogenous variation in competition) I define two groups of industries in the NES following the classification in Griffith (2001). Industries are defined by their SIC80 3-digit code.

Finally, trade data are used in the last part of the empirical section. These were obtained from the "Imports and exports data: MQ10 dataset", elaborated by the ONS[15]

[14]The ARD is the establishment level data that is collected under the Annual Census of Production in the UK.

[15]Available online on the ONS website.

that provides imports and exports by three digit SIC92 code at current prices (in million pounds) and seasonally adjusted derived from the balance of payments. The data are available yearly from 1990. To construct import penetration (imports divided by total sector product), I use total production form the ARD/ONS dataset previously mentioned.

The analysis is done on three slightly different subsections of the data because of limitations in the process of merging the datasets. I deliberately chose to keep the three different subgroups instead of restricting the analysis to one homogeneous subgroup by deliberately dropping sectors. The sample size for the basic specification contains 449551 observations representing 83002 individuals. It contains male workers in manufacturing industries (SIC 151 to SIC 372) for the years 1982 to 1999. The SMP analysis is limited by the definition of the affected sectors and the fact that they are defined with the SIC80 classification. I have 415306 observations. Finally in the exchange rate experiment, the analysis is done on the manufacturing sector for the years 1992 to 1999. The three samples do no differ substantially in terms of descriptive statistics. The descriptive statistics for the basic specification can be found in table 1.1.

1.4.2 Empirical results

Basic specification

This section aims to provide a picture of how competition in the product market relates to the wage structure, and how the returns to skill change with changes in competition. The central hypothesis to be tested is whether as product market competition goes up the wage gap between high and low skilled workers increases[16]. This was the main prediction of the model in section 2. However when we go from the theory to the empirical testing a number of comments are in order and a series of other mechanisms must be accounted for.

[16]Note that this does not imply anything on wether wages for either skill level will increase or decrease.

First, one must account for the possible presence of interindustry wage differentials. This should mean that sectors with more competition will pay lower wages on average. This is a different problem from whether the returns to skills are higher or lower in more competitive sectors. But the two effects interact. Even if the returns to skill are higher in competitive sectors, it may well be that even for that high skilled worker wages are lower than in non-competitive sectors. This is important when we think about possible selection issues since it is not clear that even though able workers will reap higher rewards in competitive sectors, since their wages may be lower there, it does not necessarily follow that good workers will end up in competitive sectors. In any case, controlling for individual fixed effects should account for this.

Second, note that if skills are not fully transferable between sectors[17], it will be the sectoral variation in competition that matters for individual wages. In a way workers consider their sector as the economy and only large swings in product market competition will make it worthwhile to change sectors. That is why sectoral variation in competition is exploited here.

My measure of wages is real weekly pay of workers whose pay was not affected by absence excluding over-time pay divided by weekly hours excluding over-time hours. Note that the measure of wages obtained from the NES is very accurate and this measure is not sensitive to variations in pay due to the business cycle. This is one of the reasons why I use this dataset the other main reason being that it is a very long panel (with full employment histories since 1982) which provides a lot of information from the within individual variation.

The skill groups are derived from the occupational data and I obtain three skill groups along the lines suggested by Elias (1995) and shown in table 0. I will also use job tenure as a measure of skill later on.

Table 1.3 presents the results for the basic specification. The dependent variable is log

[17] If there is a cost of changing sector or if the worker is less productive in another sector than in hte one of origin.

real hourly wages and results for two different concentration measured by employment and output are presented. The coefficients of interest are those on the interaction of the medium and high skill variables with sectoral concentration. The results show that when concentration falls (competition increases) highly skilled workers see their wages go up more than low skill workers, ceteris paribus. So there will be more wage compression in sectors with low competition. For the top 5 concentration ratio on output (CR5 output in what follows) change from the 75th to the 25th percentile in CR5 raises the difference between high and low skill wages by 2%. When measured by CR5 employment, this implies a 3.9% difference in relative wages. Note that the overall increase in wage dispersion between high and low skilled workers in the sample is 0.16 log points.

The identification of the impact of competition on wage dispersion is done here through the within sectoral changes in competition. Note that it seems that as soon as one controls for sector fixed effects the level of concentration is not very powerful in explaining the level of wages (the coefficient on concentration is not significant) but it does explain relative wages. The identification does not require that all sectors share the same trend in wages, since the effect is being estimated out of the within sector difference between two skill levels. However, if there is self selection of workers into sectors because of their level of competition or if competition is correlated with an omitted variable the estimates will be biased. This is addressed in the following tables.

The rest of the covariates behave as expected although I will comment on their magnitudes in the individual fixed effects specification that one expects to provide more accurate and reliable estimations.

Tables 1.4 for CR5 output and 1.5 for CR5 employment, are all individual fixed effects specifications and progressively include the year, sector dummies and the time*skill (standard errors are adjusted for clustering on the concentration measure). Hausman tests of random versus fixed effects rejected the null of absence of correlation between the error term and the regressors.

The coefficients of interest on the interaction of the skill variables with sectoral concentration show again that when competition increases the gap between high and low skill wages is higher, ceteris paribus. As for the magnitude of the effect, estimated coefficients are (in absolute value) lower than in the pooled observations specification. This may be because of a negative (positive) correlation between the individual fixed effects and the level of concentration (competition). The intuition would be that good workers self-select into highly competitive sectors because they know they will obtain higher relative wages there. The alternative explanation is that in the presence of measurement error the fixed effects specification exarcebates the attenuation effect and the bias towards zero may be very large.

The tenure and age coefficients (and their squares) have the expected inverse U-shape. Wage as a function of tenure reaches a maximum at 22 years and as a function of age after 62 years (it basically continually increases and levels off before retirement). Notice that in the first column of tables 1.4 and 1.5, without sector dummies, we find that more concentrated sectors pay higher wages as would be predicted by the inter-industry wage differentials story. However, as soon as one includes sector dummies that effect becomes not significant for the levels of CR5 output, but negative and significant for CR5 employment.

Table 1.6 presents the fully saturated specification, the results go through although now the coefficient for CR5*high skill is less negative. However, this is not statistically significantly different form the one for CR5*medium skill. So we find again wage inequality is increasing within sector with product market competition.

Now recall that my argument is one of skills being more highly rewarded in competitive sectors. An alternative measure of the skill of a worker is given by tenure. Workers with more tenure have accumulated more experience and have higher skills at the job. Table 1.7 replaces the quadratic in tenure with four tenure groups and then interacts these four groups with CR5. The results show that as competition increases (CR5 falls) tenure is more highly rewarded which again confirms the main hypothesis (the effect levels off at more than 10 years of tenure).

If the skill measure is not capturing all of the real skill observed to the employer and known to the worker and on which wages are actually set, then the error term will be capturing that differential reward to unobserved skill depending on sectoral competitiveness. An indirect look at this is to study the variance of the error term as a function of the competition variable. The coefficient of a regression of the variance of the error term on competition is reported in all tables as "Auxiliary regression". Again, the variance of the residual is higher in highly competitive sectors (where CR5 is low). Following the story developed in section 3 this is possibly capturing the fact that there is some unobserved ability that interacts with competition and that increases the variance of wages in competitive sectors even after conditioning for the returns to observable skill.

A different way of assessing the greater dispersion in wages resulting from increased product market competition and differential returns to skills is using quantile regressions. This assumes that wages are the best indicator of skill and we can see the effect of competition on wage/skills at different percentiles conditional on the covariates. Tables 1.13 and 1.14 present the results for the 10th, 25th, 50th, 75th and 90th quantiles. The coefficient on the concentration variable has a decreasing pattern that seems to accelerate at the 75th and 90th quantiles. The fact that it is larger in absolute value for the for the high percentiles indicates again that the returns to being in a competitive sector are higher for high wage/skill workers, and that returns to skill are increasing in product market competition once we have conditioned on individual characteristics, sector and year (note I have also conditioned on skill, so this is within observable skill differential returns).

At this point and as was mentioned above, there are a number of reasons why we might want to have a strictly exogenous measure of an increase in competition to test the basic relationship. First, concentration may be criticised as an imperfect measure of product market competition. Second, even though we had a fully saturated model, it is still possible that concentration is correlated with another variable that also varies by sector and time and that determines wage dispersion. To account for this I explore two different exogenous sources of variation. The SMP experiment and the 1996 appreciation of the British pound and compute two stage least squares estimates.

The 1992 Single Market Programme as an instrument

The introduction of the SMP meant a larger increase in product market competition for sectors that had high non-tariff barriers prior to 1992. To test the impact and validity of the programme as an indicator of product market competition one can look at wether it affected differently what we call high and low sensitivity sectors before and after 1992. The period covered is 1982-1999. To assess the impact I regress concentration ratios by sector (3-digit SIC80) on a set of time and industry dummies and the interaction of the SMP group (a dummy variable that equals one if the sector is classified as having moderate or high barriers previous to SMP) and the post-92 period. This is shown on table 1.10 as the first stage of the IV estimation. Output top 5 concentration ratio fell by 1.5% more in the sensitive sectors post-SMP than in the sectors that were expected to be least affected. Employment top5 concentration ratios fell by 4.4% more in sensitive sectors. Griffith (2001) who also uses this experiment, is able to test directly (using the ARD database) the effect of the SMP programme on firm level rents, measured by the Lerner index. She finds that the Lerner index fell by 1% more in sensitive sectors. This combined evidence indicates that the classification is a good measure for changes in competitive pressure in the different groups of sectors.

This "natural experiment" can be used in two different ways. One is that as it represents in itself an exogenous increase in product market competition it can be used as an uncontroversial right hand side variable for competition. The results for this reduced form specification are presented in table 1.9.

Table 1.9 is a fixed effects regression of log wages on the same individual characteristics as before and an interaction of the SMP affected variable and the skill levels defined by educational group.

Results confirm that in sectors more affected by the SMP, i.e. where competition increased most, the relative wage of high to low skilled workers increased by more. The difference of high skill to low skill log wages after 1992 was about 10% higher in the more affected than in the less affected industries. So wage differentials where higher in more competitive sectors.

The experiment can then be used to instrument directly the CR5 of the previous section. Both are measures with error of some underlying degree of product market competition and hence we can use one to instrument the other. This is indirectly what we think when we test the instrument by assessing the impact it had on concentration ratios. However, even if the variable was not highly correlated with CR5 it could still be used in a reduced form as a measure of competition (provided one is ready to believe that deregulation implies an increase in competition). The t-statistics of the first stage may not be very high but we can still rely on the evidence provided by the experiment directly. It could well be possible for a deregulation to have an impact in the degree of competition of a sector without it having much of an effect on the concentration structure of the sector. So the fact that it is not a very good instrument for concentration (the correlation is significant but not very high) does not necessarily mean that it is a bad variable of competition. These can be seen as two somewhat different things.

Table 1.10 presents the two stage least squares of instrumenting concentration with the SMP variable. The first stage has low t-statistics in the CR5 output case but a high and reliable one for CR5 output (above 5), so one should focus on the IV estimates for the latter. Note that since the instrument is a dummy variable, there is limited cross sectional variation to exploit. However the IV estimates without individual fixed effects confirm the hypothesis developed throughout the paper, but 2SLS estimates are insignificant when I take individual fixed effects into account (possibly because there is not enough within variation in the instrument).

Exchange rate changes as an instrument

The second natural experiment used is the strong appreciation of the British pound in 1996. The Sterling appreciation implied an exogenous increase in competition that should affect more those sectors more open to foreign trade, that either export a larger fraction of their product (the relative price of their products went up) or that are in sectors where imports are already a large fraction of total sales. I exploit this exogenous increase and compare the behaviour of the different sectors in their wage setting behaviour before and after 1996 as a function of their openness. Figure 1.9 shows the evolution of the effective exchange rate of the British pound. Two different regimes of low and high exchange rate before and after 1996 are apparent. These will be the two periods exploited.

The first panel of table 1.12 will be the first stage of the IV regressions and constitutes a test of the identification strategy. It presents regressions of the concentration measures on the openness measure (import penetration) interacted with a post 96 dummy. It shows that the fall in the concentration ratio was increasing in the degree of openness. The impact of the appreciation (at mean openness and concentration) was to reduce output concentration by 7.2% and employment concentration by 3.8%.

The reduced form estimates in table 1.11 use the appreciation as an indicator of competition itself. This is a differences in differences specification (with openness a continuous variable).

The sample period included here is 1992 to 1999 and the two time periods considered are 1992 to 1995 and 1996 to 1999 as before and after the exchange rate change.

The results indicate that returns to skill increased more the more open the sector was after the appreciation. At average openness, the wage gap between high and low skill workers increased by 3.4%. I also find that after the appreciation, that reflected an increase in competition, the more exposed the sector was, the higher the fall in average wages. At average openness wages fell by 0.5%.

Again in this case IV estimates can be computed. These are presented in table 1.12. Again, t-statistics for the first stage are significant but just between 2 and 3. For both measures of concentration that are instrumented I obtain that wage dispersion increases with competition. The estimated IV coefficient is very similar for both instrumented variables and larger than in the basic specification that was probably subjected to measurement error.

Contribution to changes in wage inequality

The analysis above indicates that product market competition increases returns to skill and hence wage inequality. One would now want to have a sense of how big the effect is. In my sample, the ratio of wages of high to low skilled workers increased by 0.16 log points. At the same time employment (output) concentration fell 5.5 (2) percentage points. This implies an increase of inequality between 0.003 and 0.0078 (0.002) log points. That is changes in concentration can explain between 1.3% and 5% of the total increase in the gap between skills (2.5% in the IV specification).

But this is just the effect of changes in concentration from the basic specification. The effects of the natural experiments from the reduced forms indicate that the direct effect of the SMP on relative wages was to raise by 0.097 the gap between high and low skilled. Taking into account the fact that 41% of the labour force was affected by the programme, this implies a change in inequality of 0.039 log points. And the effect of the 1996 appreciation yields a difference of 0.034 log points at average import penetration. These all are non-negligible effects.

1.5 Conclusion

This paper identified product market competition as a source of wage dispersion. The mechanism that feeds back from changes in competition in goods and services markets to changes in the wage structure is the following. As competition increases, profits are more sensitive to cost reductions and since high skilled workers are better at producing at low costs firms will be willing to pay them higher wages relative to low skilled workers. This will generate increased wage differentials. I developed a stylised model of that mechanism that does not rely on particular functional forms to deliver that link. The mechanism identified is actually very general and relies on two basic assumptions: that (at least some) product markets are imperfectly competitive and that workers are heterogeneous.

I then tested the main hypothesis: that skills are more highly rewarded (in relative terms) in highly competitive industries. Using an individual panel of UK male workers in the manufacturing sector for the period 1982-1999 the hypothesis is confirmed after controlling for a number of effects in the basic fixed effects specifications. Then, in order to account for the fact that my measure of competition may be correlated with the error term, I use two different quasi-natural experiments that the British economy underwent. The first one is the introduction of the European Single Market programme in 1992 that developed the European internal market by reducing a number of barriers to trade. The second one is the strong appreciation of the British pound in 1996 that implied an increase in competition for traded sectors, the effect being higher in sectors with a high openness to trade. The results are again confirmed when these natural experiments are used to instrument the concentration variables.

This research only constitutes a first attempt to establish the relationship between product market competition and the wage structure. In the light of the evidence provided here there seems to be a robust relationship between the two and further investigation to clarify those links is required. This avenue can yield interesting insights to understand aspects of wage differentials like within sector and skill differences or differences between firms in a sector. It also calls for as study of the interaction between product market competition on the one hand and de-unionisation, technical change and organisational change as explanations of changes in the wage structure. These questions are left for future research.

1.6 Appendices

1.6.1 Cournot model

Part 1:

I prove that

$$\frac{d(\pi^*(d_j)/\pi^*(d_i))}{dPd(d_j/d_i)} > 0 \tag{1.24}$$

$$\frac{d(\pi^*(d_j)/\pi^*(d_i))}{dPd(d_j/d_i)} = 2d_i\frac{[-(P-d_i)^2+2(P-d_i)(P-d_j)]}{(P-d_i)^4}$$

Which is always positive since $2(P-d_j) > (P-d_i)$ (actually $(P-d_j) > (P-d_i)$)

Part 2 (price is decreasing in the number of competitors)

$$\begin{aligned}
PY_i &= (P-d_i)\eta Y \\
\sum_{i=1}^{N} PY_i &= PY = NP\eta Y - \eta Y\sum_{i=1}^{N} d_i \\
P &= \frac{\eta N\bar{d}_N}{(\eta N-1)}
\end{aligned}$$

Where $\bar{d}_N = \frac{1}{N}\sum_{i=1}^{N} d_i$.

Denote the price in an industry of size N as $P_N = \frac{\eta N\bar{d}_N}{(\eta N-1)}$

In order for the model to make sense, Y_N must be positive, so $P_N > d_N$ since $Y_N = \frac{\eta Y(P-d_N)}{P}$ for an industry of size N. Now $P_N > d_N$ implies that $\frac{\eta N\bar{d}_N}{(\eta N-1)} > d_N$, hence

$$\begin{aligned} \eta N\overline{d}_N - (\eta N - 1) &> 0 \\ N &< \frac{\overline{d}_N}{\eta(d_N - \overline{d}_N)} \end{aligned} \tag{1.25}$$

The right hand side depends on the pattern of d.

For prices to be decreasing in N, we need to show that $\frac{P_{N-1}}{P_N} > 1$

$$\begin{aligned} \frac{P_{N-1}}{P_N} &= \frac{\eta(N-1)\overline{d}_{N-1}}{\eta(N-1)-1} * \frac{\eta(N-1)}{\eta N\overline{d}_N} \\ &= \frac{\eta(N-1)(N\overline{d}_N - \overline{d}_N)}{(N-1)(\eta(N-1)-1)} * \frac{\eta(N-1)}{\eta N\overline{d}_N} \end{aligned} \tag{1.26}$$

Since $\overline{d}_{N-1} = \frac{1}{N-1}\sum_{i=1}^{N} d_i = \frac{1}{N-1}(\sum_{i=1}^{N} d_i - d_N) = \frac{1}{N-1}(N\overline{d}_N - d_N)$

Manipulation of 1.26 yields:

$$\eta N\overline{d}_N - d_N(\eta N - 1) > 0$$

which is true if and only if $P_N > d_N$ from 1.25 above. So all that is required is that output is positive for all N firms, in that case prices fall as firms enter in this case the heterogeneous costs. Note that I also assumed constant elasticity η.

1.6.2 Data Appendix

Skill classification

Table 0: Skill groups in the NES

Skill level	Major groups	SOC code (minor gr.)
High	Managers and administrators	10,11,12,15,19
	(excl. office manag. and manag./prop. in agric.&services)	
	Professional occupations	20-27,29
Medium	Office managers and manag./propietors in agric. and services	13,14,16,17
	Associate professional and technician occupations	30-39
	Craft and relations occupations	50-59
	Buyers, brokers, sales representatives	
Low	Clerical, secretarial occupations	40-46,49
	Personal and protective services occupations	60-67,69
	Sales occupations (except buyers, browkers, sales reps)	72,73,79
	Plant and machine operatives	80-89
	Other occupations in agriculture, forestry, fishing	90
	Other elementary occupations	91-95,99

Source: Based on Elias (1995)

1.7 Figures and tables

1.7.1 Figures

Figure 1.3: High to low skill wage differential in the manufacturing sector 1982-1999

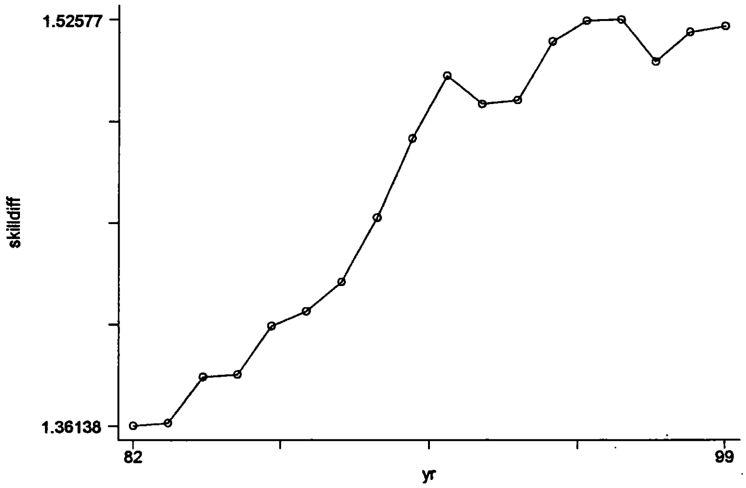
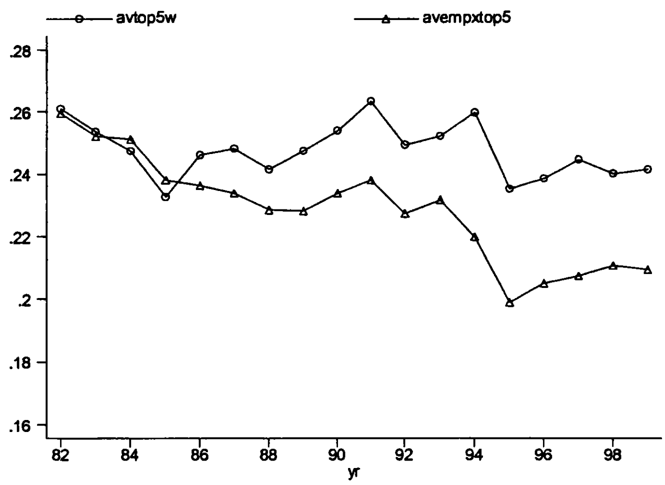


Figure 1.4: Employment and output concentration ratios for the UK manuf. sector



o output conc. Δ employment conc.

Figure 1.5: Between sector correlation CR5 output and wage dispersion

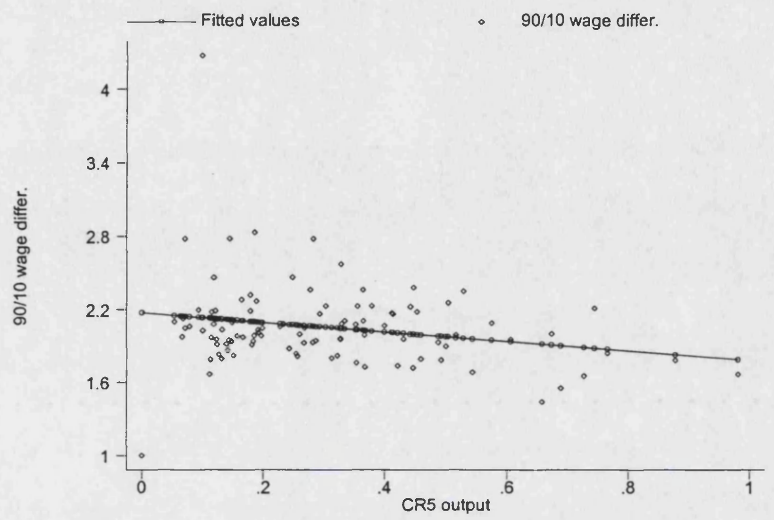


Figure 1.6: Between sector correlation CR5 employment and wage dispersion

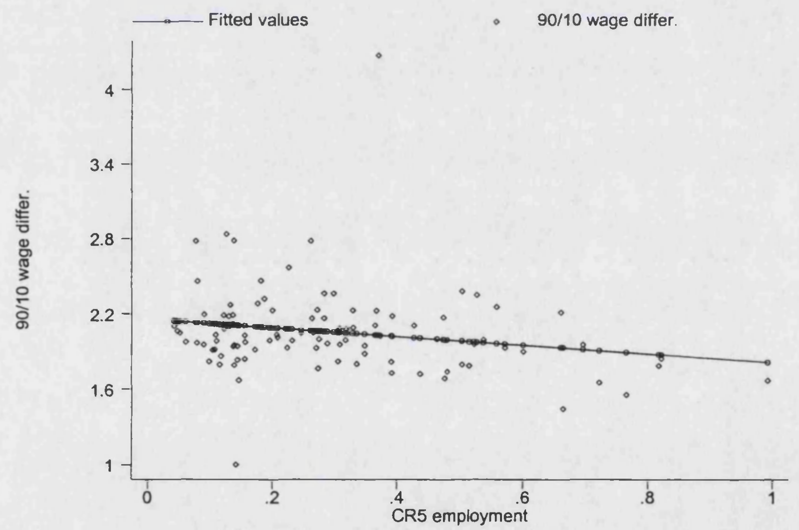


Figure 1.7: Time series correlation between CR5 employment and wage dispersion

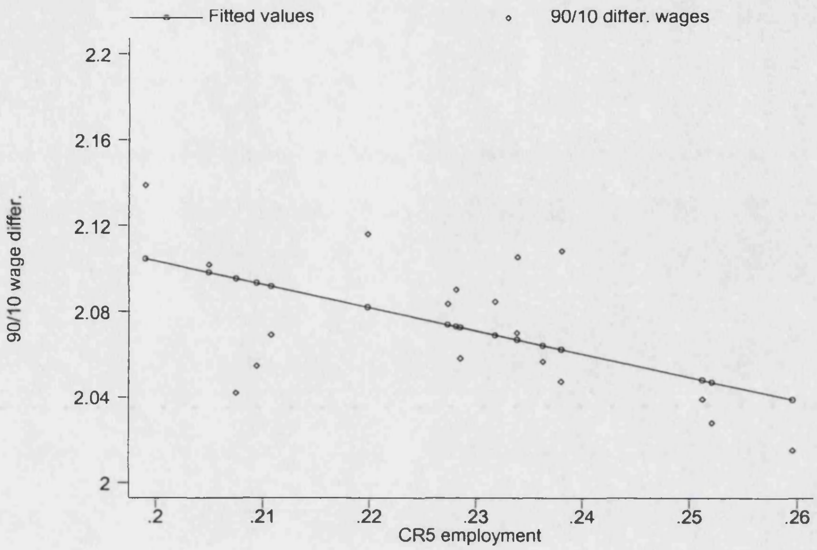


Figure 1.8:
Employment concentration ratio (top5) for prepared animal feeds (SIC 157)

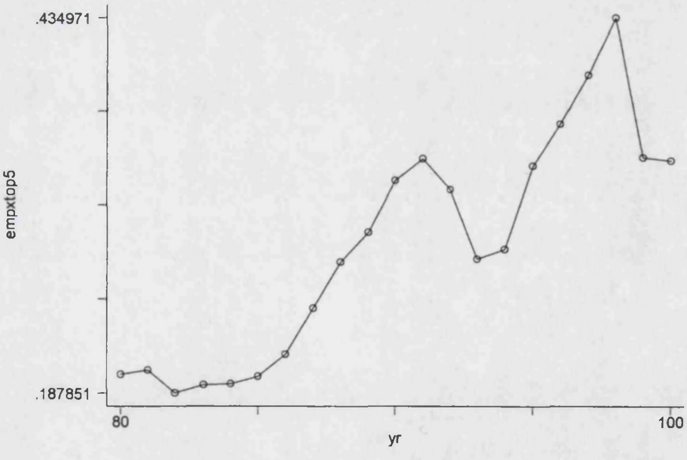


Figure 1.9: Employment concentration (top 5) for Printing (SIC 222)

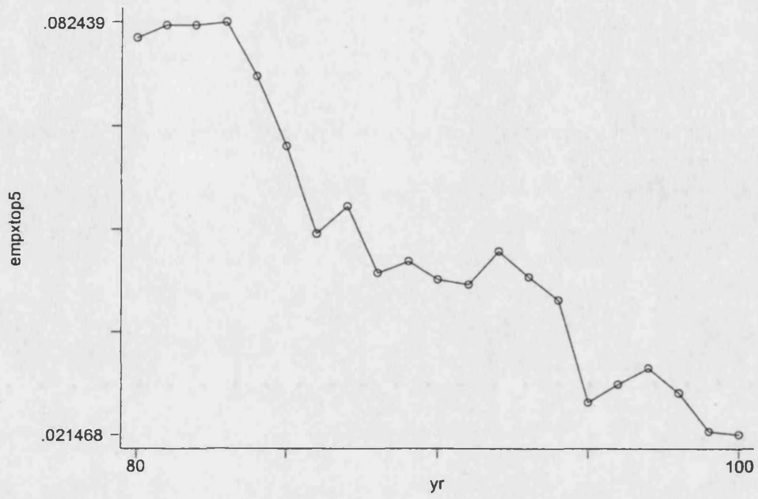
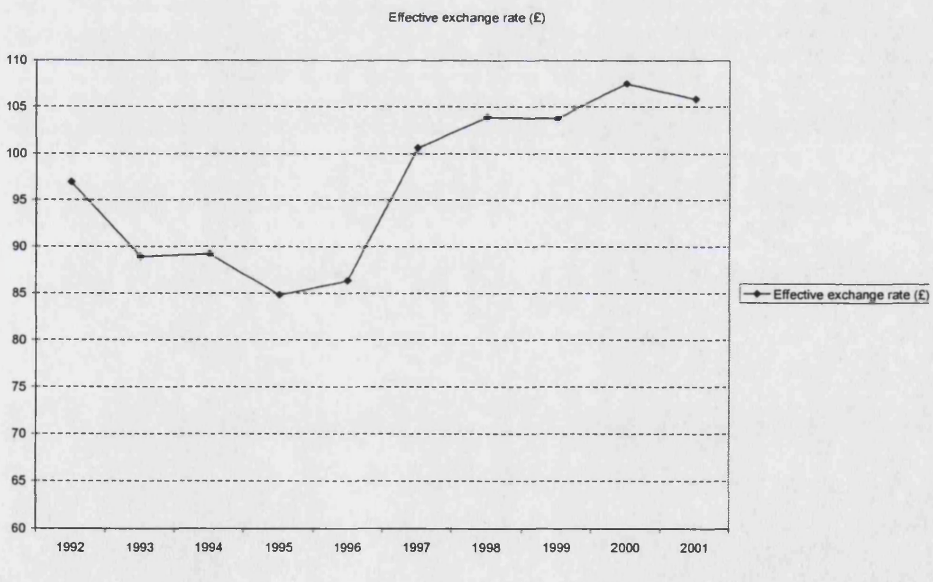


Figure 1.10: Effective exchange rate, Pound Sterling



1.7.2 Tables

Descriptive statistics

Table 1.1: Descriptive statistics

std. deviations in parenthesis

	All skill groups	Low skill	Med skill	High skill
log real hourly wages	1.480 (0.446)	1.310 (0.344)	1.466 (0.397)	1.921 (0.478)
real hourly wages	4.910 (3.04)	3.936 (1.437)	4.709 (2.428)	7.729 (4.887)
age	39.30 (12.41)	39.213 (12.86)	38.46 (12.44)	41.42 (10.92)
age squared	1698.6 (1004.5)	1703.1 (1039.9)	1633.(7 995.9)	1834.9 (919.2)
tenure	4.874 (4.165)	4.866 (4.172)	4.964 (995.9)	4.69 (3.98)
tenure squared	41.10 (69.7)	41.08 (69.92)	42.54 (71.57)	37.9 (64.8)
low skilled		1		0
medium skilled	0.398 (0.489)	0	1	0
high skilled	0.176 (0.380)	0	0	1
CR5 output	0.248 (0.194)	0.242 (0.188)	0.244 (0.196)	0.271 (0.200)
Herfindahl output	0.0006 (0.0051)	0.0005 (0.0046)	0.0006 (0.005)	0.0007 (0.006)
CR5 employment	0.230 (0.187)	0.229 (0.186)	0.225 (0.188)	0.244 (0.185)
Import penetration	0.238 (0.141)			
Observations	449551	191597	178822	79111

Table 1.2: Coeff. of correl. between different concentration measures and distributions

Correlations	CR5 output	Herfindahl output	CR5 employment
CR5 output	1		
Herfindahl output	0.312	1	
CR5 employment	0.928	0.331	1
Distributions	25th perc.	Median	75th perc.
CR5 output	0.136	0.240	0.408
CR5 employment	0.133	0.244	0.405

Results

Table 1.3: Basic specification, different concentration measures
absolute t-values in parenthesis

ln real wages	CR5 output (1)	CR5 employment (2)
Constant	-0.128 (10.83)	-0.124 (10.14)
Age	0.063 (127.9)	0.063 (172.7)
Age squared	-0.0007 (123.2)	-0.0007 (123.0)
Tenure	0.11 (24.5)	0.11 (24.4)
Tenure squared	-0.0005 (20.2)	-0.0005 (20.2)
Med. skill	0.159 (43.2)	0.167 (48.02)
High skill	0.549 (80.4)	0.562 (82.9)
Concentration	-0.014 (0.95)	-0.022 (0.79)
Med. skill*Conc.	-0.014 (0.095)	-0.053 (4.27)
High skill*Conc.	-0.08 (4.0)	-0.142 (7.17)
Indiv. fixed effects	x	x
Year dummies	yes	yes
Sector dummies	yes	yes
Year*skill	x	x
Sector(2 dig.)*skill	x	x
Auxiliary:	-0.024 (13.26)	-0.04 (21.1)
Observations	449551	449551
R^2	0.45	0.45

Table 1.4: Individual fixed effects and top5 output concentration ratio
absolute t-value in parenthesis, s.e. adjusted for clustering on concentration

ln real wages	Ind . fixed eff. (1)	Ind . fixed eff. (2)	Ind . fixed eff. (3)
Constant	-0.062 (1.12)	-0.087 (1.57)	-0.084 (1.5)
Age	0.062 (35.5)	0.062 (35.2)	0.064 (35.9)
Age squared	-0.001 (135.07)	-0.0006 (134.4)	-0.0007 (138.6)
Tenure	0.009 (37.26)	0.009 (36.7)	0.009 (35.47)
Tenure squared	-0.0004 (30.75)	-0.0004 (30.4)	-0.0004 (26.96)
Med. skill	0.040 (18.28)	0.041 (18.63)	0.015 (4.36)
High skill	0.132 (40.75)	0.132 (40.61)	-0.010 (2.06)
Concentration	0.085 (17.68)	-0.006 (0.91)	-0.002 (0.32)
Med. skill*Conc.	-0.015 (2.52)	-0.015 (2.57)	-0.018 (2.97)
High skill*Conc.	-0.025 (3.02)	-0.024 (2.84)	-0.038 (4.71)
Indiv. fixed effects	yes	yes	yes
Year dummies	yes	yes	yes
Sector dummies	x	yes	yes
Year*skill	x	x	yes
Sector*skill	x	x	x
Auxiliary	-0.007 (9.30)	-0.007 (9.45)	-0.007 (8.83)
Observations	449551	449551	449551
Individuals	83002	83002	83022

Table 1.5: Individual fixed effects and top5 empl. concentration ratio
absolute t-value in parenthesis, s.e. adjusted for clustering on concentration

ln real wages	Ind . fixed eff. (1)	Ind . fixed eff. (2)	Ind . fixed eff. (3)
Med. skill	0.045 (20.44)	0.046 (20.87)	0.019 (5.25)
High skill	0.149 (45.45)	0.149 (45.4)	-0.006 (1.24)
Concentration	0.102 (19.24)	-0.099 (10.62)	-0.077 (8.37)
Med. skill*Conc.	-0.038 (5.93)	-0.038 (6.09)	-0.030 (4.7)
High skill*Conc.	-0.100 (10.68)	-0.101 (10.81)	-0.051 (5.64)
Indiv. fixed effects	yes	yes	yes
Year dummies	yes	yes	yes
Sector dummies	x	yes	yes
Year*skill	x	x	yes
Sector*skill	x	x	x
Auxiliary	-0.009 (11.6)	-0.009 (11.8)	-0.009 (12.07)
Observations	449551	449551	449551
Individuals	83002	83002	83002

Table 1.6: Fully saturated specification
absolute t-values in parenthesis, s.e. adjusted for clustering on concentration

ln real wages	CR5 output (1)	CR5 employment (2)
Med. skill	0.048 (7.39)	0.045 (7.56)
High skill	0.037 (3.95)	0.039 (4.15)
Concentration	0.001 (0.16)	-0.082 (8.56)
Med. skill*Conc.	-0.033 (4.47)	-0.037 (4.55)
High skill*Conc.	-0.023 (2.32)	-0.022 (1.98)
Indiv. fixed effects	yes	yes
Year dummies	yes	yes
Sector dummies	yes	yes
Year*skill	yes	yes
Sector(2 dig,.)*skill	yes	yes
Auxiliary:	-0.008 (9.75)	-0.009 (12.12)
Observations	449551	449551
Individuals	83022	83022

Table 1.7: CR5 output and tenure
absolute t-values in parenthesis; std.errors adjusted for clustering on concentration

ln real wages	Fixed effects (1)	Fixed effects (2)
Constant	-0.084 (1.49)	-0.096 (1.71)
Tenure 3 to 5 yrs	0.033 (23.39)	0.033 (23.4)
Tenure 6 to 9 yrs	0.044 (30.10)	0.044 (29.9)
Tenure 10 plus	0.033 (16.34)	0.033 (16.3)
CR5.output	0.0156 (2.04)	0.019 (2.4)
Ten 3 to 5 yrs*CR5 .	-0.021 (4.71)	-0.021 (4.71)
Ten 6 to 9 yrs*CR5.	-0.036 (8.16)	-0.0359 (8.08)
Ten 10 plus*CR5	-0.020 (3.56)	-0.021 (3.64)
Med. skill	0.016 (4.29)	0.037 (3.91)
High skill	-0.010 (2.07)	0.047 (7.33)
Med. skill*CR5	-0.017 (2.92)	-0.033 (4.45)
High skill*CR5	-0.039 (4.75)	-0.024 (2.35)
Indiv. fixed effects	yes	yes
Year dummies	yes	yes
Sector dummies	yes	yes
Year*skill	yes	yes
Sector*skill	x	yes
Aux. Regression	-0.0076 (9.71)	-0.0077 9.85
Observations	449551	449551
Individuals	83022	83022

Table 1.8: CR5 employment and tenure
absolute t-values in parenthesis; std.errors adjusted for clustering on concentration

ln real wages	Indiv.fixed effects (1)	Indiv fixed effects (2)
Tenure 3 to 5 yrs	0.033 (23.97)	0.33 (23.95)
Tenure 6 to 9 yrs	0.044 (30.39)	0.044 (30.31)
Tenure 10 plus	0.032 (16.1)	0.032 (16.05)
CR5.employment	-0.060 (6.2)	-0.065 (6.48)
Ten 3 to 5 yrs*CR5 .	-0.023 (5.11)	-0.023 (5.09)
Ten 6 to 9 yrs*CR5.	-0.039 (8.34)	-0.038 (8.26)
Ten 10 plus*CR5	-0.018 (3.03)	-0.018 (3.05)
Med. skill	0.018 (5.19)	0.049 (1.79)
High skill	-0.007 (1.25)	0.039 (4.12)
Med. skill*CR5	-0.030 (4.64)	-0.036 (4.50)
High skill*CR5	-0.056 (5.67)	-0.022 (1.99)
Year dummies	yes	yes
Sector dummies	yes	yes
Year*skill	yes	yes
Sector(2 dig.)*skill	x	yes
Aux. Regression	-0.009 12.17	-0.010 12.23
Observations	449551	449551
Individuals	83022	83022

Includes age and age squared as regressors

Table 1.9: Reduced form estimates for SMP experiment
absolute t-values in parenthesis

ln real wages	Fixed effects manuf. sect. (1)
Constant	0.226 (3.35)
Age	0.064 (76.56)
Age squared	-0.0007 (185.92)
Tenure	0.009 (38.33)
Tenure squared	-0.0004 (29.71)
Med. skill	0.036 (26.26)
High skill	0.110 (57.88)
SMP affected (post92)	-0.011 (5.37)
Med. skill*SMP	0.021 (8.58)
High skill*SMP	0.097 (34.95)
Indiv. fixed eff.	yes
Year dummies 82-99	yes
Sector dummies	yes
Observations	365228

Table 1.10: The effect of concentration on returns to skill, SMP experiment
absolute t-values in parenthesis

ln real wages	CR5 Output (1)	CR5 Output (2)	CR5 Employment (3)	CR5 Employment (4)
First stage				
SMPaffected (post92)	-0.015 (1.52)	-0.015 (1.52)	-0.044 (5.03)	-0.044 (5.03)
Second stage				
Conc.	-0.327 (1.85)	-1.33 (3.91)	0.404 (5.38)	-0.515 (5.57)
Med. skill*Conc.	-1.115 (7.75)	-0.404 (0.97)	-0.928 (10.05)	-0.084 (0.59)
High skill*Conc.	-4.522 (24.82)	-0.233 (0.42)	-2.968 (26.82)	0.104 (0.55)
Individual fixed effects	x	yes	x	yes
Year dummies	yes	yes	yes	yes
Sector dummies	yes	yes	yes	yes
Observations	364543	364543	364543	364543

First stage includes d_t and d_j. Second stage also includes age and tenure, their squares and skill dummies.

Table 1.11: Reduced form estimates for exchange rate experiment
absolute t-values in parenthesis, clustered s.e.

ln real wages	Indiv fixed eff.
Constant	0.099 (0.74)
Age	0.064 (15.92)
Age squared	-0.0007 (19.9)
Tenure	0.0049 (5.77)
Tenure squared	-0.0002 (5.91)
Med. skill	0.028 (4.88)
High skill	0.093 (10.29)
Imp.penetr.96	-0.020 (1.27)
Med. skill*Imp.penetr.96	0.055 (5.38)
High skill*Imp.penetr.96	0.141 (9.42)
Individual fixed eff.	yes
Year dummies	yes
Sector dummies	yes
Observations	415306

Table 1.12: The effect of concentration on returns to skill, exch. rate experiment
absolute t-values in parenthesis

Instrumented var:	CR5 Output (1)	CR5 Employment (2)
First stage		
Imp.penetr.96	-0.075 (2.77)	-0.037 (2.14)
Second stage		
Conc.	-0.412 (5.07)	-0.852 (4.94)
Med. skill*Conc.	-0.004 (0.21)	-0.010 (0.41)
High skill*Conc.	-0.071 (2.39)	-0.071 (2.08)
Individual fixed effects	yes	yes
Year dummies	yes	yes
Sector dummies	yes	yes
Observations	174129	174129

Includes age and tenure, their squares and skill dummies.

Table 1.13: Quantile regressions with CR5 output
absolute t-values in parenthesis

	10th percentile	25th percentile	50th percentile	75th percentile	90th percentile
Med. skill	0.127 (83.81)	0.132 (105.5)	0.140 (116.16)	0.158 (107.2)	0.182 (90.85)
High skill	0.413 (203.8)	0.455 (276.2)	0.504 (323.2)	0.572 (304)	0.660 (259.6)
Concentration	-0.033 (2.64)	-0.032 (2.99)	-0.029 (2.86)	-0.055 (4.46)	-0.082 (4.92)
Year dum.	yes	yes	yes	yes	yes
Sector dum.	yes	yes	yes	yes	yes
Observations	449551	449551	449551	449551	449551

Table 1.14: Quantile regressions with CR5 employment
absolute t-values in parenthesis

	10th percentile	25th percentile	50th percentile	75th percentile	90th percentile
Med. skill	0.127 (83.12)	0.132 (113.62)	0.140 (119.87)	0.158 (109.41)	0.182 (94.45)
High skill	0.413 (202.4)	0.455 (297.34)	0.504 (333.06)	0.573 (309.8)	0.660 (270.3)
Concentration	-0.049 (3.14)	-0.062 (5.21)	-0.064 (5.33)	-0.110 (7.35)	-0.144 (7.26)
Year dum.	yes	yes	yes	yes	yes
Sector dum.	yes	yes	yes	yes	yes
Observations	449562	449562	449562	449562	449562

Regressions include tenure, tenure squared, age and age squared

Chapter 2

Executive compensation and product market competition

2.1 Introduction[1]

A large amount of effort and literature has been devoted to understanding the determinants of executive compensation. The availability of data and the belief that firms can greatly improve their performance by setting the right incentives has induced researchers to search for complex compensation packages in the spirit of principal-agent theory. In general, shareholders are considered in this literature as a risk neutral coordinated principal and managers are considered risk averse agents (Holmstrom (1979) Mirrlees (1976) (1974)). The quantity of theoretical work devoted to the topic is extremely large, and there are numerous articles aiming to test empirically the implications of these models (see Murphy 1999 for an extensive survey). However, in spite of all the existing work, there is still considerable controversy on the determinants of executive compensation and their magnitude although what seems to be an established fact is the increase over the past twenty years in performance pay sensitivities and in the use of stock options,

[1]This chapter is based on joint work with Vicente Cuñat from Universitat Pompeu Fabra.

that dominate compensation packages for many executives (Hall and Liebman (1998), Murphy (1999)).

Our aim with this paper is to study the effects of product market competition on the explicit compensation packages that firms offer to their executives. This is a relevant question given the increase in product market competition through different channels (from deregulation to technological change and increased trade) over the past decades and because it provides a potential explanation to the increased reliance on performance related pay in executive compensation packages.

Product market competition will have an effect on managerial compensation through the following channels. In the first place competition changes the elasticity of the profits of the firm to increases in productivity. Therefore it changes the returns to effort of the executives of the firm (Schmidt (1997), Raith (forthcoming)) thus following a change in the competitive environment, firms may decide to reoptimize their compensation packages. Secondly competition changes the risk and implicit incentives that the economic environment provides to managers and accordingly, it may change the optimal explicit incentive package that firms offer to them (Aggarwal and Samwyck (1999), Schmidt (1997)). Finally and possibly departing from the standard principal-agent approach, changes in competition may alter the profit levels of the firm, the relative bargaining power and the incentives for managers to extract rents from the firm (Bebchuck, Fried & Walker (2002)).

To achieve our goal of measuring the net effect of competition through these channels we estimate individual compensation equations that take into account the theoretical structure of the incentive contracts (in particular the existence of a risk-return trade-off) and the fact that individuals may self-select into different sectors according to the degree of competition.

However, since our ultimate purpose is to isolate the causal effect of competition on the sensitivity of pay to performance, the crucial issue in the analysis will be the measure of competition used. Even though most economists may agree on a definition of a perfectly competitive market, or a monopoly, problems arise when trying to find a measure of the degree of competition that is unanimously accepted. We use two alternative measures of competition to overcome this problem.

First we use concentration ratios which is a standard measure used in the industrial organisation literature and allows for comparison with other empirical papers. However this measure can be criticised from a theoretical point of view (under certain parametrisations of the product market it may not be a meaningful measure of competition) and from an econometric point of view since the degree of concentration may be correlated with an omitted variable in the error term or it may be endogenous to the wage setting for managers. To account for these criticisms we develop most of the analysis using two important deregulation waves in US financial markets as natural experiments. These deregulation episodes are exogenous and more uncontroversial sources of competition that affect particular sectors on particular sample years. We obtain a differences in differences estimator using these deregulatory episodes and check their robustness to different specifications. Our results show that a higher level of product market competition increases the performance pay sensitivity of executive compensation schemes.

The added value of our work is therefore to clarify the direct and indirect effects that competition has on the compensation packages offered to executives. This is a relatively unexplored question at an empirical level even though a number of theoretical papers have implications regarding this interaction. The consequences in terms of understanding executive compensation, the recent increased reliance on stock options and the increases in sensitivities and the wider implications on the increased variance of earnings are important implications of the paper.

2.2 Theoretical background

The closest theoretical contributions to our empirical problem are the models by Schmidt (1997) and Raith (forthcoming). In Schmidt (1997) the explicit contract signed by a risk neutral principal (shareholders) and a risk averse agent (CEO, executive) is influenced by the implicit incentives given by the competitive environment of the firm. The contract induces the manager to exert effort in cost cutting activities. Competition affects the contract through two channels. On the one hand, a higher level of competition will increase the marginal profit to cost cutting activities, (for instance if the elasticity of substitution between goods is higher) and therefore the contract will have steeper incentives to induce the manager to exert more effort as the profit of stealing market share from other firms increases. On the other hand a higher level of competition will reduce the average profits of the firm and therefore increase the likelihood of bankruptcy. If managers are worried about this bankruptcy they will exert more effort, so there is less need for an explicit contract that induces effort and therefore one should expect a contract with flatter incentives. Overall, the effect of an increase in competition is ambiguous.

Raith (forthcoming) has a variation on this model that solves the ambiguity. By allowing entry and exit, endogenous exit guarantees that the average profits do not drop like in Schmidt´s model, so the first effect dominates and we should expect steeper incentives associated to more competition due to more profitable market stealing activities. The objective of our work is to have a clear measure of the total effect of a change in competition.

A decrease in competition may increase the explicit incentives provided in executive contracts to compensate for the reduction on incentives produced by a fall in the bankruptcy risk, however this is not the only mechanism for this correlation. Bebchuk, Fried & Walker (2002) explore the evidence in existing literature for rent extracting activities in managerial compensation and they find a fair number of puzzles that cannot be explained using the standard principal agent theory and could be consistent with rent extraction explanations. In principle one could expect that if executives are risk averse, most of the rent extraction activities would be done through the fixed part of the compensation. However, for "camouflage" reasons we may also observe some rent extraction in the variable part of managerial compensation. Bertrand and Mullainathan (2000) calculate a measure of "pay for luck" associated with rent extraction activities on the performance based part of the executive compensation packages. Moreover, they find that this pay for luck is more intense in firms with bad governance.

An important point when assessing the incentives implicit in a compensation package is to assess whether the fixed part of the pay provides incentives. In this sense the efficiency wages theory claims that this part should have a discipline effect. One of the various possible reasonings for this incentive is that the fear of losing their job would discipline managers and this discipline effect will be larger the larger the fixed pay that they receive. To capture these effects we will not only measure the interaction of the slope of the compensation packages with the competition measures but also the effect of competition on the fixed component of pay. Although we will interpret some of the results on the basis of rent extraction, some of them can equally be reinterpreted in terms of efficiency wages and voluntary rent sharing by the principal/employer. (See Shapiro and Stiglitz 1984).

The few empirical papers that relate product market competition and executive compensation are mostly in the line of Aggarwal and Samwyck (1999a) (Kedia (1996), Joh (1999)). These papers introduce explicitly strategic considerations and the structure of the product market in managerial compensation to address the relative performance evaluation puzzle (the fact that empirical studies seem not to find any role for relative performance evaluation in incentive contracts). In particular they argue that principals will commit to particular compensation structures to soften or increase the aggressiveness of their managers in the output market. This leads to an observed relationship between product market competition and rivals' outcomes[2]. Their empirical analysis uses Execucomp data between 1993 and 1995. They claim to find support for the strategic complements model[3]. Furthermore they find that performance-pay sensitivity is decreasing in the degree of competition measured by this variable. Our work explicitly contradicts this result. The main reasons for this are the inclusion in this paper of a number of explicit control variables in the regressions and the use of a larger sample that covers years 1992 to 2000 -this actually makes most of the difference. We also use two alternative measures of competition, one of which we argue is a true measure of competition (a sector deregulation) that is not contingent on the type of competition in place. As will be shown below we obtain similar results for both measures.

2.3 Specification and identification strategy

Our aim is to estimate the effect of product market competition on the sensitivity of performance related pay. For this purpose we posit a wage equation at the individual level to estimate the fixed component (A_{ifjt}) and the variable component of compensation (B_{fjt}(Performance$_{fjt}$), a function of performance). Total compensation for executive i, in firm f, in sector j in year t, can be written as $W_{ifjt} = A_{ifjt} + B_{fjt}(\text{Performance}_{fjt}) + u_{ifjt}$. The theoretical predictions outlined in the previous section imply that not only total pay

[2] When the actions of the agents are strategic complements (prices in the Bertrand model) the principal's interest is to avoid aggressive price setting and hence they will not compensate managers by their relative performance. On the contrary, managers will be compensated by the own firm performance and the performance of the industry as a whole. As competition (defined by the elasticity of substitution between goods) increases, the weight given to the values of other firms in the compensation contract increases. With strategic substitutes (quantities in Cournot), principals will reward managers positively on own performance and negatively on industry performance. As competition increases,the weight given to the values of other firms in the compensation contract increases (becomes more negative) to induce them to behave more aggressively.

[3] One limitation is that they proxy the elasticity of substitution, that is the measure of product market competition on which the theoretical analysis is based by a Herfindahl index which is a measure of concentration. This is a serious limitation in interpreting the results since concentration and the elasticity of substitution are positively correlated in standard models of competition like the Dixit Stiglitz model. A higher elasticity of substitution in standard models represents an increase in competition but leads to lower concentration, so the best measure to test their theoretical model is not the Herfindahl index.

will depend on a number of individual and firm characteristics, but the sensitivity pay to performance itself will vary across firms and sectors with different features. We explicitly model the major determinants of these coefficients in our empirical analysis. These can be written as: $A_{ifjt} = f(\text{Competition}_{jt}, \text{individual}_{ifjt}$ & firm characteristics$_{fjt})$ and $B_{fjt} = g(\text{Competition}_{jt}, \text{variance}_{f})$. Assuming linear relationships[4], then:

$$W_{ifjt} = A_{ifjt} + B_{fjt}Perf_{fjt} + u_{fijt} \tag{2.1}$$

$$\begin{aligned} A_{ifjt} &= a_0 + a_1 Competition_{jt} + a_2\ var_f + \sum a_z Controls_{ifjt} \\ B_{fjt} &= b_0 + b_1 Competition_{jt} + b_2\ var_f \end{aligned}$$

where the slope component depends itself on sector and firm characteristics. Given the compensation structure assumed, the estimation of the compensation equation should include terms where the performance measures interact with competition, rents and other variables. The specification we will estimate is:

$$\begin{aligned} W_{ifjt} &= a_0 + a_1 Competition_{jt} + a_2\ var_f + \sum a_z Controls_{ifjt} \\ &\quad + b_0 Perf_{fjt} + b_1 Competition_{jt} Perf_{fjt} + b_2 var_j Perf_{fjt} + u_{fijt} \end{aligned} \tag{2.2}$$

$$u_{ifjt} = \eta_i + \delta_j + d_t + \epsilon_{it} \tag{2.3}$$

Where $Perf_{fjt}$ is performance, var_f is the variance of the performance measure,

[4]Even though the compensation package of many executives may contain complex formulae, we are imposing linearity and implicitly estimating a simple compensation package that has a fixed element and a variable one related to the firm´s own profit. This is obviously a simplifying assumption, but our approach is sufficiently flexible to capture most of the effects that we are interested in while keeping the results interpretable. Moreover it seems that the non-discretionary component of executive compensation, usually follows simple formulas. And there are theoretical results on the linearity of incentives (Holmstrom and Milgrom (1987)).

$Competition_{jt}$ is the relevant competition measure, d_t are time dummies, η_i and δ_j are individual and sector permanent unobserved components and ϵ_{it} is a white noise.

The specifications are fixed effects regression of the levels of different compensation measures on levels of performance measures (we later use the logarithm of compensation as dependent variable as a robustness check). It therefore estimates the sensitivity of pay to performance (Murphy (1999)). The main coefficient of interest is b_1 , i.e. how the performance pay sensitivity B changes with the level of competition in the sector. This captures the net effect of competition from the different channels outlined in the previous section.

The estimation must account for other sources of variation of the performance pay sensitivity that might be correlated with the level of competition and hence bias the coefficient. We explicitly introduce the variance of performance, since in the standard principal agent model the limiting factor to a very steep incentive contract is the risk aversion of the agent and the fact that the returns of the firm depend not only on her effort, but also on other random factors (therefore one expects b_3 to be negative[5]). In fact omitting the variance term biases the estimate of the performance sensitivity towards zero. We also account explicitly for the size of the firm (to isolate the firm size effect).

The level of variation of competition is at a sector level, and we identify b_1 by comparing two individuals working in firms with the same level of performance in sectors with different levels of competition. Now one must take into account any other biases arising from the correlation between any permanent unobserved component of the wage equation and the included regressors.

First of all we account for permanent unobserved differences between sectors. If the sector fixed effects δ_j are correlated with $Competition_{jt}Perf_{fjt}$ for instance because highly competitive sectors pay higher wages regardless of the level of performance, this

[5]This effect may however be less clear when we introduce measures of granted options in our compensation package, as the valuation of these options depends positively on the volatility of the underlying shares

will bias the results. Given that our interest variable (i.e. competition) is a sector characteristic, our main specification will include sector fixed effects δ_j. If the above specification is correct, then provided $Cov((Competition_{jt}Perf_{fjt}), \eta_i) = 0$ the coefficient of interest will be unbiased. However there are reasons to expect that is not true, in particular if managers select themselves towards sectors with lower levels of competition that have higher rents and pay higher wages. In that case b_1 will underestimate the effect of competition on performance pay sensitivities (so this bias goes in our favour). In the sample, 2.4% of the individuals actually change firms at least once, and only one third of these are within sector changes. Note that given that we are dealing with the market for executives in the top 1500 firms in the US, there are strong reasons to believe that the labour market for executives is not restricted to the sector, but that there is considerable flexibility for managers to migrate between sectors[6].

The second strategy used is therefore to control additionally for individual fixed effects. The cost of this strategy is that there may not be enough individual variation to capture the effects and that the loss in efficiency from including individual fixed effects is large. The average number of observations per executive is just 3.8 and individual fixed effects implicitly mean losing one degree of freedom per individual. The advantage though is that movers from one sector to another provide useful variation to identify the effect of competition since our measure of concentration only varies by sector (the experiments will have time series variation) and hence they allow us to compare the same individual in sectors with different levels of competition[7]. Furthermore, it is still possible that individuals self select towards particular firms within their sector according to their skills in a systematic way. Individual fixed effects deal with these issues.

The above comments concerned the model specification. However, the most import-

[6]Furthermore in the section that uses concentration ratios sectors are defined at 5 digit NAICS level, which is a quite narrow definition of sector, so sector changes are frequent and if these changes are correlated with η_i this will bias the results.

[7]The results go through when we look at stayers only. Some results for stayers are shown later on on the robustness checks section.

ant aspect of the analysis probably concerns the measure of product market competition used. We pursue two different strategies. The first is to use concentration ratios for the four largest firms in the sector at NAICS 5 digit level obtained from the US census of manufacturers for 1997. The variation in concentration is purely cross-sectional and we use this measure to start with because it is a standard measure of competition used in previous studies. However, the use of concentration ratios may be subject to a number of criticisms. First, under some parametrisations of competition, concentration is a very imperfect measure of the competitiveness of the sector. Furthermore there are measurement issues on how these ratios should be measured. Second, concentration may be a response to the way in which compensation is set in the sector and hence be endogenous, or it may be correlated with some omitted variable.

To address these issues we use an alternative measure of changes in competition that exploits the two deregulation Acts that were passed in the US in the nineties to deregulate the financial services. These are explained in the next section.

2.3.1 Two quasi-natural experiments: Financial deregulation in the 90's

The decade of the 1990s is thought of as the major deregulation period for the financial sector in the United States. Two major acts were implemented that were designed to foster competition in the financial sector.

The first one was the 1994 Riegle-Neal interstate banking and Branching Efficiency Act that repealed two previous amendments that curtailed interstate banking. It implied that banks were allowed to own and operate branches in different states thus generating an increase in product market competition. Prior to that there where restrictions for banks to operate across borders (although there were limited agreements between some states). While the empirical literature on the impact of these reforms is still limited, there seems to be a consensus between practitioners and academics on the increase of competition that it generated and the pressure on inefficient banks that held local monopolies before. e.g. "The lobbying force behind banking restrictions is widely known to be *the preservation of local monopolies or oligopolies for community banks*" (Kane 1996 commenting on Golenbe 1994 (in italics)). In addition, studies on similar reforms (the bilateral state agreements) for earlier periods seem to find a considerable impact on the sector[8]. The fact that this is the most wide-ranging reform of the kind for the US since it affects the whole country indicates that the impact of the deregulation was very large. This is the first natural experiment used for the 1994 turning period. We compare the years before 1994 (period 1992 and 1994) to those after 1994 (1995 to 1996).The treatment sector is the banking sector (SIC code at two digits is 60).

The second major reform to the financial industry regulation was brought about in 1999 with the Gramm-Leach-Bliley Act also known as the financial services modernisation act. This repealed previous legislation (dating from the great Depression in the 1930s) that imposed barriers separating traditional banking, insurance and securities underwriting into three distinct industries which in practice meant that banks and investment firms were not competing with each other. The effect on the financial services industry was considered as rather dramatic: "Since congress passed [...] the Gramm-Leach-Bliley act the financial services industry has undergone a dramatic change as it explores developing the best mix of products and services that can be offered to customers.[...] investors, institutions and companies are quickly benefiting form enhanced organizational agility and greater competition in the industry. Allan E. Sorcher (Vice-President of the Securities Industry Association).

Thus our second test period are the years between 1997 and 1999 versus year 2000. The treatment group here is made by firms in sectors with SIC codes 60 to 64 and 67. They constitute natural experiments that affect only particular industries after a given

[8]Nichols and Hendrickson show the impact of previous deregulation waves from 1929 to 1989 using Canadian banks as a benchmark for US reforms and viceversa. The freedom to establish new branches seems to have contributed to higher levels of efficiency.

year and therefore can be used to identify the effects of competition.

Exploiting this variation we implement a differences in differences estimation of the effect of the increase in competition in the US financial sector following the two legislation pieces. These deregulations constitute our preferred specification (relative to the one using concentration ratios) because they exploit a clear measure of an increase in competition. The estimated compensation equation now is:

$$\begin{aligned} W_{ifjt} &= a_0 + a_1 DEREG_{jt} + a_2\ var_f + \sum a_z Controls_{ifjt} \qquad (2.4) \\ &\quad + b_0 Perf_{fjt} + b_1 DEREG_{jt} Perf_{fjt} + b_2 var_j Perf_{fjt} + u_{fijt} \end{aligned}$$

$$u_{ifjt} = \eta_i + \delta_j + t\delta_j + d_t + \epsilon_{it} \qquad (2.5)$$

The deregulation indicator $DEREG_{jt}$ takes value one for the treated sectors (banking in the 1994 deregulation or financial services in the 1999) in the treatment period (post 1994 and post 1999 respectively). As before, results will be presented with sector and both sector δ_j and individual η_i fixed effects. Now, given the effect of the deregulations arises over time, it is important to ensure that we are not just capturing the fact that different sectors have different trends in performance pay. To control for this possibility, sector specific time trends are introduced $t\delta_j$. This will capture any differing time trends by sector.

In addition to the basic specifications with the natural experiments we do a number of robustness checks.

The first robustness check is to run the analysis only on the services industry (SIC codes 60 to 81). This is a much closer comparison group than the one used before, and one would expect that the performance pay sensitivities evolve similarly. By taking the rest of services as a benchmark we are possibly able to more closely identify the effect of the deregulation (although the inclusion of a sector trend accounted to a large extend for these potential between sector differences).

The second check is to use the logarithm of total compensation instead of its level as a dependent variable.

The third check is to introduce explicitly a measure of rents in the regression. The reason for this is that in addition to these pure competition effects we also expect that rent extraction activities may affect the compensation package offered to executives. In principle higher rents should increase the fixed component of the compensation and leave the variable part unaffected. That is the way in which risk averse managers can obtain the highest utility for a given amount of rent extraction. However, if they intend to camouflage this rent extraction as a provision of incentives they may decide to extract rents also in the variable part of the compensation package. This effect goes in the same direction as the one predicted by the implicit incentives of the risk of the firm going bankrupt, i.e. it would tend to reduce the sensitivity of pay to performance as competition increases (rents fall). As will be seen below, the results indicate that the sensitivity increases with competition, so if anything omitting rents would increase that coefficient. In addition to this, the risk of using the rents measure is that it may be endogenous if we think that the level of managerial pay affects rents. The support for this is rather limited (managerial pay is a tiny fraction of rents). As we will see measure of rents used has an almost negligible effect on the coefficient of interest indicating that it is to a large extent orthogonal to our problem and hence leaving it out does not have any major implications. Finally, the results are presented on stayers exclusively.

2.4 Data description

To develop the analysis outlined above we use the Standard&Poor's Execucomp dataset. This is a panel dataset that covers up to the top 5 executives (ranked by salary and bonus) of the top firms in the US economy (it includes all of the S&P 1500, and a few other large firms). We use yearly data from 1992 to 2000. It records exhaustive data on executive´s compensation schemes as well as some individual characteristics[9]. The individual level data on compensation includes yearly wage, bonus, stock options and other compensation. The data also contain information on firm characteristics and performance that will be used in the analysis such as total assets, sales, earnings before interest and taxes (our accounting profits measure), total market return (dividend plus appreciation) of holding all stock during the year. The full sample contains around 95000 observations that correspond to 22000 individuals.

To construct the competition variables we obtained concentration ratios from the 1997 US Economic Census (published by US Census) at different levels (the share of production of the top four, eight, twenty and fifty firms in a given sector). These measures are computed at the NAICS 5 digit level and we use the top four concentration ratio throughout since at this high level of disaggregation it is the magnitude with more variation. The top four concentration ratio is the proportion of total sector revenue accounted for by the largest four firms in the sector. The average concentration ratio in the sample is 30%.

We also use an alternative competition measure that comes from 2 deregulation episodes in the banking and financial sectors. The Riegle-Neal interstate banking and Branching Efficiency Act, published in 1994 increased interstate competition between commercial banks, and the Gramm-Leach-Bliley Act also known as the financial services modernisation act meant a drastic liberalisation of financial services in 1999. Both of them affect particular sectors in particular periods of time, so we can use them as natural experiments following a differences in differences procedure. To avoid the interference between both natural experiments we use the period 1993-1994 as the control sample for the first experiment (banking sector) and 1995-1996 as the treatment period. For

[9]There is also a limited amount of individual characteristics. We will use gender. Age and tenure are only a vailable for a very limited number of observations, and the criteria of selection are not clear, so we decided not to include these.

the second experiment (financial services sector) we will use 1997-1999 as control sample and 1999-2000 as treatment period.

With these data a number of econometric specifications were evaluated and the results are described below. The aim is to evaluate the effect of competition on variations in the variable component of the compensation scheme. For this purpose we use as dependent variables three different magnitudes that capture this variable component. First we used total executive compensation earned by the executive in a given year including the profit from exercising stock options in that year (and excluding options granted). Second, we use salary plus bonus (to abstract form the impact of stock options). Finally we used the Black-Sholes value of options granted[10].

We then evaluate the effect of accounting and market returns separately on these compensation measures. All variables are at constant 1996 prices. Even though corporate finance would predict that market returns are the relevant magnitude in this respect, previous research points to the fact that accounting profits are also relevant (Bushman and Smith 2001).

Accounting returns are measured as earnings before interest and taxes and market

[10] A comment is in order on the use of stock options granted as a dependent variable. Stock options are an increasingly important component of executive compensation. However, given their magnitude and volatility, it is problematic to analyse them jointly with other compensation items. It is important when dealing with stock options to value them adequately, especially given that granting stock options is at the same time a reward for performance and an incentive device in itself.

There are two main ways to deal with options in this environment. One possibility is to consider the value of the options granted as a sum of money given to the executive. This possibility is particularly attractive if executives already hold a portfolio of the firm´s shares and can rebalance it to keep an optimal exposure to the firm´s risk or if they can trade on derivatives to achieve the same goal. However if such portfolio cannot "absorb" the amount of stock options granted and there is not a liquid market for such options this approach does not take into account that the number of options granted, not only has some intrinsic value but also this value is sensitive to the firm´s performance. In this latter case it is also true that using the Black-Scholes formula to value these options may overstate their value, as it is not taking into account the illiquidity of these options and the limited diversification strategies available (Hall and Murphy 2000).

Another possibility would be to calculate the aggregate sensitivity of the value of all granted options to firm performance (overall delta) and consider them as an incentive contract. This strategy has two limitations: a practical limitation, as with the available data it is hard to measure this aggregate sensitivity and a limitation related to the extent to which executives can "undo" this incentive contract by rebalancing their portfolios. Throughout this paper we take a pragmatic approach, showing regressions explaining total compensation (including options executed) and options granted (at B&S value).

returns are total market returns (dividend plus appreciation) of holding the stock during the year.

Since risk must be accounted for when estimating compensation sensitivities the variance of the return is computed over the sample period. The relevant risk measure is the variance of performance since that is the risk faced by the variable component of pay[11]. We compute a variable that is the sample cumulative density of the variance of the returns of the firm. This is a measure of the relative position of the firm variance with respect to the variance of returns of other firms that smooths the measure of the variance such that it contains no outliers. This is our risk measure throughout the paper.

The robustness checks include a measure of the rents available to the firm to account for the feasibility of rent extraction. Given the available data this is defined as a markup measure computed as profits before interest, taxes and extraordinary items over sales[12]. The size of the firm is also controlled for by the logarithm of assets.

We also include as explanatory variables gender and whether the individual is the company's CEO. All regressions include year dummies to account for the cyclicality of compensation.

A main concern in the analysis was that many of the dependent and independent variables used typically have very large outliers. This is problematic when running ordinary least squares-type regressions. To deal with this issue we restricted somewhat the sample and dropped the top outliers[13] of options granted and total compensation. The results are not sensitive to the exact cut-off point chosen. It is only the inclusion of

[11] In principle managers could have a well diversified port-folio in which case the relevant measure of risk would be the covariance of performance with the stock market divided by the varaince of market returns (the betas). In practice manager's human capital and assets are heavily invested in the firm and the variance of risk is a more relevant risk measure.

[12] Because of data limitations we cannot deduce the true cost of capital.

[13] The sample was restricted by excluding from the analysis executives with very large outliers of either total compensation or options granted. The 99% cutoff point for total compensation the sample was 14887, but the maximum value was 655717 (respectively 11001 and 557529 for granted options) -the minimum in either case being zero. The enormous weight of these variables in a least squares framework led us to drop variables with total compensation greater than 30000 and options granted greater than 24000 (these values were chosen at above the 99% cutoff point to include roughly 0.3% of the sample). In total this amounts to 528 observations, i.e, 0.6% of the total sample.

very large option grants or total compensation that alters the results. Previous analysis using median regressions to minimise the impact of outliers was consistent with these results. However the impossibility to account for individual fixed effects in those regressions (and the relevance of accounting for unobserved heterogeneity that is confirmed by the results) is what lead us to have least squares regressions without outliers as our preferred specification.

2.5 Results

In this section we present the results obtained for the determinants of managerial compensation, in particular of total compensation (including options executed) and stock options granted. We estimate equation (2.1) and present the sensitivity analysis and robustness checks progressively.

2.5.1 Analysis using concentration ratios

The results in this section use as competition measure concentration ratios by sector. These are at highly disaggregated sector levels for 1997.

Tables 2.2 to 2.4 present results using accounting returns as the measure of performance for the equation on Total Compensation, Salary plus bonus and Options granted respectively. Tables 2.5 and 2.7 use market returns as measure of performance. Columns 1 and 2 contain sector fixed effects only. Column 3 contains individual fixed effects in addition to the sector dummies.

As is well known in this setting it is crucial to control for the fact that the level of compensation will depend on the risk associated to the contract, to the performance of the company. Hence we introduce the variance of the relevant performance measure in the regressions in column 2 of all tables. When this is interacted with the performance measure in levels we find that the sensitivity of pay to performance is decreasing in the variance of the firm. Again, this is true for accounting profits and market returns.

To summarise the results, the performance pay sensitivity is increasing in the performance measure and levels off after some point (has a very smooth hump shape). Concerning the effect of product market competition on incentives provided we find that the estimated coefficient $\widehat{b_1}$ on the interaction between concentration and returns is negative and significant in most specifications. This indicates that more competitive sectors provide steeper incentives to their managers and hence that the incentive provision effect dominates the market discipline effect in net terms. Let's see now in more detail the results obtained.

On the effect of competition on the sensitivity of total compensation to accounting profits (table 2.2) the first thing to note is that the estimate changes substantially from the sector effects to the individual fixed effects model (indicating selection on unobservables for that magnitude), actually more than doubling the estimated sensitivity. This suggests a negative correlation between the individual fixed effect and accounting returns (the same qualitative results apply to the salary plus bonus specification). In the fixed effects specification an increase in a million dollars in accounting returns increases total compensation by 5702 dollars. The effect of competition on this sensitivity is to increase it by 5% if one goes from a concentration ratio of one -where the four largest firms dominate the whole market- to a highly competitive sector (with close to zero CR4). The increase in sensitivity of salary plus bonus due to competition is around 2% and that of stock options is 11%[14].

Concerning the sensitivity of total compensation to market returns with minimal concentration, it around 1300 dollars for every extra million dollars in market returns. This is reduced by 3% if we consider a monopoly in the sector fixed effects specification (column 2). The average market return is around 700 million dollars, that gives a variable pay at mean market return of 910 thousand dollars per annum. In a monopolistic sector this is reduced by 27300 dollars. In the individual fixed effects regression the sensitivity

[14] All effects in what follows are computed at the median where the effect of the variance term of the performance measure is negligible with respect to the coefficient on performance in levels.

of pay to performance is very similar (indicating no selection on unobservables with respect to market returns). However significance is lost for the effect of product market competition.

The effect of competition on stock options granted is substantial. In all tables we find that only when we introduce individual fixed effects the effect of product market competition becomes significant suggesting a negative correlation between the competition/performance interaction and the fixed effect. In the individual fixed effects specification concentration reduces the sensitivity by 11% in the accounting and 20% in the market returns cases.

The size of the firm (measured by the log of assets) affects positively both total compensation and options granted. It is interesting to note that the estimate of that effect changes substantially (it double or triples) when we allow for individual fixed effects. This suggests a negative correlation between the individual fixed effect and the size of the firm.

Finally we controlled for gender and whether the individual was the CEO of the company. Men represent 96% of the sample and they earn significantly more than women (around 250 thousand dollars more on average). CEOs also earn more than non-CEOs by whichever measure we measure compensation. In the individual fixed effects specification (that estimates the impact of being a CEO exclusively through changers of CEO status) the effect is around 200 thousand dollars total compensation and 350 thousand dollars more options granted for CEOs.

2.5.2 A natural experiment: Deregulation in the 90's

The previous section showed that competition measured by concentration ratios tends to increase the steepness of pay-performance contracts offered to executives. An extensive set of controls and fixed effects regressions were used to control for as many observable and unobservable factors as possible. However, as was mentioned before, concentration ratios may be objected to on the grounds that they are an imperfect measure of competition or that they may be correlated with some omitted variable leading to omitted variable bias. This section uses two quasi- natural experiments to address these problems and confirm the results.

Given that these deregulation processes only affected particular industries in given periods, the identification strategy is based on a differences in differences estimation. Control variables identical to the ones used in the previous section are included in the regressions. To avoid spurious results that could be driven by the fact that different sectors are subject to different trends independently from the experiment we also include sector specific time trends for all sectors.

The results can be seen in tables 2.8 to 2.12. Estimates are shown for total compensation (columns 1 and 4), salary plus bonus (columns 2 and 5) and options granted (columns 3 and 6). Columns 4 to 6 include individual fixed effects. The variables FIN and FIN94 take value 1 in the treatment periods for the sectors that experienced deregulation and 0 for the control sample and the pre-treatment period. FIN94 corresponds to the effect of the Riegle-Neal interstate banking and Branching Efficiency Act between 1994 and 1997 and FIN corresponds to the effect of the Gramm-Leach-Bliley Act from 1999 to 2000. These same variables also interact with the performance levels of firms to see the effect of deregulation on the pay-performance slope.

In all specifications we find that after the deregulation, the slope of performance related pay becomes steeper. The coefficient is both quantitatively important and statistically significant. The positive sign shows how the pay-performance sensitivity increased after deregulation happened, thus confirming our results of section (2.5.1). Whether we look at total compensation, salary plus bonus or options granted, and whether we use accounting profits or market returns as our performance measure the result seems to be confirmed. This is true including individual fixed effects and a sector specific trend in the regressions (only the specification for options granted loses significance when we introduce individual fixed effects). Quantitatively the effect is also very large, for example, table 2.8 shows that the market pay performance sensitivity is 31% higher in the treated (banking) sector after the deregulation than before. Table 2.9 shows that the pay performance sensitivity to accounting returns increases by 12% post deregulation.

Similar results are shown in tables 2.9 and 2.11 for the 1999 deregulation of financial services. The sensitivity of total compensation to market returns is increased by 15% in the financial services sectors after deregulation. That of salary and bonus increased by 11% and that of options granted by 42%. For accounting profits the effects are 9%, 13% and 13% respectively. Higher levels of competition are therefore here again associated with steeper incentive schemes.

Note also that in most specifications there is a negative and significant effect of the deregulation on the level (i.e. non performance based) part of the compensation package. This may be due to the fact that the deregulation lowered profits and reduced the possibility of rent extraction. It therefore provides indirect supporting evidence that the experiments are actually capturing an increase in product market competition since this is the effect one would expect.

Robustness checks of these basic specifications are presented on tables 2.10 and 2.13. These are for total compensation as dependent variable and market returns as performance measure (so it should be compared to column 4 of the corresponding deregulation table with market returns as performance measure). The first column of tables 2.10 and 2.13 restricts the analysis to the services industries (including financial and other services instead of taking as benchmark all other sectors of the economy). By taking sectors that are closer to the deregulated industries the benchmark is stricter (although the inclusion of a sector trend deals with this in a parametric way). The results are almost unchanged with respect to the previous analysis (only the sensitivity to market returns is somewhat reduced).

The second column takes the logarithm of the dependent variable and results are qualitatively unchanged.

The third column introduces a measure of rents (computed as net income over sales). As we mentioned before the fact that profits may fall as competition increases implies that performance pay sensitivities may be reduced (because of reduced return to effort form the fall in profits or because reduced rent extraction). To address to what extent this mechanism plays a role we introduce explicitly a measure of rents in column 3. Our coefficient of interest is again robust to introducing rents which indicates that omitting this variable does not affect the results.

Finally, the fourth column restricts the analysis to stayers. This restricts the identification of the effect to workers who were in the deregulated industries prior to deregulation and that underwent it. In the specification with movers, the effect was also identified through workers who moved into the deregulated sectors after deregulation. If these changes are correlated with some unobserved characteristic, the coefficient will not be capturing the causal effect of competition on performance pay sensitivities. Again, the results on the variable of interest are unchanged.

The results are robust to all these checks and the overall evidence from these experiments indicates that the increase in competition reduced the fixed component of pay and increased the sensitivity of the variable component.

2.6 Conclusions

The determinants of managerial compensation have received a lot of attention and faced heated debate but little is known about how these are affected by the degree of product market competition that firms face. The competitive environment generates implicit incentives that determine the design of compensation packages and hence alter the need for and magnitude of explicit incentives. In this paper we draw together the main theories explaining managerial compensation and the impact of product market competition on compensation packages and evaluate empirically its effect.

Our results show that the net effect of product market competition is to increase the performance pay sensitivity, indicating that as competition increases managers will be faced with steeper explicit incentives. This is true after controlling for the implicit risk in the economic environment faced by the manager. The results are also robust to different measures of product market competition. In particular, we use two deregulation experiences as a natural experiment in which a dramatic increase of the competition levels happened for a subsample of firms. The results using this measure are highly significant and robust to a number of different specifications. Furthermore they do not differ qualitatively from the ones using a standard concentration ratio index.

The results therefore indicate that increased product market competition leads to a higher reliance on performance related pay. Thus it provides a potential explanation for the trend over the past decades of an increased used of these compensation mechanisms. It also indicates that the dispersion of earnings in the economy is likely to increase as product markets become more competitive and hence this can be an additional explanation for the recent increase in earnings inequality. Direct tests of these issues are left for future research.

2.7 Tables

Table 2.1: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Median	Minimum	Maximum
Salary	95545	305.17	207.77	250	0	4065.1
Bonus	95545	237.26	500.29	108	0	14276
Total comp.	95545	1158.02	2173.68	512.0	0	29988.38
Salary+bonus	95545	542.44	620.96	370.8	0	15251
Options granted	80766	640.26	1679.23	139.7	0	23991.26
Conc. ratio top4	86131	0.30	0.15	0.28	0.007	0.89
CR4*mkt. ret.	73420	24818.8	217942.3	1689.6	-5995770	7680000
CR4*acc.prof	85765	102.54	421.84	16.6	-3180.04	11643.2
Acc. profits (million US dollars)	95170	293.40	978.92	65.5	-9026	27493
Acc. profits sqd. (million US dollars)	95170	995935.1	1.05e+07	6193.6	3.95e-06	6.52e+08
Market returns (10,000s US dollars)	81540	70479.8	548955	7110.3	-1.09e+07	2.08e+07
Market returns sqd (10,000s US doll.)	81540	3.06e+11	5.53e+12	5.13e+08	0	4.31e+14
Var. (cdf) profits	95514	0.51	0.28	0.5	0	1
Var. (cdf) mkt.ret.	93336	0.50	0.28	0.5	0	1
Rents	95067	-.09	6.11	0.054	-670.36	232.7
ln assets	95247	7.08	1.77	6.9	-3.07	13.26
CEO	95549	0.13	0.34	0	0	1
male	95549	0.96	0.18	1	0	1
Var.acc.prof*acc.prof	95144	249.40	962.87	25.03	-9026	27448.03
Var. mkt.ret.*mkt.ret.	81025	65017.7	542141.3	1622.6	-1.09e+07	2.07e+07

Table 2.2: Effect of acc. profits and concentration on total compensation

	(1) Total Comp.	(2) Total Comp.	(3) Total Comp.
Acc. profits	0.5704***	2.0769***	5.7121***
	(29.20)	(13.97)	(21.73)
Acc. profits squd.	-2.4e-6*	2.0e-6	2.5e-6*
	(1.91)	(1.52)	(1.69)
CR4*acc. prof.	-0.3642***	-0.3213***	-0.2895***
	(8.76)	(7.74)	(4.06)
ln assets	342.2036***	197.8142***	533.5037***
	(59.28)	(22.16)	(29.68)
ceo	1,339.37***	1,344.08***	216.89***
	(68.81)	(69.21)	(7.03)
Male	238.3880***	242.1911***	
	(6.67)	(6.79)	
Variance prof.		871.35***	-200.84
		(20.49)	(1.03)
Var. prof*acc.		-1.56***	-5.14***
		(10.27)	(19.04)
Constant	-1,983***	-1,421***	-2,465
	(33.91)	(22.18)	(1.10)
Time dummies	yes	yes	yes
Sector dummies	yes	yes	yes
Individual effects	no	no	yes
Observations	85765	85739	85739
Number of sect.	333	333	
R-squared	0.18	0.18	0.13
Number of indiv.			19138

Absolute value of t statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%..

Table 2.3: Effect of acc. profits and concentration on salary plus bonus

	(1) Sal+bonus	(2) Sal+bonus	(3) Sal+bonus
Acc. profits	0.2024***	0.7432***	1.7342***
	(42.48)	(20.49)	(36.99)
Acc. profits squd.	-4.7e-6***	-3.2e-6***	-1.6e-6***
	(14.98)	(9.93)	(6.16)
CR4*acc. prof.	-0.1285***	-0.1162***	-0.0305**
	(12.68)	(11.47)	(2.40)
ln assets	124.9530***	92.7460***	11.6399***
	(88.76)	(42.60)	(3.63)
ceo	579.2479***	579.9217***	220.8892***
	(122.03)	(122.43)	(40.14)
Male	82.6519***	82.9749***	
	(9.48)	(9.53)	
Variance prof.		181.8449***	397.8593***
		(17.54)	(11.42)
Var. prof*acc. prof		-0.5607***	-1.6029***
		(15.08)	(33.24)
Constant	-629.0431***	-502.2700***	333.9345
	(44.11)	(32.13)	(0.84)
Observations	85765	85739	85739
Time dummies	yes	yes	yes
Sector dummies	yes	yes	yes
Indiv. effects	no	no	yes
Number of sectors	333	333	333
R-squared	0.32	0.32	0.24
Number of indiv.			19138

Absolute value of t statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%..

Table 2.4: Effect of acc. profits and concentration on options granted

	(1) Options grant.	(2) Options grant.	(3) Options grant.
Acc. profits	0.1071***	-0.2642**	1.2875***
	(6.15)	(2.07)	(5.40)
Acc. profits squd.	7.3e-6***	6.9e-6***	4.4e-6***
	(6.54)	(5.97)	(3.24)
CR4*acc. prof.	-0.0648*	-0.0548	-0.1478**
	(1.79)	(1.52)	(2.34)
ln assets	242.9377***	142.3704***	355.9343***
	(46.69)	(17.65)	(20.87)
ceo	758.9020***	760.9737***	347.0298***
	(47.57)	(47.84)	(13.24)
Male	70.2694**	75.6455**	
	(2.13)	(2.30)	
Variance prof.		672.2337***	-421.3920**
		(17.87)	(2.44)
Var. prof*acc. prof		0.3814***	-1.0211***
		(2.91)	(4.13)
Constant	-1,612.96***	-1,214.43***	-1,721.26
	(29.85)	(20.48)	(0.70)
Time dummies	yes	yes	yes
Sector dummies	yes	yes	yes
Individual effects	no	no	yes
Observations	72482	72456	72456
Number of sectors	333	333	333
R-squared	0.11	0.12	0.08
Number of indiv.			19104

Absolute value of t statistics in parentheses

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

Table 2.5: Effect of market returns and concentration on total compensation

	(1) Total Comp.	(2) Total Comp.	(3) Total Comp.
Market return	0.0006***	0.0136***	0.0132***
	(14.54)	(34.10)	(32.54)
Market ret. squd.	3.5e-12*	1.8e-11***	2.2e-11***
	(1.92)	(10.03)	(11.15)
CR4*market ret.	-0.0006***	-0.0003***	-0.0000
	(6.47)	(3.02)	(0.00)
ln assets	477.7028***	317.5006***	675.3671***
	(79.47)	(36.18)	(28.43)
ceo	1,346.8148***	1,355.2711***	191.3208***
	(64.64)	(65.85)	(5.03)
Male	246.7655***	253.1776***	
	(6.20)	(6.44)	
Variance*market ret.		-0.0134***	-0.0132***
		(32.78)	(31.78)
Variance market		1,000.7254***	-40.4610
		(22.25)	(0.17)
Constant	-3,066.92***	-2,457.03***	-3,498.35
	(49.24)	(37.06)	(1.26)
Time dummies	yes	yes	yes
Sector dummies	yes	yes	yes
Individual effects	no	no	yes
Observations	73370	72904	72904
Number of sectors	331	327	
R-squared	0.17	0.19	0.12
Number of individuals	.		18422

Absolute value of t statistics in parentheses
significant at 10%; ** significant at 5%; *** significant at 1%

Table 2.6: Effect of market returns and concentration on salary plus bonus

	(1) Salary+bonus	(2) Salary+bonus	(3) Salary+bonus
Market return	0.0001***	0.0024***	0.0023***
	(12.57)	(24.69)	(31.52)
Market ret. squd.	-1.3e-12***	1.2e-12***	3.0e-12***
	(2.87)	(2.65)	(8.29)
CR4*market ret.	-0.0001***	-0.00005**	-0.000008
	(4.55)	(2.10)	(0.43)
ln assets	173.0780***	159.0564***	45.6089***
	(117.67)	(73.79)	(10.62)
ceo	589.3344***	590.1983***	251.0295***
	(115.59)	(116.75)	(36.52)
Male	79.8776***	82.6025***	
	(8.20)	(8.55)	
Variance*market ret.		-0.0024***	-0.0023***
		(23.50)	(30.45)
Variance market		76.6788***	354.52***
		(6.94)	(8.19)
Constant	-973.8***	-921.6***	122.6
	(63.90)	(56.60)	(0.24)
Time dummies	yes	yes	yes
Sector dummies	yes	yes	yes
Individual effects	no	no	yes
Observations	73370	72904	72904
Number of sectors	331	327	
R-squared	0.30	0.31	0.19
Number of indiv.			18422

Absolute value of t statistics in parentheses
significant at 10%; ** significant at 5%; *** significant at 1%

Table 2.7: Effect of market returns and concentration on options granted

	(1) Options grant.	(2) Options grant.	(4) Options grant.
Market return	0.0000	0.0023***	0.0015***
	(1.29)	(6.73)	(4.31)
Market ret. squd.	2.3e-11***	2.6e-11***	1.9e-11***
	(15.11)	(17.35)	(10.00)
CR4*market ret.	0.0000	0.0001	-0.0003***
	(0.13)	(0.66)	(2.92)
ln assets	287.1187***	133.8204***	355.3578***
	(55.90)	(17.94)	(16.74)
ceo	761.3032***	765.2617***	335.3355***
	(45.61)	(46.54)	(10.80)
Male	85.0443**	93.0642***	
	(2.40)	(2.67)	
Variance*market ret.		-0.0023***	-0.0014***
		(6.64)	(3.80)
Variance market		1,020.4509***	483.3271**
		(26.91)	(2.32)
Constant	-1,039.07***	-1,385.13***	-1,938.96
	(20.18)	(24.18)	(0.77)
Time dummies	yes	yes	yes
Sector dummies	yes	yes	yes
Individual effects	no	no	yes
Observations	63872	63408	63408
Number of sectors	331	327	
R-squared	0.11	0.13	0.07
Number of indiv.			18388

Absolute value of t statistics in parentheses
significant at 10%; ** significant at 5%; *** significant at 1%

Table 2.8: Deregulation of the banking sector 1994, market returns

	(1) Total comp.	(2) Salary+bon.	(3) Options gr..	(4) Total comp.	(5) Salary+bon.	(6) Options gr.
Market return	0.0061***	0.0018***	-0.0018***	0.0070***	0.0020***	-0.0003
	(10.99)	(10.52)	(3.76)	(11.77)	(16.07)	(0.47)
Market ret. squd.	-4.4e-11**	-1.9e-11***	-5.6e-11***	5.2e-11***	2.3e-12	-1.2e-11
	(2.37)	(3.59)	(3.65)	(2.96)	(0.62)	(0.71)
fin94	-561.92***	-164.92***	-220.08**	-504.36***	-94.70***	-163.60
	(4.19)	(4.00)	(2.04)	(4.50)	(4.01)	(1.57)
fin94Xmktret	0.0022***	0.0011***	0.0004***	0.0022***	0.0007***	-0.0000
	(11.86)	(19.79)	(2.73)	(10.29)	(14.93)	(0.16)
Variance*mk. ret.	-0.0052***	-0.0016***	0.0022***	-0.0065***	-0.002***	0.0005
	(8.84)	(9.13)	(4.55)	(10.45)	(14.97)	(0.74)
Variance market	783.29***	113.88***	686.30***	533.57**	488.65***	219.87
	(21.35)	(10.09)	(22.64)	(2.32)	(10.12)	(0.92)
ln assets	162.41***	122.58***	24.28***	350.98***	34.67***	29.93
	(22.61)	(55.48)	(4.06)	(12.04)	(5.65)	(1.02)
ceo	1,174.55***	553.19***	536.59***	137.13***	180.97***	109.17***
	(59.38)	(90.93)	(34.82)	(3.51)	(22.05)	(3.13)
Male	136.73***	72.53***	8.44			
	(3.23)	(5.57)	(0.22)			
Constant	-127,635***	-63,847***	-153,660***	-143,329	-44,782	-6,714
	(8.87)	(14.42)	(12.85)	(0.83)	(1.23)	(0.02)
Observations	39484	39484	33844	39484	39484	33844
Time dummies	yes	yes	yes	yes	yes	yes
Sector dummies	yes	yes	yes	yes	yes	yes
Sector trend	yes	yes	yes	yes	yes	yes
Indiv. effectc.	no	no	no	yes	yes	yes
Number of sic2	61	61	61	61	61	61
R-squared	0.21	0.34	0.09	0.09	0.15	0.03
Number of indiv.	14161	14161	12975	14161	14161	12975

Absolute value of t statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%..

Table 2.9: Deregulation of the banking sector 1994, accounting profits

	(1) Total comp.	(2) Sal+bonus	(3) Options gr.	(4) Total comp.	(5) Sal+bonus	(6) Options gr.
Acc. profits	1.3980***	0.4828***	-0.3659***	3.8495***	1.6770***	0.8158***
	(8.92)	(10.55)	(2.89)	(12.20)	(27.16)	(2.76)
Acc. profits squd.	1.1e-6	-3.5e-6***	1.3e-7	0.00002***	4.7e-6***	2.6e-6
	(0.56)	(6.28)	(0.08)	(7.49)	(8.19)	(0.84)
fin94	-212.49*	-107.50***	-196.20**	-247.13***	-67.32***	-166.19**
	(1.95)	(3.38)	(2.29)	(2.60)	(3.62)	(2.02)
fin94Xpre	0.4960***	0.2293***	0.1024***	0.4773***	0.1209***	0.0514
	(11.43)	(18.10)	(3.05)	(9.78)	(12.66)	(1.24)
Variance prof.	722.66***	116.23***	528.60***	232.07	290.75***	259.84
	(19.50)	(10.74)	(17.28)	(1.14)	(7.33)	(1.36)
Var. prof*acc. prof	-1.1117***	-0.3753***	0.4404***	-3.6427***	-1.5984***	-0.7951***
	(6.95)	(8.03)	(3.39)	(11.30)	(25.34)	(2.62)
ln assets	117.4362***	90.8302***	33.8528***	213.9012***	4.0159	28.3626
	(15.54)	(41.16)	(5.33)	(10.36)	(0.99)	(1.44)
ceo	1,180.88***	543.83***	534.34***	73.38**	150.00***	139.65***
	(62.02)	(97.78)	(36.95)	(2.48)	(25.92)	(5.45)
Male	124.53***	73.37***	-14.39			
	(3.26)	(6.57)	(0.43)			
Constant	-25,306**	-36,689***	-109,613***	-115,975	-34,735	-39,312
	(2.31)	(11.49)	(11.68)	(0.86)	(1.32)	(0.21)
Time dummies	yes	yes	yes	yes	yes	yes
Sector dummies	yes	yes	yes	yes	yes	yes
Sector trend	yes	yes	yes	yes	yes	yes
Individual effects	no	no	no	yes	yes	yes
Observations	50977	50977	41777	50977	50977	41777
Number of sect.	62	62	62	62	62	62
R-squared	0.18	0.33	0.08	0.07	0.20	0.04
Number of indiv.	15436	15436	13952	15436	15436	13952

Absolute value of t statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%..

Table 2.10: Deregulation of the banking sector 1994, robustness checks

	(1) Fin. and services sec.	(2) ln Tot.Comp.	(3) Rents	(4) Stayers
Market return	0.0071***	4.64e-6***	0.0070***	0.0069***
	(4.42)	(20.02)	(11.68)	(11.55)
Market ret. squd.	1.5e-10**	5.7e-15	4.4e-11**	5.1e-11***
	(2.57)	(0.72)	(2.39)	(2.89)
fin94	-505.3621***	-0.1083**	-508.0139***	-530.6380***
	(3.50)	(2.15)	(4.52)	(4.74)
fin94Xmktret	0.0018***	1.95e-7**	0.0022***	0.0022***
	(6.50)	(2.54)	(10.21)	(10.20)
Variance*market ret.	-0.0064***	-0.0000***	-0.0065***	-0.0064***
	(3.72)	(18.80)	(10.41)	(10.19)
Variance market	643.4061	0.1743*	510.5187**	
	(1.31)	(1.68)	(2.22)	
ln assets	637.31***	0.2093***	349.27***	374.37***
	(9.51)	(15.94)	(11.92)	(11.66)
ceo	287.72***	0.1293***	136.31***	124.44***
	(3.08)	(7.37)	(3.48)	(3.13)
Rents			-0.0580	
			(0.02)	
Rents*market ret.			0.0004	
			(1.37)	
Constant	-340,736***	-251***	-144,791	-329,757***
	(3.88)	(3.23)	(0.84)	(24.57)
Time dummies	yes	yes	yes	yes
Sector dummies	yes	yes	yes	yes
Sector trend	yes	yes	yes	yes
Individual effects	yes	yes	yes	yes
Observations	9247	39445	39418	39484
Number of indiv	3474	14147	14154	
R-squared	0.15	0.17	0.09	0.08
Number of stayers				14449

Absolute value of t statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%..

Notes: The reference estimation is column 4 of Table 2.8: (1) is computed on service industries (SIC 60 to 81) (2) has ln(tot.comp.) as dep. variable (3) includes rents in the specification (4) is computed on workers within the same firm

Table 2.11: Deregulation of the financial sector 1999, market returns

	(1) Total comp.	(2) Sal+bonus	(3) Options gr.	(4) Total comp.	(5) Sal+bonus	(6) Options gr.
Market return	0.0137***	0.0025***	0.0029***	0.0103***	0.0018***	0.0007
	(25.91)	(19.93)	(6.59)	(19.39)	(20.10)	(1.53)
Market ret. sq.	1.9e-11***	1.0e-12**	1.9e-11***	1.1e-11***	2.2e-12***	1.5e-11***
	(9.63)	(2.22)	(11.72)	(5.31)	(6.03)	(7.24)
fin	-793.2***	-175.5***	-326.2***	-635.4***	-147.8***	-237.5**
	(5.87)	(5.55)	(2.93)	(5.42)	(7.57)	(2.32)
finXmktret	0.0015***	0.0002***	0.0002**	0.0016***	0.0002***	0.0003***
	(12.76)	(8.35)	(2.06)	(14.11)	(10.39)	(2.83)
Var.*mark. ret.	-0.0136***	-0.0024***	-0.0029***	-0.0104***	-0.0018***	-0.0007
	(25.28)	(19.30)	(6.42)	(19.28)	(19.75)	(1.43)
Variance mark.	1,622.8***	44.8***	1,873.5***	-578.6	744.8***	-960.6**
	(25.22)	(2.98)	(34.51)	(1.05)	(8.13)	(2.02)
ln assets	342.9069***	195.0105***	110.8193***	1,100.0066***	74.4715***	584.2***
	(27.08)	(65.79)	(10.33)	(24.98)	(10.15)	(14.62)
ceo	1,529.1***	631.8***	980.5***	194.4***	268.3***	316.4***
	(48.07)	(84.86)	(38.41)	(2.89)	(23.94)	(5.65)
Male	259.6527***	73.3866***	25.8249			
	(4.69)	(5.67)	(0.53)			
Constant	-497,822***	-110,447***	-321,563***	-62,499	-45,489	-176,154
	(19.54)	(18.52)	(15.28)	(0.07)	(0.32)	(0.29)
Time dummies	yes	yes	yes	yes	yes	yes
Sector dummies	yes	yes	yes	yes	yes	yes
Sector trend	yes	yes	yes	yes	yes	yes
Individual eff.	no	no	no	yes	yes	yes
Observations	41486	41486	36662	41486	41486	36662
Number of sic2	62	62	62	62	62	62
R-squared	0.21	0.33	0.16	0.11	0.17	0.06
Number of indiv.	14943	14943	14898	14943	14943	14898

Absolute value of t statistics in parentheses

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

Table 2.12: Deregulation of the financial sector 1999, accounting profits

	(1) Total comp.	(2) Sal+bonus	(3) Options gr.	(4) Total comp.	(5) Sal+bonus	(6) Options gr.
Acc. profits	1.1834***	0.4525***	-0.9696***	5.4825***	1.367***	1.0060**
	(5.67)	(9.36)	(5.38)	(12.48)	(18.99)	(2.45)
Acc. profits sq.	-0.00001***	-3.9e-6***	-2.3e-6*	1.3e-6	-1.6e-6***	7.2e-6***
	(6.70)	(11.26)	(1.66)	(0.76)	(5.53)	(4.05)
fin	-53.3	-96.9***	-212.1*	-123.8	-47.21***	-164.2
	(0.41)	(3.19)	(1.91)	(1.09)	(2.53)	(1.63)
finXpre	0.4277***	0.1888***	0.1313***	0.4839***	0.07***	0.1317***
	(9.97)	(18.99)	(3.73)	(11.02)	(10.17)	(3.19)
Variance prof.	1,089.1***	133.2***	1,170.5***	-1,038.9**	-473.3***	-1,671.8***
	(15.88)	(8.38)	(19.29)	(2.55)	(7.09)	(4.63)
Var. pr*acc.pr.	-0.6677***	-0.3087***	1.1542***	-5.3795***	-1.299**	-1.0225**
	(3.13)	(6.24)	(6.25)	(11.70)	(17.24)	(2.37)
ln assets	263.0***	131.8***	172.2***	906.3***	34.51***	598.6***
	(17.37)	(37.54)	(12.72)	(24.56)	(5.7)	(16.89)
ceo	1,519.7***	627.1***	991.0***	197.1***	252.5***	390.5***
	(48.61)	(86.50)	(38.33)	(3.15)	(24.63)	(7.28)
Male	253.1560***	75.8750***	10.3479			
	(4.77)	(6.17)	(0.21)			
Constant	-373,684***	-73,268***	-341,964***	-423,541	-195,686	45,479
	(15.27)	(12.91)	(16.40)	(0.50)	(1.40)	(0.04)
Time dummies	yes	yes	yes	yes	yes	yes
Sector dummies	yes	yes	yes	yes	yes	yes
Sector trend	yes	yes	yes	yes	yes	yes
Individual eff.	no	no	no	yes	yes	yes
Observations	44167	44167	38746	44167	38746	38746
Number of sic2	62	62	62	62	62	62
R-squared	0.20	0.34	0.14	0.11	0.17	0.06
Number of ind.	15480	15432	15432	15480	15480	15432

Absolute value of t statistics in parentheses

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

Table 2.13: Deregulation of the financial sector 1999, robustness checks

	(1) Fin. and services sec.	(2) ln Tot.Comp.	(3) Rents	(4) Stayers
Market return	0.0117***	4.64e-6***	0.0102***	0.0105***
	(10.64)	(27.28)	(19.09)	(19.77)
Market ret. squd.	2.7e-11***	3.7e-16	1.2e-11***	1.1e-11***
	(8.10)	(0.53)	(5.53)	(5.12)
fin	-674.0828***	-0.2743***	-638.7240***	-616.1032***
	(4.05)	(7.31)	(5.42)	(5.28)
finXmktret	0.0017***	1.95e-7***	0.0016***	0.0016***
	(13.42)	(5.27)	(14.07)	(14.07)
Variance*market ret.	-0.0120***	-0.0000***	-0.0103***	-0.0106***
	(10.84)	(26.90)	(18.91)	(19.66)
Variance market	704.8854	-0.2098	-581.6126	
	(0.49)	(1.15)	(1.06)	
ln assets	1,027.3077***	0.4299***	1,114.5571***	1,216.1255***
	(12.50)	(30.41)	(24.91)	(25.88)
ceo	139.5992	0.1673***	194.4852***	130.9413*
	(1.01)	(7.74)	(2.88)	(1.90)
Rents			11.0591**	
			(2.11)	
Rents*market ret.			-0.0001	
			(1.53)	
Constant	-2,093,703.1***	-99.0	-65,368.8	-724,942.3***
	(8.90)	(0.36)	(0.08)	(30.08)
Time dummies	yes	yes	yes	yes
Sector dummies	yes	yes	yes	yes
Sector trend	yes	yes	yes	yes
Individual effects	yes	yes	yes	yes
Observations	11092	41403	41425	41486
Number of individuals	4127	14925	14933	
R-squared	0.13	0.19	0.11	0.11
Number of stayers				15280

Absolute value of t statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%..

Notes: The reference estimation is column 4 Table 2.11: (1) is computed on service industries (SIC 60 to 81) (2) has ln(tot.comp.) asdep.variable (3) includes rents in the specification (4) is computed on workers within the same firm

Chapter 3

The hidden costs of fixed term contracts: the impact on work accidents

3.1 Introduction

What are the consequences of allowing for different contractual arrangements within the labour market on productivity and workers' welfare? Different arrangements for labour market institutions and the types of contracts allowed in an economy may have different consequences in terms of labour market efficiency and productivity. It is therefore important to take these consequences into account in order to devise the optimal design for a labour market. Different types of contracts have been shown to differ in the wages they offer[1] and in the training provided by employers[2]. However, there is little evidence on other consequences of the incentives generated by the different types of contracts such

[1] Jimeno and Toharia (1993) show that Spanish workers on temporary contracts receive a lower pay than their permanent counterparts

[2] Booth et al. (2001) find that the probability of receiving on-the-job training for workers in some type of FTC with respect to their permanent counterparts is 12% lower for male and 7% lower for female workers.

as their impact on productivity and workers welfare.

In this paper I develop the idea that different types of employment contracts provide different incentives to both the worker and the firm and hence result in different labour market outcomes. More precisely I focus on the differential impact of the type of contract on work accident rates for fixed term contract (FTC) versus indefinite or permanent contract (IC) workers. In a market where firms can chose between fixed term and permanent contracts for their workers, theory predicts that workers on fixed term contracts (characterised by a shorter duration and where rehiring is uncertain) will have a lower investment in specific human capital than their colleagues on permanent contracts. In addition FTC workers may also exert more effort on the job to raise their rehiring probabilities. The direct consequence of both a lower investment in human capital and higher effort is that FTC workers will have a higher probability of having an accident at the workplace.

In many countries there is no difference between the types of contracts legally allowed, or these are very similar, and it is therefore difficult to assess the actual impact of those arrangements (since there is no counterfactual available). This is why Spain is an ideal scenario to study these issues since it has a dual system in which temporary and permanent contracts are very different in terms of job protection. Furthermore a substantial part of the Spanish workforce (31% in 2000) is on fixed term contracts, and its accident rate has fluctuated substantially in the past 20 years. Spain has the highest work accident rate in the European Union, and while the European Union average in 1998 was 4.09 accidents per 100 workers, the Spanish incidence rate was 7.07 accidents per 100 workers[3]. Concerning the different incidence of accidents between FTC and IC workers, in 1999 the incidence of work accidents for FTC workers was 13 % while that of IC was 4.1%. The increase in work accidents has gone parallel to that in fixed term

[3] These are harmonised data from the ESAW (European Statistics on Accidents at Work) study run by the EU Commission and correspond to accidetns at work resulting in more tha n 3 days of absence and fatal accidents at work. For reference see Dupre (2001).

contracts (figures 1 and 4).This paper attempts to explain what part of this very large difference is due to a pure contractual effect.

There are other elements that create a differential in the accident rates of temporary and permanent contract workers that do not result strictly from a contractual effect. First, there may be some type of selection that results in FTC workers being more or less accident prone independently of the contract type. For instance if employers systematically hire the low ability workers under FTC. This would result in a higher accident rate for workers that is not a result of a contractual effect. Second, fixed term contract workers may systematically misreport the true accident rate. As a result of moral hazard, workers on FTC may report accidents more frequently than IC workers. On the other hand, having had an accident may be a bad signal to your current employer, who is also a potential future employer, and to other potential employers. In that case FTC workers have an incentive to under-report their accidents in order to have a higher probability of having their contracts renewed. For these reasons FTC may alter the reporting incentives and this will also reflect in differential accident rates.

In this paper I analyse two panels of sectoral work accidents between 1988 and 1998 for 32 industrial branches and apply two different identification strategies to distinguish the pure contractual effect from the selection and reporting biases. The first identification strategy is a difference estimator while the second exploits accidents on the way to work to identify the pure contractual effect.

In what follows I assess what fraction of the raw difference in accident probabilities between fixed term and permanent workers is due to the pure contractual effect derived from the duality of contracts, and see if after controlling for all the elements that may affect that gap a differential between FTC and IC accident rates persists. If this is so, one can conclude that temporary workers not only earn lower wages (Jimeno and Toharia (1993)) but they also have a higher accident risk[4]. This would be consistent with the

[4]A potential explanation to the difference in accident rates would be that FTC workers are systematically assigned to dangerous tasks. If this were the only explanation then the incidence for IC workers

theory and empirical analysis developed by Hamermesh (1999) where increasing wage inequality is accompanied by increasing inequality in work disamenities including risk of work injury.

The next section describes what determines the different accident rates between contracts. Section 3 outlines the econometric specification. Section 4 describes the data used and the identification strategies. Section 5 presents the results and section 6 concludes.

3.2 Reasons for a differential in accident rates between FTC and IC workers

From the existing theory we can select three different sets of reasons why there may be a systematic difference between the accident rate of fixed term workers and that of permanent workers.

Firstly investments in specific human capital depend on the expected return of the investment. For workers with short duration contracts the incentives of the employer and the worker to invest in specific human capital are lower than for identical workers with longer contract durations. These lower investments create a differential in human capital that may lead to systematically higher accident rates for those with temporary contracts. In this framework specific human capital would include not only on-the-job training to learn to do the job better, but also investment/training in health and safety (that are typically done by the employer). As far as related evidence on this is concerned Booth et al.(2002) find on UK data that temporary workers receive less on-the-job training than permanent workers. Furthermore there is a related literature in the medical and epidemiology fields on the impact of contract precariousness on health. Benavides et al. (2000) and Benavides and Benach (1999) find that job dissatisfaction, fatigue, backache and muscular pains are positively associated with precarious employment. This seems to

should have been falling over time (unless risk in the economy had increased dramatically). Figure 4 shows that it has remained stable while that of FTC workers is much higher and increased over time.

indicate that investments made by employers in health and safety measures are lower for FTC workers[5]. These differential investments in human capital arise from the difference in contract durations, and hence a lot will hinge on the probability that a fixed term worker is rehired on a permanent basis. If the worker is relatively certain that he will be rehired then there should not be much difference between the two types of contract, but when rehiring probabilities are low the mentioned effect will be fully at work. Güell and Petrongolo (2000) find that in Spain the probability of conversion of a fixed term contract into a permanent one went down from almost 20% in 1987 to 7% in 1996[6]. Booth et al.(2001) find for the UK that on the job training is lower for FTC workers. In fact previous studies have shown that fixed term contracts are used by firms as a flexible mechanism to adjust employment to fluctuations in the business cycle rather than using them as a worker screening or testing device (see Blanchard and Landier (2001)). It is also possible that the fact that FTC workers are less protected by trade unions reduces their bargaining power enabling employers to reduce their investment in safety measure and training for those workers. This would reinforce the mentioned effect of having a fixed term contract on accident rates through human capital differences.

Secondly a stream of literature has analysed the moral hazard effects in relation to work accidents. Fortin et al. (1999) analyse the relationship between workers compensation (WC) and the probability of reporting accidents and incorporate the interaction between WC and unemployment benefit. They argue that if WC is more generous than unemployment benefit (UB), those workers who are close to being laid off will try to benefit from WC as much as they can. This applies straightforwardly to the case of

[5] Amuedo-Dorantes (2002) finds in a study for Spain in 1997 that workers on FTC have worse working conditions than IC workers. She then studies the impact of the type of contract on the accident probability after controlling for these working conditions and finds a negligible effect. Unfortunately that study does not attempt to control for the moral hazard, reporting effects and selection on ability biases as I do in this paper. This residual contractual effect is likely to be a combination of all these reasons plus the pure contractual effect.

[6] They explain that in their sample from the Spanish Labour Force survey, a third of fixed term contracts terminate with a new FTC, a third terminate in unemployment or inactivity and 11% are renewed to a permanent basis. 20% of the spells they observe are censored.

FTC, and workers who know their contract is close to expiry will report more since they are entitled to WC (and maybe not to UB). This is referred to as ex ante moral hazard. There is also a form of ex post moral hazard given by those who have injuries that are difficult to diagnose. These people will claim WC and exaggerate their state. A related reporting effect is outlined in Boone and Van Ours (2002) that find in a cross-country analysis of fluctuation in accident rates that work accidents are counter-cyclical. In the analysis below I condition explicitly for the sectoral unemployment rate.

In Spain, a FTC worker who has an accident is entitled to 75% of his previous wage as worker compensation. This may last for a maximum of 12 months (plus six if those extra six months lead to recovery). To be entitled to benefit the worker must have made social contributions for at least 12 months in the previous 6 years (6 months in the previous 4 years before the 1992 reform). The amount of unemployment benefit received is 70% of the previous wage (80% before 1992) for the first six months subject to a maximum and a minimum cap.

Within this system, a moral hazard problem of the ex ante type may appear especially for young workers on FTC who are not entitled to unemployment benefit because they have not been contributing long enough.

A third source of hazard for the temporary workers is that if the probability of being rehired is increasing in effort, then FTC workers will exert more effort on the job. Intensity of work (or faster pace to impress the employer) will increase accident probabilities. Jimeno and Toharia (1996) find evidence that this is happening in Spain but do not make the link to the accident rate[7]. Descriptive studies on health at the workplace also find that FTC workers are less absent from work than permanent workers (Benavides et al. (2000)). At the same time, and following this argument, a systematic under-reporting of accidents might appear since if having had an accident is a negative

[7] In the empirical analysis they proxy effort with absenteeism but the data are such that one cannot distinguish absences due to illness and those due to accidents. They run a probit of the probability of being absent form work controlling for different measures of sectoral/occupational accident rates to separate absences due to accidents from the absenteeism effect.

signal for the employer and reduces (re)employment probabilities, FTC workers will tend to under-report accidents. So the reporting effect may go either way. In our estimation the net reporting effect will be dealt with using accidents on the way to work.

In addition to the human capital and reporting effects, the difference in accident rates between the two types of contracts may be the result of some type of selection on who holds a fixed term contract. If it is "bad" workers who are systematically hired on temporary contracts, then the gap is just a result of some unobserved difference in the quality/ability of workers. The analysis in this paper provides a way to control for this.

It must also be noted that there are no systematic institutional differences in the treatment of FTC and IC workers. Health and safety regulations treat both types of workers equally[8]. Furthermore the reporting procedure of work accidents, the fact that firms are not penalised for housing a lot of accidents (no experience rating) and that it is insurance companies who pay the workers compensation implies that there is close to 100% notification and that there are no differences in the behaviour of workers due to different incentives provided by the legislation.

Finally, in the empirical analysis other mechanisms must be controlled for. Workers on FTC will typically have less tenure and if experience is acquired with tenure then FTC workers will have more accidents just through this compositional effect. The empirical analysis will account for these and other observable differences (see table 3.1) to disentangle what is the proportion of the actual raw difference in accident probabilities that is exclusively due to the type of contract.

[8]The adoption of the EC 91/383 directive on health and safety for FTC workers in the Spanish legislation (in the Ley de Prevencion de Riesgos Laborales in 1995, article 28) has established equal treatment for both types of workers. Nevertheless, the ban on dangerous jobs for FTC workers has only been adopted for workers hired through temporary work agencies since 1999 (RD 216/1999).

3.3 Econometric specification

The probability of an accident can be written as a function a of a series of covariates as $y^*_{ijt} = \Pr(y_{ijt} = 1) = F(X_{ijt}, \beta)$. At the individual level we would observe $y_{ijt} = 1$ if $F(X_{ijt}, \beta) > z^*$ and $y_{ijt} = 0$ otherwise. Aggregating all the individuals in a sector j yields the proportion of the n_{jt} individuals in sector j who had an accident in time t. This observed proportion P_{jt} is an estimate of the population quantity π_{jt}, which is determined by $F(X_{jt}, \beta)$. A standard econometric technique to apply to these data is the minimum chi-square logit estimator[9]. Assuming a logistic distribution for F allows us to work with the transformation::

$$\ln(\frac{\pi_{jt}}{1-\pi_{jt}}) = \beta' X_{jt} \tag{3.1}$$

This is estimated by weighted least squares and produces the minimum chi-squared logit estimates of β. Marginal effects are computed as: $Ma.effect = \widehat{\beta} * \overline{P}(1-\overline{P})$, where $\overline{P}$ is the average sample probability of an accident.

My analysis is based on computing the sample probabilities of having an accident in a given sector and year. This is regressed using the minimum chi-squared logit method on a series of covariates that account for the business cycle, sectoral variables and individual characteristics. The standard errors are computed using the White covariance matrix. The individual level regression would be a limited dependent variable regression of:

$$\begin{aligned} y_{ijt} &= 1 \text{ if } \alpha + X'_{ijt}\beta_1 + Z'_{jt}\beta_2 + \gamma_1 FTC_{ijt} + \gamma_2 dt_t + \gamma_3 dj_j + \varepsilon_{ijt} > 0 \qquad (3.2) \\ y_{ijt} &= 0 \text{ otherwise} \end{aligned}$$

Where X_{ijt} are individual characteristics, Z_{jt} are sectoral variables, FTC_{ijt} is a dummy variable of whether the individual is on fixed term contracts, dt_t and dj_j are a set of time

[9] See Amemiya, T. (1981) for a complete analysis.

and sector dummies. Since I have data for the proportions P_{cjt} of accidents by industrial branch and type of contract, equation (3.2) can be naturally specified in the grouped logit framework as:

$$\ln(\frac{P_{cjt}}{1-P_{cjt}}) = \alpha + \overline{x}'_{cjt}\beta_1 + Z'_{jt}\beta_2 + \gamma_1 FTC_{cjt} + \gamma_2 dt_t + \gamma_3 dj_j + +\overline{\varepsilon}_{cjt} \tag{3.3}$$

Where $\overline{x}_{cjt}$ are the mean values of individual characteristics by type of contract, sector and time. Note that it is possible in this framework to identify the coefficients of equation (3.3) . The gap between the accident rates of the two types of workers will be captured by the coefficient γ_1.

Similarly, if instead using P_{cjt}, P_{jt} is used (accident probabilities by branch j and time t), then the equation to be estimated becomes:

$$\ln(\frac{P_{jt}}{1-P_{jt}}) = \alpha + \overline{x}'_{jt}\beta_1 + Z'_{jt}\beta_2 + \gamma_1 \overline{FTC}_{jt} + \gamma_2 dt_t + \gamma_3 dj_j + \overline{\varepsilon}_{jt} \tag{3.4}$$

Where $\overline{FTC}_{jt}$ is the proportion of workers in sector j at time t that have a fixed term contract.

Equations (3.3) and (3.4) are the basis of the empirical analysis.

3.4 Data and identification strategies

I use the work accidents data published by the Spanish Ministry of Labour and Social Affairs in the Estadistica de Accidentes de Trabajo (E.A.T.). In Spain all salaried workers must be insured against work accidents by law. The employer can choose whether to use public insurance with the national social security or to use a private insurance company (Mutuas de Accidentes laborales) and the premium paid depends on the wage of the worker regardless of the type of contract. In the event that an accident occurs there is an obligation to declare it, fill in a report and pass it to the insurance company and the Public Administration. From those reports[10] aggregate statistics on the number of accidents according to different classifications are published in the E.A.T.

I use two different classifications from the E.A.T., and for each of them I have a different identification strategy. The aim is to have a measure for the pure contractual effect net of all compositional effects including the accident proneness and reporting biases.

Firstly I use the number of work accidents by year, industrial branch and type of contract occurred in the period 1989-1998 to estimate equation (3.3). I identify the effect of temporary contracts using a difference estimator on the effect of holding a temporary contract. The problem with this estimator is that if there is a selection bias into FTC as a function of ability, accident proneness or any other unobserved variable, then the contract coefficient will be capturing this. The problem arises only if the selection is done through the unobserved characteristics.

To assess to what extent this coefficient captures the effect of ability or other types of systematic differences -like under or over-reporting- between workers in either type of contract I use another dataset, namely the total number of accidents by industrial branch. These data are split into two groups: accidents occurred at the workplace and accidents on the way to work. The identification strategy here relies on the assumption that the individual probability of having an accident on the way to work is independent of the type of contract held, but will depend on the accident proneness of workers. On the one hand, both the probability of having a serious or a fatal accident on the way to work and the probability of having an accident at work will depend on the accident proneness of the individual. Hence, introducing the probability of having a serious or a fatal accident in the estimation of equation (3.4) will capture the accident proneness and the contract coefficient will then be net of the ability/selection bias related to accident proneness. On the other hand, if there is a systematic reporting difference between the

[10] Partes de accidentes laborales

two groups (temporary and permanent), this should be captured by the variation in light accidents on the way to work. But light accidents also capture the accident proneness differential mentioned before (since one can misreport light accidents but not serious or fatal accidents). So including total accidents on the way to work (light, serious and deadly) in the regression will capture both the selection bias due to differences in accident proneness and due to systematic misreporting differences of workers on either type of contract

Figure 3.2 presents evidence for the validity of the identification strategy. If accidents on the way to work capture the changes in the accident proneness composition of both groups, then the ratio of accidents on the way to work to accidents at the workplace should be stable over time, everything else equal. Changes in that ratio should only be due to factors that affect differentially both magnitudes, like the changes in the proportion of people holding fixed term contracts. The main characteristic of the 1984 reform -a major reform of the Spanish employment legislation- was that it introduced fixed term contracts as a standard contract that could be used under a large number of circumstances (before that date they were seldom used and restricted to specific cases). So we should expect that before the reform this accident type ratio is stable and that if fixed term contracts are indeed relevant the ratio will fall as the proportion of FTC in the economy increases. This is indeed what happens in figure 3.2. After the introduction of fixed term contracts in 1984 the rise in the proportion of workers under FTC is accompanied by a fall in the ratio of accidents[11]. Further, Figure 3.5 shows the distribution of travel time to work for both types of workers[12]. These are virtually identical supporting the idea that accidents on the way to work and type of contract are independent. This confirms the validity of the use of accidents on the way to work as a way to identify the

[11] Figure 3 shows the evolution of the total number of accidents at work and on the way to work. Both series are smooth and confirm that the big fall in the accident type ratio is capturing a progressive change in the risk of work accidents that is due to the widespread use of fixed term contracts and is not a measurement problem

[12] In the Canaries between 1996-2000, 61% of accidents on the way to work were caused by vehicles, the next larger category being falls (13%) (data provided by the Labour Agency)

pure contractual effect, since the variation in compositional changes will be captured by the accidents on the way to work. Thus I estimate equations 3.3 and 3.4 using two different panels of work accidents by branch. The following section describes the covariates used.

3.4.1 Determinants of the injury probability

The difference in accident rates of FTC and IC workers could arise from other differences that have nothing to do with the contract. The most immediate one is that workers on fixed term contracts have shorter tenure and since the probability of an accident is decreasing in tenure and experience, FTC contracts will show a higher incidence just from this fact. But many other elements have an impact on injury probabilities. The determinants of injury probabilities fall into two categories: that of sectoral or aggregate data, i.e. how sectoral economic conditions affect injury probabilities, and then the individual characteristics of the worker. In the former category I will include the following variables: sectoral unemployment rates and the growth rate of sectoral valued added as indicators of the business cycle; the sector to which the worker belongs; the sectoral vacancy rate as a proxy for the degree of expertise of those entering the labour force (when the vacancy rate is high it should mean that all the experts in the workforce have been employed and hence that the new recruits will have less expertise); year dummies to account for other macroeconomic effects that may not be captured in the previous variables and a sectoral trend in the first set of regressions.

The other relevant set of factors are individual characteristics. Among these I include: the type of contract; the age, gender and tenure distributions and the proportion of people that work overtime hours in the sector as a proxy for work intensity computed from the EPA. Finally, in the second set of results I include the probability of having an accident on the way to work. Tables 3.1,3.2 and 3.3 contain the descriptive statistics of the variables used and the detail of how these are built can be found in the appendix.

3.5 Results

To analyse the effect of FTC on the probability of work accidents I run the minimum chi-squared logit method on two sets of data. First, I use the data of work accidents at the workplace by branch and type of contract from 1989 to 1998. The covariates used in the estimation are as described in the previous section. The contract effect is captured by a dummy variable that indicates if the workers were on FTC.

The results are presented in Table 3.5 .The sample raw differential in accident probabilities is of about 7 percentage points. FTC workers have an accident probability of 11.6% while for IC workers it is 4.5%.

Without introducing any other covariates, the effect of FTC is to increase by 5.8 percentage points the probability of having an accident. After introducing the set of controls, sectoral and time dummies the contract effect still survives and indicates that having a FTC increases the probability of accident by 7.2 percentage points. One might think that the coefficient may be biased if temporary workers are systematically of a different quality than permanent workers. In that case this coefficient will be capturing that selection[13].

The behaviour of the rest of covariates is as follows. The coefficients on the tenure distribution confirm that the accident probability is higher for people with short tenure and reaches a maximum for those between 6 months to 1 year of tenure. The results for the age distribution show that the age groups with more accidents are old workers (above 55) and those between 25 and 35. This may capture a number of effects like how careful these groups are at the workplace. Concerning gender differences, male workers have more accidents. Finally, the coefficient on the proportion of workers who did overtime hours, that was used as a measure of work intensity, is negative and significant. This

[13] Observed differences in the selection are controlled for in the regressors. If there are any unobserved differences determining whether the worker holds a FTC then this would result in omitted variable bias. The second specification in table 5 excludes as covariates the individual characteristics. The FTC coefficient changes considerably when one omits these variables indicating that selection into either type of contract is correlated with the observable characteristics.

is probably because the probability of having an accident for a low tenure worker is higher than that of an experienced worker even when the latter works overtime. In sectors that prefer to make their workers work extra hours instead of hiring new workers the accident rate will be lower. Finally, branch and year dummies as well as a sector trend were included. Sector dummies were highly significant confirming the idea that the risk differential between sectors is important and must be accounted for in the analysis. When these dummies were included the sectoral variables lost significance although they kept the expected sign: the unemployment rate has a negative impact on accidents, indicating that when unemployment is high there are fewer accidents because activity is low, remaining workers are of higher ability or because reporting is higher as in Boone and Van Ours (2002)). Vacancies and the growth rate of value added have a positive effect on accidents.

The results confirm the idea that there is a contractual effect at work and it appears to be very large. But as mentioned above if FTC workers are systematically selected according to some unobserved elements (such as ability), then the reported coefficient may be capturing that systematic difference and hence biased. To check that there is no underlying characteristic of fixed term contract workers biasing the results, I exploit the second dataset.

The second set of data records total accidents at the workplace by branch between 1988 and 1998. A grouped logit regression is run on the same set of industry variables as before. Now the contract effect is captured by the proportion of FTC workers in the branch. Note that most of the accidents are light (the probability of having a light accident at the workplace is 5%, that of a serious accident is 0.1% an that of a deadly accident is 0.001%), and hence the probabilities of serious and fatal accidents are too small to run the analysis for the different types of accidents.

Table 3.6 shows the results for accidents occurred at the workplace. After controlling for all covariates, the marginal effect of an increase in the proportion of temporary contracts of one percent is 0.038 (though with a t-value of only 1.3).

At this point and as mentioned above, a potential problem with the estimation of the FTC effect must be dealt with. If there is some type of selection process by which FTC workers are of lower ability and hence have more accidents -and the selection is not constant across sectors-, then the FTC coefficient will be capturing this. The other problem is that FTC workers may consistently over-report accidents (because of the moral hazard reasons mentioned before) or under-report them, if they want to make sure they are reemployed and want to avoid the stigma of looking like a "bad worker".

The identification strategy used for these data exploits accidents on the way to work and is based on the assumption that the true probability of having an accident on the way to work is independent of the contract held. Hence using the proportion of serious and fatal accidents on the way to work as a regressor should control for the variation of accidents at the workplace that are due to variations in the quality of workers hired and hence the FTC coefficient will be free from the quality composition problem.

I also assume that the tendency to over/under report an accident for an individual should be the same whether the accident occurs at work or on the way to work since the compensation received in either case is the same (in Spain accidents on the way to work are considered by law as work accidents). Hence variations in the reporting bias because of changes in the composition of the workforce will be captured by variations in accidents on the way to work. In this case it is light accidents on the way to work that enable the identification since only for this type of accidents workers can misreport the true state. Serious and fatal accidents are harder or impossible to misreport, so serious and fatal accidents will capture the "ability" or accident proneness element of the bias while light accidents will capture both the accident proneness and the reporting effects.

So including the proportion of serious and fatal accidents occurred on the way to work as a regressor in the workplace accidents regression should eliminate the systematic differences between the two groups and we are left with a pure contractual effect that includes the human capital, increased effort and reporting effects. Then using the proportion of all types of accidents on the way to work also captures the variation in systematic reporting differences or other aspects that can be manipulated by the worker.

After introducing the proportion of serious and fatal accidents on the way to work and hence controlling for systematic differences in accident proneness the contractual effect survives and is about 7.4 percentage points (Table 3.7). Further, controlling for all types of systematic differences including reporting biases preserves the positive effect of fixed term contracts on the probability of accidents and yields a marginal effect of 0.051 (Table ??)[14]. That is, after cleaning the contract coefficient of the selection and reporting biases the contractual effect results in an increase of 5 points in the accident probability, i.e. it roughly doubles that probability..

3.6 Conclusion

This paper assesses whether there is a systematic difference between the accident rates of fixed term and permanent contracts workers that is not just the result of a compositional effect. A pure contractual differential may arise because the nature of the temporary contract, namely its short duration, reduces the incentives to invest in specific human capital and hence reduces the expertise of the worker leading to a higher accident rate. It may also increase effort exerted thus resulting in more accidents. On the other hand there may be a systematic selection of workers into either type of contract due to ability or systematic reporting differences that might explain why fixed term contract workers have more accidents. I try to separate the different effects and see if after controlling for all relevant elements, a contractual effect subsists.

I use a sectoral panel with 32 industrial branches over 11 years. The results indicate that there is a contractual effect at work that explains a very large part of the raw

[14] In any case note the increase in the R^2 in the first specification from table 6 to tables 7 and 8 indicates that accidents on the way to work are capturing a variation that explains a lot of the changes in workplace accidents. Also, the associated coefficients are positive and higly significant.

differential (around 70%). This effect subsists after I control for all observables plus the ability and reporting biases using accidents on the way to work. I claim that the resulting difference of 5 percentage points in accident probabilities is due to different investments in human capital (including safety training/measures) and different effort levels exerted on the job.

The consequences of these results in terms of social cost and productivity are evident. Workers on temporary contracts suffer from higher job insecurity both in terms of lower wages and higher accident risk. On the labour demand side, there are negative effects of allowing employers to use FTC to adjust employment to the business cycle at low cost: temporary contracts imply lower human capital accumulation and potentially lower productivity. A policy implication of these results would be to try to limit the use of FTC to cases where it is really necessary and bring in labour market flexibility using another type of institution that does not have this negative feature. Or set up the conditions so that more FTC are transformed into permanent contracts and the mechanisms through which the pure contractual effect appears are no longer present.

3.7 Appendix: Construction of the variables

A) Sectors: I had to homogenise the industrial classifications CNAE74, CNAE 92 and the sectors as defined in the EAT (which groups the CNAE subsectors -2digits- into 44 industrial groups). This forced me to group further some categories and I ended up with 32 “branches” or ”sectors” that represent all areas of activity.

B) Work accidents: three different panels of sectoral accidents were used. These were obtained from the Estadistica de Accidentes de Trabajo (E.A.T.) provided by the Ministerio de Trabajo y Asuntos sociales (M.T.A.S.). These are public data that are provided in paper format. The series are constructed from the aggregation of individual records and are provided by the M.T.A.S. The series used here were: 1) Total number of accidents at the workplace per industrial branch, year and type of contract (fixed-term or permanent); 2) Total number of accidents at the workplace per industrial branch, year and seriousness of the accident; 3) Total number of accidents occurred on the way to work (in itinere) per industrial branch, year and seriousness of the accident. This is divided into light, serious and fatal accidents. All accidents refer to accidents leading to at least one day of absence from work.

C) Employment by sector and other covariates: To obtain the risk of having an accident I built the series of the population at risk (employment) per sector (and type of contract where relevant) from the second quarter of the Spanish labour force survey (E.P.A., I.N.E.). The covariates on individual characteristics were also obtained from the E.P.A. These are constructed as the proportions per sector, year (and contract were relevant) of individuals with the relevant characteristic. These were:

- Age, job tenure and gender distributions

- Overtime hours worked: proportion of employed who worked more than fourty hours in the reference week.

D) Sectoral variables

- Proportion of fixed term contracts in the sector. Source: 2nd quarter 1987-1998, EPA INE

- Unemployment: The unemployment rate in the sector is the number unemployed workers who previously held a job in the sector over the number of active workers in the sector. Source: 2nd quarter 1987-1998, EPA INE

- Vacancies: number of vacancies in the sector posted in the national employment institute (INEM). Source: I.N.E.M. vacancies publication.

- Gross value added (sector): I had quarterly GVA for agriculture, industry, construction, services (market and non market). The series were transformed to constant prices using the corresponding sector price indices.

3.8 Figures and tables

Figure 3.1: Evolution of work accidents and fixed term contracts

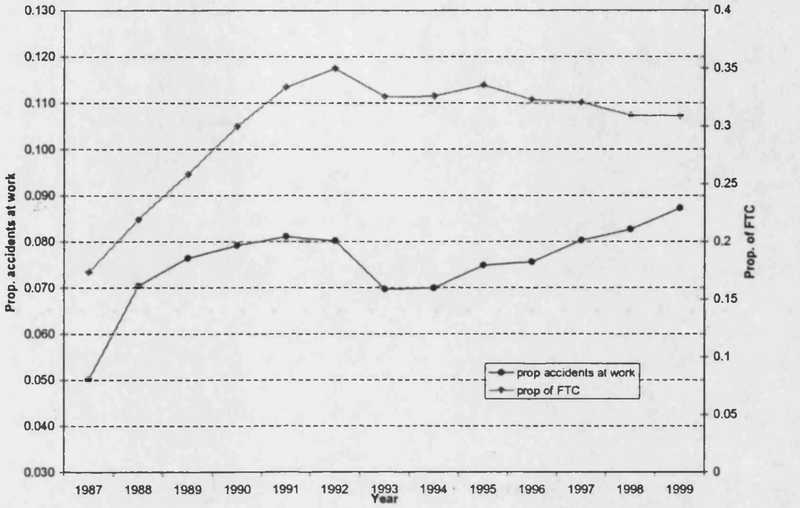
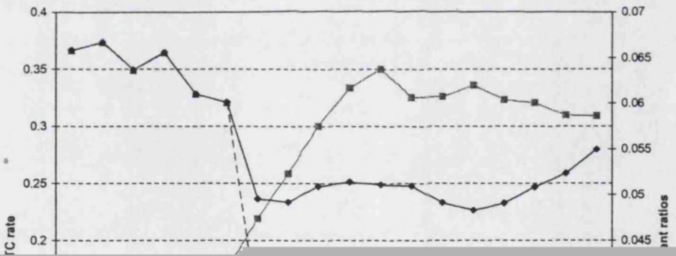
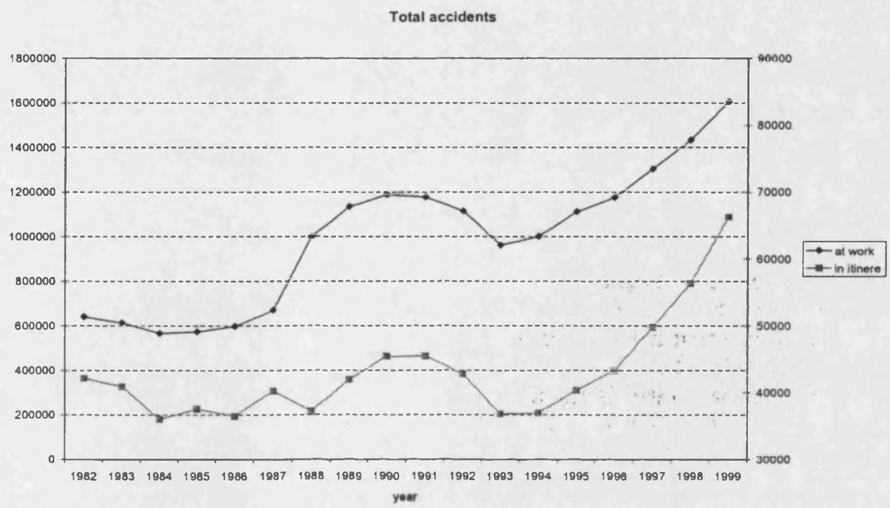


Figure 3.2: Validity of the identification strategy



statistical break, the solid line assumes that the increase in work accidents in 1988 is the same as that in 1987 and plots the ratio after this based on that figure. Also note that the FTC rate data before 1987 are an extrapolation: before 1984 FTCs were restricted to seasonal contracts and I assume they grow linearly after that (no data are available from EPA on FTC before 1987).

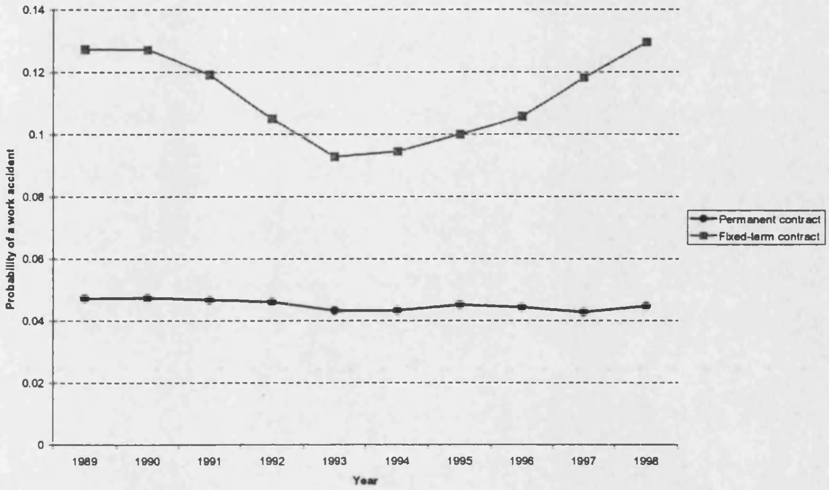
Figure 3.3: Total number of accidents at work and on the way to work



Source: E.A.T.

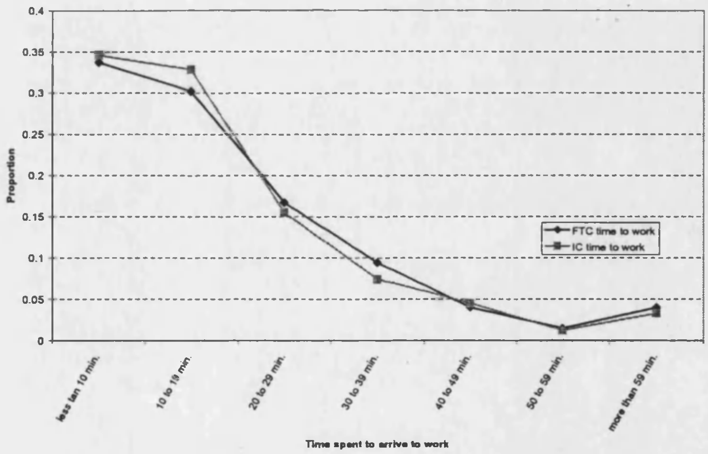
Figure 3.4: Incidence of accidents for FTC and IC workers 1989-1998

Figure 4:



Source: own elaboration from E.A.T. and E.P.A.

Figure 3.5: Distribution of travel times to work by type of contract



Source: Encuesta Nacional de Condiciones de Trabajo, 1997, C.I.S. Based on 3804 observations.

Table 3.1: Descriptive statistics

	Fixed term contract		Permanent contract	
	mean	std. dev	mean	std. dev.
Accident probability	0.116	0.105	0.0457	0.043
Tenure: $\leq$ 2 months	0.353	0.127	0.016	0.012
2 months to 6 months	0.296	0.057	0.024	0.014
6 months to 1 year	0.251	0.844	0.076	0.032
1 year to 3 years	0.075	0.058	0.104	0.036
3 years to 10 years	0.0199	0.024	0.283	0.046
more than 10 years	0.0046	0.009	0.498	0.103
Age: $\leq$ 25	0.415	0.132	0.099	0.062
26 to 35	0.310	0.077	0.282	0.055
36 to 45	0.153	0.055	0.286	0.056
46 to 55	0.088	0.049	0.216	0.056
more than 55	0.034	0.030	0.116	0.044
overtime	0.115	0.081	0.102	0.077
Male	0.622	0.262	0.675	0.209
Training contract	0.029	0.021	0	0
Seasonal contract	0.111	0.128	0	0
Other FTC contract	0.859	0.121	0	0

Table 3.2: Descriptive statistics of accidents by seriousness (at the workplace/on the way to work)

	mean	std. dev.
Accident probability (yearly)		
light, at the workplace	0.0509	0.0460
serious, at the workplace	0.00096	0.00073
deadly, at the workplace	0.000097	0.0011
total at the workplace	0.052	0.0467
light, on the way to work	0.00313	0.00199
serious, on the way to work	0.00020	0.00011
deadly, on the way to work	0.00003	0.000026
Covariates		
Tenure (proportion): $\leq$ 2 months	0.097	0.045
2 months to 6 months	0.089	0.034
6 months to 1 year	0.121	0.042
1 year to 3 years	0.101	0.036
3 years to 10 years	0.217	0.042
more than 10 years	0.377	0.110
Age (proportion): $\leq$ 25	0.169	0.061
26 to 35	0.342	0.062
36 to 45	0.247	0.044
46 to 55	0.195	0.039
more than 55	0.122	0.065
Overtime (> 40 hours per week)	0.198	0.141
Male	0.666	0.208
Training contract	0.007	0.005
Seasonal contract	0.029	0.030
Other FTC contract	0.198	0.0.096

Source: E.P.A and E.A.T, see Appendix for description

Table 3.3: Sectoral variables

	Mean	Std. Dev.
Proportion of FTC	0.232	0.092
Prop. first time unemployed	0.251	0.047
Sector Unempl. rate	0.136	0.055
Gross value added growth rate	0.029	0.039
Vacancies	30399	28886

Source: various sources, see Appendix for description

Table 3.4: Probability of accidents at the workplace by type of contract

	Coefficient	Coefficient	Coefficient
Constant	-4.879** (0.084)	-137.665**(28.89)	-159.46** (29.32)
FTC dummy	1.032**(1) (0.114)	0.838**(2) (0.0256)	1.464**(3) (0.270)
U rate	x	-0.669 (0.709)	-0.307 (0.615)
GVA growth rate	x	0.189 (0.496)	0.210 (0.365)
Vacancies	x	-5.59e-07(1.58e-06)	6.23e-08 (1.21e-06)
Male	x	x	0.355*(0.210)
Tenure distribution: 2-6 m.	x	x	0.485 (0.350)
6m to 1yr	x	x	1.568** (0.231)
1yr to 3yr	x	x	1.125** (0.432)
3 to 10 years	x	x	0.651 (0.495)
more than 10 years	x	x	1.191** (0.385)
Age distribution:26 to 35	x	x	1.330** (0.304)
36 to 45	x	x	0.139 (0.279)
46 to 55	x	x	0.054 (0.388)
more than 55	x	x	2.852** (0.604)
Overtime	x	x	-1.189** (0.393)
Year dummies	x	yes	yes
Sector dummies	x	yes	yes
Sector trend	x	yes	yes
Observations	640	640	640
R^2	0.212	0.944	0.957

** indicates 5% significance, * 10% significance; std. errors in parenthesis

Marginal effects: (1) 0.058 (2) 0.041 (3)0.072

Table 3.5: Probability of accidents at the workplace

	Coefficient	Coefficient
Constant	-5.094** (0.417)	-5.813** (1.113)
Proportion of FTC	1.847**(1) (0.679)	0.762(2) (0.587)
U rate	x	-0.357 (0.666)
GVA growth rate	x	-0.051 (0.3324)
Vacancies	x	1.75e-06* (9.06e-07)
Male	x	-0.222 (0.243)
Tenure distribution: 2-6 m.	x	1.361 (1.408)
6m to 1yr	x	3.307** (0.917)
1yr to 3yr	x	2.849** (0.956)
3 to 10 years	x	0.512 (1.00)
more than 10 years	x	2.120** (0.838)
Age distribution:26 to 35	x	-0.702 (0.758)
36 to 45	x	1.130 (0.801)
46 to 55	x	0.165 (1.058)
more than 55	x	-0.443 (1.325)
Overtime	x	-1.708** (0.511)
Year dummies	x	yes
Sector dummies	x	yes
Observations	352	352
R^2	0.033	0.970

** indicates 5% significance, * 10% significance; std. errors in parenthesis

Marginal effects: (1) 0.091 (2) 0.038

Table 3.6: Probability of accidents at the workplace, control for quality

	Coefficient	Coefficient
Constant	-5.495** (0.118)	-7.369** (0.877)
Proportion of FTC	1.872**(1) (0.495)	1.501**(2) (0.482)
Prop. ser.+fat. ac. to work	1795.01** (110.0)	814.33** (72.7)
Set of controls	x	yes
Year dummies	x	yes
Sector dummies	x	yes
Observations	352	352
R^2	0.386	0.979

** indicates 5% significance, * 10% significance; std. errors in parenthesis

Marginal effects: (1) 0.092 (2) 0.074

Table 3.7: Probability of accidents at the workplace, control for all unobservable hazard

	Coefficient	Coefficient
Constant	-5.366** (0.122)	-7.718** (-0.640)
Proportion of FTC	1.533**(1) (0.555)	1.043**(2) (0.396)
Prop. total acc. to work	115.03** (7.540)	78.714** (5.387)
Set of controls	x	yes
Year dummies	x	yes
Sector dummies	x	yes
Observations	352	352
R^2	0.454	0.984

** indicates 5% significance, * 10% significance; std. errors in parenthesis

Marginal effects: (1) 0.075 (2) 0.051

Chapter 4

Unemployment duration, unemployment benefit and household income: the Spanish case

4.1 Introduction

How does the income available to an unemployed person affect his/her probability of becoming employed? The level of household income and of unemployment benefit are very important in determining unemployment behaviour. However, even though this seems a crucial question, no paper has addressed it directly for the case of Spain. This paper addresses the following two questions: what is the effect of the level of household income on the incentives of an unemployed person to find a job and whether unemployment benefit *levels* actually have an impact on the probability of an unemployed person obtaining a job in Spain. In Spain, the effect of unemployment benefit has only been analysed comparing those who are actually receiving unemployment benefit and those who are not. But the impact of the different *levels* of unemployment benefit on the exit rates has not been analysed explicitly. More importantly, the effect of household income (defined as the income brought to the household by the other members), has traditionally been thought to be very large due to the existence of strong family ties, as in other Mediterranean countries. Nevertheless the actual impact of household income on the behaviour of the Spanish unemployed remains largely unexplored.

The reason why these questions have not been tackled directly until now is that Spanish micro-datasets like the Spanish labour force survey (EPA) and others do not include data on income variables. Only the Encuesta Continua de Presupuestos Familiares (ECPF), a family expenditure survey, contains the data that we are interested in, namely income data and information on the structure of the household. But this richness in the dataset, comes at the expense of having an imperfect measure of unemployment duration. Indeed, in the ECPF the full duration of the unemployment spell is not available because the exact moment of entry and exit are not observed. Instead we have discrete records, separated in time and limited information on the individual between the spells. And the interviews are three months apart from each other, so grouping the data would result in a considerable loss in precision. In this paper I develop a hazard model that accounts for these limitations and allows to use the panel to analyse the transitions to employment in Spain. Hence I provide a way to extract optimally the information on flows contained in a dataset which measures stocks at different points in time.

The empirical literature on unemployment duration in Spain has failed to address the differential impact of unemployment benefit and of other sources of income, such as household income, on unemployment duration. The added value of this paper is precisely to take these sources of income into account explicitly and assess to what extent they affect the behaviour of the unemployed. In particular I study to what extent household support is important in explaining long unemployment durations, as it is argued for many Mediterranean countries (Bentolila and Ichino (2000)). I can assess the actual impact of the level of household support on behaviour. In addition, household income, together with information on the household structure, is considered to be vital in the study of female unemployment insofar as they capture the division of labour in the household. I am able to study this explicitly with the ECPF while much of this information was missing in previous studies.

Concerning the level of benefits, existing studies do not specify the level of the benefits itself and only use a dummy variable for benefit receipt. They find that benefit recipients have lower hazard rates (Arellano (1997), Garcia Perez (1997)) and that the hazard increases when the time of benefit exhaustion is closer (Ahn (1995))[1]. In this paper I analyse the effect of the level of unemployment benefit received explicitly, and hence I am in a position to provide an elasticity of duration to unemployment benefits for Spain.

The next section outlines the main theoretical drivers of the behavior of the unemployed that constitute the background to the empirical analysis. Section three describes the data and provides the detail of how maximum likelihood estimation is used to deal with the sampling structure of the dataset. Section four presents the results and section five concludes.

4.2 Theoretical background

This paper assesses empirically two aspects of job search. The first one is the effect of the level of unemployment benefit on the likelihood of exiting unemployment. The second is how family income affects these exit rates. The theoretical model underlying our empirical estimation is that of Mortensen (1977). Mortensen provides a dynamic search model where individuals chose their optimal search strategy given the benefit system and the probability of layoff when employed. In the model, unemployed individuals receive

[1] Cebrian et al. (1996) find that benefit recepients are more likely to exit unemployment, but this is mostly due to the sample selection present in their dataset (they use administrative records of the unemployment insurance system, and these only sample those who register and hence are entitled to benefit).

employment offers with some probability for a certain wage and in the face of each offer they decide whether to take up the job or to keep on searching. A dynamic optimisation programme is solved where individual utility is a function of leisure and consumption. Consumption is defined as the goods purchased with the income received (this can be, depending on the state, unemployment benefit, the wage or, as in our case, household income). Individuals will accept the offer it they prefer the offered wage to continuing in unemployment. The wage that leaves them indifferent between the two alternatives is the reservation wage. Wage offers follow a certain distribution, known to the individuals. Thus the probability of exiting unemployment (the hazard rate) is just the product of the probability of receiving an offer and the probability that the offer exceeds the reservation wage.

The reservation wage is a function of the income received by the individual while unemployed -like unemployment benefit-, the rate of arrival of the offers, the search cost and the wage distribution.

Mortensen shows that unemployment benefit has two effects: a disincentive effect, whereby the hazard rate is reduced by increasing the value of being unemployed; and an entitlement effect, that provides a higher value to employment to those who are not receiving any unemployment benefit or who are near unemployment benefit exhaustion.

However, Mortensen's model does not include other sources of income available to the individual such as income earned by other household members. So, what is the expected effect of household income on exit rates? We can think of different effects. The first one is a pure income effect. The higher the "household income" that is at the disposal of the individual the lesser the pressure to find work because the utility from leisure is higher since he has some level of consumption. So in the trade off between staying unemployed and searching harder to find a job, a higher household income reduces the incentives to search[2].

[2]There is also a second order effect in the sense that if the individual is receiving unemployment benefit and has some level of household income, an increase in the level of unemployment benefit will

Additionally, there is a differential predicted effect of household income on men and women that is due to the division of labour within the household. In the traditional model of division of labour and specialisation in the household, women are said to be responsible for the household duties. Given this structure, female search intensity will in general be lower than that of males because their "leisure" time is devoted both to search and to fulfilling those household duties. But at the same time they will be more sensitive to differences in the level of income in the household. In the extreme model men are expected to work regardless of the income earned by other members while women will only work when household income is very low. Thus, the higher the earnings of her partner, the lower the probability that she looks for a job. Notice though that by the same token, she is more likely to exit into inactivity. So we would expect that household income is more significant for women than for men. This is somewhat related to the added- worker effect literature that claims that when the income of the household drops, the wife has a greater incentive to look for work[3]. But instead of identifying out of time series variation in household income -as in the standard added worker effect literature- I study whether there is a cross sectional difference for households with different levels of wealth[4].

4.3 Econometric Specification

4.3.1 The dataset: Encuesta Continua de Presupuestos Familiares (ECPF)

The ECPF is a household expenditure survey designed to provide information on the source and level of the household income and expenditure, but it also contains a series of variables that allow us to undertake an analysis of labour market behaviour. 3200

increase utility by less than if no income was available, from the marginally decreasing utility of leisure, thus the negative effect on his search intensity will be lower.

[3] Cullen and Gruber (2000) link the added worker effect to the receival of unemployment insurance by the husband by arguing that unemployment insurance actually crowds out the spousal labour supply.

[4] Prieto and Rodriguez (2000) study the added worker effect for the Spanish case. They find evidence of female labour participation being stimulated when their husband is unemployed.

households are interviewed every quarter and 1/8th of the sample is renewed every quarter. The sample used here covers the years 1985 to 1995.

One of the problems found with the data is that, although they contain a lot of information for the head of household (hoh), they have less information for the partner and the children. In particular there is no information on the activity status of dependents. Thus, I only include heads of household and partners in the analysis. Table 4.1 shows the information provided for each category:

Table 4.1: ECPF dataset

	Hoh	Partner	Children
Sex	yes	yes	yes
Age	yes	yes	yes
Whether they received income in the last 3 months	yes	yes	yes
Work Status in the last week	yes	yes	no
Income data (wage, unemployment benefit, pension...)	yes	yes	yes
Education	yes	no	no
Activity group	yes	yes	no

A further point related to the way the dataset is built concerns the definition of the heads of household. "Head of household" is the individual with the highest income[5]. Since the head of household dummy refers to the observation before the individual becomes unemployed, I consider it does not induce endogeneity problems. The case would be different and problems might arise, if I used later changes.

An important issue when using this dataset is the way the question on employment status is asked. The interviewees answer what their status was during the "reference week" (the week before the interview)[6]. This means that I only have information on the

[5]For this reason, in the panel we observe heads of household apparently "changing" sex and age from one interview to the next. This is because when the head of household dies or experiences a substantial loss of income, another member of the household takes their position. This was dealt with by tracking the head of household when they changed and recovering them from their new position when this was possible, and the same was done for the partners. This implies that our sample also includes all those individuals that went from a position of head of household to that of partner and vice versa.

[6]Status includes part time or full time employed, unemployed, retired, work on the household duties, other

employment status of an individual at discrete points in time -during the week of the interview-, not the full duration of each spell nor the exact point in time when a transition occurred. Hence, what I observe for each individual is a series of observations on status, a sequence of employed/unemployed elements. However, I ignore what occurred between two elements of the sequence. This implies that if I observe an individual who reported to be employed in one interview and declares he is unemployed in the next (three months later), I don't know the exact moment when he became unemployed. Similarly I do not know the exact moment when an individual who is unemployed in one interview and employed in the next exits unemployment. But as the interviews are three months apart in time, I will observe the same pattern of replies to the question on labour market status for individuals that have a difference in unemployment of up to six months minus two weeks.

Given the characteristics of the sample and the fact that I don't know the exact moment when the individual entered or exited unemployment, standard survival estimation procedures may not be used and I must instead adapt a likelihood function to the sampling of the data. This is done in the next section.

4.3.2 The Likelihood Function

The sampling structure of the ECPF raises a number of issues that must be dealt with in the likelihood. The first problem is that the exact moments of entry and exit are unobserved, but I know within which three month bracket they occurred. This in not standard left or right censoring since I know entry times (and exit for those not truly censored) up to a three month error. This information needs to be exploited. Furthermore the only individuals for whom I observe a spell of unemployment are those who do not exit before their next interview, so very short spells (less than three months) will be under-represented and this must be accounted for. Similarly, since the probability of becoming unemployed varies within and across quarters and that I only observe durations at the end of each quarter, the likelihood will account for some form of stock sampling bias. This is not too problematic in my case because I am working at quarterly frequencies, but if this likelihood were to be applied to samples with lower frequencies of observations, it becomes more important to account for this. In what follows I derive the density function of uncompleted spell durations that applies to this type of sample. I do so thinking in terms of *numbers and proportions of people* to compute the appropriate probabilities.

Individuals are interviewed every quarter and declare their employment status in the week of the interview. The sample goes from the first quarter in 1985 to the last quarter of 1995. Let us take the sample of people that are employed in one interview, and unemployed in the following -that we observe "entering" unemployment. In the subsequent periods they may follow any pattern of unemployment to employment, and all these patterns are mutually exclusive. So I have a number of individuals whose probability of becoming unemployed in any quarter varies over time (empirically, the inflow rate), and who subsequently have a probability distribution over the possible pattern of the spell (where patterns are mutually exclusive events and their probability sums to one). Furthermore, some individuals may enter and exit unemployment before the following interview, so the analysis must condition on entering unemployment and remaining unemployed to the following interview. Finally, among all those entering unemployment during the time they are in the sample,there are two types of individuals: those who declare unemployment in all the interviews until their last period in the sample, at time k and those who declare employment at some point before they exit the sample (at time $k_1 < k$). The probability of each duration pattern will be derived from this partitioning of the data.

Given the partitioning, I derive an expression for the probability of an unemployed individual exiting unemployment between the $k_1 - 1$ and $k_1 th$ interview given he declared being employed at t and unemployed at $t + 1$. That is he entered unemployment at $t + v$

$(0 < v < 1)$ and remained unemployed until $t+1$. The crucial thing to note is that v is unobserved. (in what follows I avoid individual subscripts for notational simplicity)

Let $n(t, x)dt$ be the numbers entering unemployment between time t and time $t+dt$.

Now consider $S(T-v; x)$ as the proportion of people entering unemployment at $t+v$, who are still unemployed at $t+T$, i.e. at duration $T-v$. This is the survival function.

Since I will parametrise the survival function, I define the hazard rate as $\theta(\tau; x)$. The survival function is then:

$$S(T-v; x) = \exp\{-\int_0^{T-v} \theta(\tau; x)d\tau\}$$

Since v is the unobserved moment in which transitions occur I will integrate over it. Thus the number of people of type x entering unemployment between t and $t+1$ (the following interview) is given by:

$$\int_0^1 n(t+v, x)dv$$

And the number of people entering unemployment between t and $t+1$, and still unemployed at $t+1$ is:

$$\int_0^1 n(t+v, x)S(1-v; x)dv$$

The individuals are interviewed at $t = 1, 2, 3, \quad, maxQ$, where $maxQ$ is the number of quarters in the sample. So the total number of individuals entering unemployment between $t = 1$ and $t = maxQ$ is:

$$\sum_{t=1}^{\max Q} \int_0^1 n(t+v, x)S(1-v; x)dv$$

To deal with the fact that a number of observations are censored, one must distinguish between the contributions of those who exit unemployment before they exit the sample and those who don't. Thus the individual contributions to the likelihood may be written as follows.

Of the total number of individuals in the sample, the proportion who appear at t, are unemployed at $t+1$, are still unemployed at $t+k_1-1$ but are employed at $t+k_1$ is:

$$\frac{\int_0^1 n(t+v,x) * [S(k_1-1-v;x) - S(k_1-v;x)]dv}{\sum_{t=1}^{\max Q} \int_0^1 n(t+v,x)S(1-v;x)dv}$$

This serves as the contribution to the likelihood of those who exit unemployment between $t+k_1-1$ and $t+k_1$, conditional on having entered unemployment between t and $t+1$. who become employed between $t+k_1-1$ and $t+k_1$.

For censored spells:

$$\frac{\int_0^1 n(t+v,x) * [S(k-v;x)]dv}{\sum_{t=1}^{\max Q} \int_0^1 n(t+v,x)S(1-v;x)dv}$$

Here the numerator is the number of people who are employed at t who enter unemployment before $t+1$ and remain unemployed until $t+k_1$.

The contribution to the likelihood of a person entering unemployment between t and $t+1$ is:

$$\begin{aligned}
\ln L_i &= (1-d_i)\ln \frac{\int_0^1 n(t+v,x) * [S(k_1-1-v;x) - S(k_1-v;x)]dv}{\sum_{t=1}^{\max Q} \int_0^1 n(t+v,x)S(1-v;x)dv} \\
&+ d_i \ln \frac{\int_0^1 n(t+v,x) * [S(k-v;x)]dv}{\sum_{t=1}^{\max Q} \int_0^1 n(t+v,x)S(1-v;x)dv}
\end{aligned}$$

where d_i is a categorical variable that equals one if the observation is not censored. Summing over all individuals gives the sample likelihood.

To proceed, it is necessary to assume some functional form for the hazard function. It can be shown that because I am integrating over v only an exponential hazard can be integrated analytically. But as the exponential hazard function is characterised by a constant hazard rate, and that it is well known that the probability of exiting unemployment varies with the length of the spells, it is more adequate to consider a more flexible function. Weibull and log-logistic hazards were considered and for both a numerical approximation of the integral is required. Since the log-logistic hazard is more flexible and actually it approximates better the actual empirical distributions obtained in previous work (see Arellano et al. (1998), Garcia Perez (1997)) I adopt that specification in the empirical analysis.

Log-logistic hazard and survival function:

$$\begin{aligned} \theta(\tau; x) &= \frac{f(x)\alpha(\tau)^{\alpha-1}}{1+f(x)(\tau)^{\alpha}} \\ S(t; x) &= \frac{1}{1+f(x)(\tau)^{\alpha}} \end{aligned}$$

We take $f(x) = \exp(x'\beta)$ for log-linearity. The parameter α determines the type of time dependence of the hazard. If $\alpha > 1$ the hazard is first increasing and then decreasing reaching a maximum at $t = [(\alpha-1)/f(x)]^{1/\alpha}$. If $\alpha < 1$ the hazard is constantly decreasing from infinite at $t = 0$. If $\alpha = 1$ it decreases from a non infinite magnitude.

Finally I have to deal with the inflow $n(t, x)$. Since the availability of data implies that I am using quarterly inflows, the term $n(t, x)$ enters additively the log likelihood function and does not affect the estimation. Note that if the period between two interviews was longer, accounting explicitly for stock sampling bias would become more important.

Given all the above, maximum likelihood estimates may be obtained by maximising over the relevant parameters α and β:

$$\underset{\beta,\alpha}{Max} \sum_{i} \ln L_i$$

The main draw back of using a parametric form for the baseline hazard arises in the presence of unobserved heterogeneity. If there is some permanent unobserved component that is omitted and correlated with the probability of exiting unemployment the hazard rate will not be correctly estimated. An direct way to deal with this is done by the fact that I am controlling explicitly for previous wages which is possibly the best indicator of a worker's ability and employability, and in addition I use a parametric hazard that mimics the non parametric hazards estimated in previous research with Spanish data.

4.3.3 Explanatory variables

Among the explanatory variables I will include the following:

a) individual characteristics: sex, age group, education, head of household or partner status.

b) household characteristics: number of children in the household below a certain age, number of other members in the household that are not working.

c) income variables: weekly unemployment benefit (see below), income of all the other members of the household. (Both in constant pesetas)

d) economy-wide determinants: year dummies (the dataset does not specify the region of the worker so it is impossible to control for local labour market conditions).

Because of the way the data are recorded the construction of the weekly unemployment benefit variable must be explained. The ECPF provides quarterly earnings by source. So I construct an estimate of the weekly unemployment benefit (in tens of thousand pesetas). For those unemployed without any benefit the value is very straightforwardly zero. For those who remain unemployed at two points and who receive only unemployment benefit in that interval, I take the value of the unemployment benefit between the two consecutive unemployed interviews, divided by the number of weeks in the interval (i.e. thirteen since we have quarters). For those who only have one observed spell that were employed the period before the interview and received only wage, I assume that the wage did not change since the last observation and I compute the proportion of the time that the individual was unemployed and the proportion he worked. From that I obtain a measure for the weekly unemployment benefit of that person. After doing this, the only people for whom I do not have a valid value of the weekly unemployment benefit are those who were inactive and start receiving unemployment benefit at some stage. Those amount in the sample to about 200 people that I lose due to this. Those are people that seem to go from inactivity to unemployment and suddenly start claiming benefit. This is a very peculiar group and therefore dropping them to reduce heterogeneity is a natural decision.

I use the quarterly inflow data from the official unemployment register provided by the Ministerio de trabajo y asuntos sociales (MTAS). The inflows are computed using the registered unemployed and registered new contracts figures. In practice, given the likelihood function, the fact that I use quarterly inflows implies that those enter the likelihood additively and hence do not affect the coefficients.

The rest of the variables are defined in a straight forward manner. Household income is the income earned by other individuals in the household (also in tens of thousand pesetas) divided by the number of household members using an equivalence scale. I use the income corresponding to the last period that the person was unemployed to avoid possible endogeneity through an added worker effect. It gives a magnitude of the income available to each household member before the unemployment shock. I use the number of dependents in the household and split it between the number of children below six years of age and the number of other dependents. I also have the wage earned by the individual in the previous job, which captures other unobservables that determine the individual's employability and expected wage.

I treat multiple spells of an individual as if they were of different individuals and I consider exits into either part-time or full-time employment, and following Narendrathan (1993) exits into inactivity are considered as censored as if I was computing a competing risks model. Although the main analysis focuses on transitions into employment, I also provide evidence on transitions to inactivity.

A number of limitations of the dataset must be mentioned and kept in mind when interpreting the results. The first is that there is no information on the duration of the entitlement to benefit. As Atkinson and Micklewright argue and as has been found in previous literature this is the time to exhaustion of the entitlement is often a key determinant in unemployment behaviour, often more that the level of benefits itself. I am unable to account for this fact with the available data. Furthermore, there is no difference between unemployment insurance and unemployment assistance in the dataset. So the variable unemployment benefit will include both. Finally, all I observe is whether the unemployed takes-up benefit rather than whether he is entitled. Given the high replacement ratios that characterise the Spanish system (70-80% at the beginning of the spell) compared to other countries, one expects that almost all entitled will claim benefit and hence it makes sense to talk about entitlement. Furthermore, from a practical point of view one can argue that what actually matters to assess the impact of unemployment benefit on duration are claimants.

4.4 Results

I analyse the impact of both unemployment benefit and household income on the exit rate into employment in the ECPF. I take into account the gender differences in behaviour with respect to those variables given what was said before about the expected differential behaviour between men and women.

A look at the descriptive statistics shows that the groups of female heads and male non heads are rather small. 15% of females are heads and 4% of males are non heads. This is because the typical Spanish family structure conforms to the classic scheme where the male is the bread-winner and the female stays at home and takes care of the kids. Only 28% of female heads are single, so the single mother group is overall very small. Concerning men in the category of partners, they are mostly of middle age, that is that they probably are long term unemployed or in a precarious working condition (repeated fixed term contracts etc.) and that is why they are not in the position of household heads. As we will see in what follows, the results, just like these descriptive statistics reflect the importance of family structure and roles in determining behaviour.

Even though my main interest is in transitions to employment, it is important to analyse transitions to inactivity, in particular when we are looking at female behavior. All tables present results for the probability of an unemployed person becoming inactive. These are presented in a different column and actually reflect a model with competing risks of exiting unemployment into either of the two destinations.

Table 4.3 presents the results for the determinants of transitions to employment and inactivity in a pooled regression where we allow the coefficients on household income and unemployment benefit to differ by gender but the rest of the coefficients are constrained to be equal between groups.

Concerning the probability of exit into employment, the effect of household income[7] is quite large and negative. That is, the higher the income the less likely that the individual exits unemployment into employment. As noted above, a number of different forces have an impact on that coefficient. One is that a higher family income induces a lower pressure to find work because the individual has already a basic income guaranteed. This effect is reinforced for the female non-head by the fact that she "specialises" in taking care of the household and hence her hazard rate is decreasing in household income. This provides some support to the argument that household income and family ties are important in explaining unemployment duration in Spain.

To assess the impact of unemployment benefit on duration, I introduce separately a dummy variable for whether the individual is receiving benefit, the level of the benefit and previous wage. Note that previous studies have included the log of the replacement ratio directly (this is done later on) but this means that all individuals who are not

[7] Computed as the income of other members of the household (divided by an equivalence scale) in the period before the person enters unemployment

receiving benefit are dropped out. My specification exploits the information coming from individuals without any benefit, who represent 47% of the sample and allows for a non linearity in the effect of benefit. If the relationship was linear the dummy variable would not be significantly different from zero. I assume that any differential employability effects are captured by the previous wage and that it is not a result of unobserved characteristics. In practice, being entitled not only conveys information on the level of benefit received but implicitly captures the fact that the benefit will last for some time, so the expectations of the individual are different. Allowing for a different impact of entitlement (dummy) and the level of benefit goes some way in accounting for that. Finally note that unemployment benefit in Spain is computed using exogenous rules as a fixed proportion of previous wage subject to a maximum and a minimum cap (see appendix for details). The estimation includes previous wage as a regressor, but the non linearity of the benefit (through the caps, see appendix for description of the benefit rules) is what allows me to identify separately the effect of previous wage from the effect of the level of benefits. Furthermore, note that the exogeneity of the rules precludes endogeneity problems.

The effect of weekly unemployment benefit shows that both entitlement and the level of benefits have a positive effect on durations, however the effect of the level rather small -it is close to 10% significance for males but insignificant for females. This result is present in the different models estimated: the effect of the levels is smaller than the effect of entitlement itself.

Concerning the shape of the hazard function, since α is greater than one the hazard increases up to a maximum and then decreases, confirming the non-monotonicity that was expected. I will show gender specific hazard rates below.

One can then see the reflection of household structure through a number of coefficients. Males and heads of household are less likely to exit into inactivity and heads of household more likely to exit into employment. Household income deters transitions into employment but not into inactivity. The presence of younger children doesn't appear to have an effect, but this is due as we will see to the fact that we are constraining the coefficients for males and females to be equal. We have a priori reasons to think that this is inappropriate.

All the estimations control for the level of previous wage, which captures the employability of the individual and his/her ability. As one would expect higher previous wage increases transitions into employment and reduces transitions into inactivity.

Finally, I find an inverse U-shape for the effect of age on transitions into employment and a U-Shape for its impact on transitions into inactivity.

The analysis above restricted the coefficients on the rest of the covariates to be the same across groups. This is a restrictive assumption, so tables 4.4 and 4.5 show the results for females and males separately (note there is a substantial fall in sample size and hence also in significance).

First of all, note that α is greater than one in both cases and it is larger for males. Figure 4.1 shows the hazard rate into employment for a representative male and female. Males have a systematically higher probability of becoming employed.

Table 4.4 presents the results on females and table 4.5 the results for males. For women I find a sizeable effect of household income in reducing exits into employment , but no effect on exits into inactivity. The main variable that is significant for female transitions from unemployment into inactivity is whether they are entitled to benefit (the level of benefit being unimportant). When they are, exit is delayed. Previous wage is also significant for transitions into inactivity and has the opposite sign than for transitions into employment possibly capturing the employability of workers and hence their labour market prospects.

The effect of household structure is apparent in the results. The presence of children below the age of six reduces employment prospects for unemployed females but increases them for unemployed males. This again confirms the fact that household structure is important in determining unemployment duration and the fact that there is some degree of division of labour within the household.

The results for the rest of covariates is as follows. Age is not significant for women. For males, an inverted U-shape for the effect of age is obtained, with the exit rate highest for the group aged 30 to 40. Education variables are only available for heads of household. Columns 2 and 4 of table 4.5 allow us to compare results when education variables are included. The thrust of the results is unchanged, which is reassuring for the rest of the regressions. In any case, the inclusion of previous wage as a variable should capture most of the relevant information provided by the education variables.

To assess the differential effect of the different sources of income on the hazard rate, I look at how the hazard changes for the representative individual if first all unemployment benefit is withdrawn and then if all household income is withdrawn. Figures 4.2 and 4.3 (for women and men respectively) show that both benefits and income are important, but that the effect of withdrawing all benefit is much bigger than that of income in both cases. The effect of household income is higher for women than for men.

To assess the effect of benefit on employment duration taking into account the non linearity described before I compute expected unemployment duration at different levels of benefit. This is presented in table 4.7. Expected unemployment duration for an individual who is not receiving benefits is 2 months, while if the same individual received the minimum amount of benefit possible he would have an expected duration of 7.4 months[8], and at median duration it is 8.7 months. So we see again that the biggest impact comes from being entitled. The sensitivity of duration conditional on entitlement being smaller.

Finally, to allow a comparison of these results with the international literature and provide comparable elasticities I estimate the model on the logarithm of the replacement ratio and the logarithm of household income. By doing so I lose all those individuals

[8]This is expected duration computed for a male head of household, without children or dependents, aged 31 to 44, at median previous.. wage.

who are not earning benefits or whose household income is zero. In particular, since only 35% of women are receiving benefit, most women are lost due to this. Table 4.6 shows the results for this specification which is *conditional on receiving benefit.*

The estimated elasticity on benefit is 0.47 and that on the replacement ratio is 0.32. This compares to elasticities of benefit the order of 0.3 to 1 in international studies. The elasticity on household income is 0.05, although this is not significant. Note that omitting previous wage from the regressions biases the estimates towards zero indicating a positive correlation between ability/wage and the level of benefit. This supports the claim that previous wage is a good indicator of the employment prospects of individuals and validates the previous specifications with income variables in levels (to avoid losing individuals with values of zero in either household income or benefit).

4.5 Conclusion

This paper intended to clarify the nature of transitions from unemployment into employment in Spain. The existing empirical literature had not analysed the relative importance of the different sources of income of the unemployed person, such as unemployment benefit or household income in determining the transitions to employment. This is a consequence of the lack of income data in most datasets. I used the ECPF, a household expenditure survey that includes data on the income of all household members in addition to family structure variables. The problem with the dataset is that it only provides an imperfect measure of unemployment duration, namely it only records the status of the individual in discrete points in time, but does not provide the exact moment of entry to or exit from unemployment. A method was developed to solve that problem by defining a likelihood function that takes into consideration that sampling structure. Thus I can assess to what extent it is true that family support is an explanation for the long unemployment durations in Spain and assess whether the levels of unemployment benefit have any influence at all on the exit rates.

The maximum likelihood results provide a better picture of the nature of labour market transitions in Spain and confirm the idea that family structure and support are important determinants of the behaviour of the unemployed. There are significant effects of being head of household and male on the probability of an unemployed individual becoming employed or inactive. The presence of children of young age has opposite effects on men and women. Women are less likely to work and men more likely when in the presence of children below six.

Concerning the relative effect of the different sources of income, I found evidence that the level of household income has a negative net effect on the probability of exiting unemployment into employment but no effect on exits into inactivity, but it is of a much smaller size than unemployment benefit. Regarding unemployment benefit, I found that especially entitlement but also the level of unemployment benefit reduces the likelihood of exiting unemployment into employment. It is mainly entitlement that reduces the probability of exiting unemployment, with the actual elasticity of duration to benefit conditional on receiving benefits being 0.47.

4.6 Appendix

4.6.1 Sample selection

My sample keeps every unemployment spell of individuals for whom we observe entry into unemployment. Out of those I drop those for whom I cannot compute weekly unemployment benefit (namely. those who start off earning benefit after having declared inactivity -249 individuals are dropped due to this).

Pattern	%
Not receiving benefits (ub=0)	51.47
Two consecutive quarters in unemployment (ub=benefit received between the two periods)	31.84
Employed to unemployed, 1 period spell (ub imputed according to formula)	16.68

In the final sample, the computation of unemployment benefit comes from the above categories: 52% had no benefit, 17% comes from the employed/unemployed transitions, 32% takes the benefit between two consecutive unemployed interviews.

4.6.2 The Spanish Unemployment benefit system

In Spain the Unemployment Insurance system has two components: an unemployment insurance system (UI), that is only awarded to those who have worked and contributed during their previous job; and an unemployment assistance system (UA). A reform of the 1984 system was implemented in 1992 that reduced eligibility to UI and enlarged it for UA.

Unemployment insurance system

It is mostly designed for those who have exhausted their UI and have to face family burdens. To be eligible for UA, in addition to having a number of dependants, per capita family income cannot exceed the minimum wage,.

The length of the entitlement period depends on how long the individual had been making social security contributions in the 6 years (4 years before 1992) previous to the beginning of the spell.

Workers having contributed less that 6 months are not entitled to UI but they could claim UA if they had contributed at least 3 months.

The amount of benefits is determined as a percentage of the average wage in the previous 12 months (6 months before 1992) of employment, before the beginning of the unemployment period. There are some upper and lower bounds on that quantity. The minimum amount is 75% of the minimum wage and the maximum is set at 170% of the minimum wage. If the unemployed has dependents, then the upper bound is increase to 195% with one dependant and 220% with more than one.

Duration of benefits (in months)

Period of contribution	1984	1992
1-5	0	0
6-11	3	0
12-17	6	4
18-23	9	6
24-29	12	8
30-35	15	10
36-41	18	12
42-47	21	14
48-53	24	16
54-59	24	18
60-65	24	20
66-71	24	22
≥72	24	24

Amount of benefits

Period of benefits	1984	1992
1-6	80%	70%
7-12	70%	60%
13-24	60%	60%

Assistance system

The amount of UA is 75% of the minimum wage. Since 1989 the amount varies with the number of dependents for workers above 45 years, only if they had received UI for 24 months. In that case it 75% of the minimum wage ($\leq$ 1 dependents), 100% (2 dependents) and 125% ($\geq$3 dependents).

Workers aged 52 or more are eligible for UA until retirement.

Duration of benefits

Period of contributions (months)		1984	1992
1-2		0	0
3		3	3
4		4	4
5		5	5
6-11	Age<45	18	21
	Age≥45	18	21
12-17	Age<45	18	18
	Age≥45	18	24
≥18	Age<45	18	24
	Age≥45	18	30

4.7 Tables and figures

4.7.1 Tables

Table 4.2: Descriptive statistics

	Females	Males
	Frequency	Frequency
Exits to employment	26.5%	47.7%
Censored	49.1%	45.7%
Exits to inactivity	24.4%	6.5%
Total	720	1145
	Mean	Mean
Entitled to benefit	0.352 (0.478)	0.546 (0.498)
Unemployment benefit	0.409 (0.655)	0.841 (1.026)
Household income	0.138 (0.093)	0.068 (0.064)
Previous wage	0.724 (0.890)	1.674 (1.174)
Children <6	0.465 (0.666)	0.439 (0.676)
Dependents	2.334 (1.415)	2.736 (1.503)
No studies*		0.314 (0.464)
Primary studies		0.506 (0.500)
Sec. Studies		0.155 (0.362)
University		0.023 (0.149)
31 to 44	0.532 (0.147)	0.401 (0.490)
45 to 59	0.22 (0.083)	0.023 (0.151)
more than 60	0.007 (0.362)	0.021 (0.143)
Head of household	0.155 (0.363)	0.958 (0.200)

Table 4.3: Transitions to employment and inactivity, all

	Trans.to Empl All	Trans.to Inact. All
constant	-0.3746	1.2189*
	(0.89)	(1.93)
Male Entitled	-1.5932***	-1.0762**
	(6.30)	(2.11)
Female Entitled	-1.3759***	-2.6189***
	(3.24)	(5.26)
Male Unempl. benefit	-0.1821	-0.0878
	(1.61)	(0.31)
Female Unempl. benefit	-0.2636	0.0541
	(0.88)	(0.15)
Male household income	-5.1539***	2.2835
	(3.60)	(1.15)
Female household income	-1.7242	-0.0457
	(1.06)	(0.02)
male	0.1670	-1.9399***
	(0.44)	(4.02)
Head of household	0.6629**	-0.6724*
	(2.34)	(1.86)
Children <6	0.1103	-0.2604
	(0.99)	(1.58)
Previous wage	0.4785***	-0.2925***
	(6.35)	(2.73)
Dependents	0.0057	0.0154
	(0.12)	(0.22)
Aged 31 to 44	0.5054***	-0.7717***
	(3.47)	(3.33)
Aged 45 to 59	0.3234	-1.4701*
	(0.74)	(1.87)
Aged >59	-0.0936	-0.3927
	(0.19)	(0.48)
ALPHA	1.3252***	1.1152***
	(14.16)	(7.46)
Observations	1865	1865

Absolute value of z statistics in parentheses
significant at 10%; ** significant at 5%; *** significant at 1%

Table 4.4: Transitions to employment and inactivity, females

	Trans. to Empl Females	Trans to Inact. Females
constant	-0.1089	0.2240
	(0.14)	(0.25)
Entitled	-1.3581***	-2.7953***
	(2.89)	(5.41)
Unempl. benefit	-0.4460	0.2875
	(1.28)	(0.78)
household income	-3.8408**	-0.5103
	(2.07)	(0.26)
Previous wage	0.8071***	-0.6371***
	(4.52)	(3.29)
Head of household	0.0303	-0.5821
	(0.08)	(1.15)
Children <6	-0.4451**	0.0204
	(2.02)	(0.09)
Dependents	0.0019	0.1676
	(0.02)	(1.57)
Aged 31 to 44	0.1194	-0.4740
	(0.44)	(1.63)
Aged 45 to 59	-0.6860	-1.1874
	(0.76)	(1.24)
Aged >59	0.8197	1.4238
	(0.57)	(0.83)
ALPHA	1.1300***	1.1376***
	(6.20)	(6.13)
Observations	720	720

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4.5: Transitions to employment and inactivity, males

	Trans.to Empl. Males	Trans.to Empl Male heads.	Trans.to Inact. Males	Trans.to Inact Male heads
constant	-0.6422	0.3077	-0.2190	-0.9098
	(1.11)	(0.78)	(0.26)	(1.30)
Entitled	-1.6540***	-1.6608***	-1.0297*	-0.9843*
	(6.55)	(6.49)	(1.94)	(1.83)
Unempl. benefit	-0.1396	-0.1459	-0.2107	-0.2553
	(1.25)	(1.30)	(0.73)	(0.87)
household income	-3.8428***	-4.0618***	2.0418	3.3687
	(2.68)	(2.77)	(1.02)	(1.61)
Previous wage	0.3754***	0.3690***	-0.0850	-0.0513
	(4.54)	(4.50)	(0.69)	(0.39)
Head of household	1.0076**		-0.6220	
	(2.10)		(1.03)	
Children <6	0.3452**	0.2929**	-0.4883	-0.4918
	(2.46)	(2.08)	(1.57)	(1.55)
Dependents	0.0038	0.0340	-0.1160	-0.1589
	(0.07)	(0.56)	(1.16)	(1.46)
Aged 31 to 44	0.7005***	0.7031***	-1.8517***	-1.8602***
	(3.89)	(3.85)	(3.54)	(3.20)
Aged 45 to 59	0.8080	0.7343	-1.1496	-0.5096
	(1.53)	(1.32)	(0.95)	(0.42)
Aged >59	-0.1830	-0.1805	-0.9489	-1.0365
	(0.34)	(0.33)	(0.84)	(0.92)
Secondary studies		0.2805		-0.8029
		(1.14)		(1.19)
University studies		-0.6105		-1.7960
		(1.04)		(1.38)
ALPHA	1.4415***	1.4692***	1.2887***	1.4103***
	(12.59)	(12.49)	(5.44)	(5.57)
Observations	1145	1097	1145	1097

Abs. value of z stat. in parentheses
*significant at 10%; **at 5%; *** at 1%

Table 4.6: Transitions to employment for entitled, elasticities

	(1) Trans.to Empl all	(2) Trans.to Empl all
Constant	-2.5181***	-2.6830***
	(5.65)	(6.01)
Ln family income	-0.0565	-0.0558
	(1.41)	(1.39)
Previous wage		0.4155***
		(4.59)
Ln unempl. Benefit	-0.2404*	-0.4788***
	(1.70)	(3.13)
Head of household	0.9828***	0.6296***
	(4.58)	(2.77)
Children <6	0.1259	0.1169
	(0.96)	(0.88)
Dependents	-0.0576	-0.0427
	(0.98)	(0.72)
Aged 31 to 44	0.6588***	0.5568***
	(3.80)	(3.14)
Aged 45 to 59	0.3919	0.1089
	(0.75)	(0.20)
Aged >59	-1.0567	-1.0813*
	(1.61)	(1.69)
Constant	1.5788***	1.5951***
	(12.64)	(12.51)
Observations	868	868

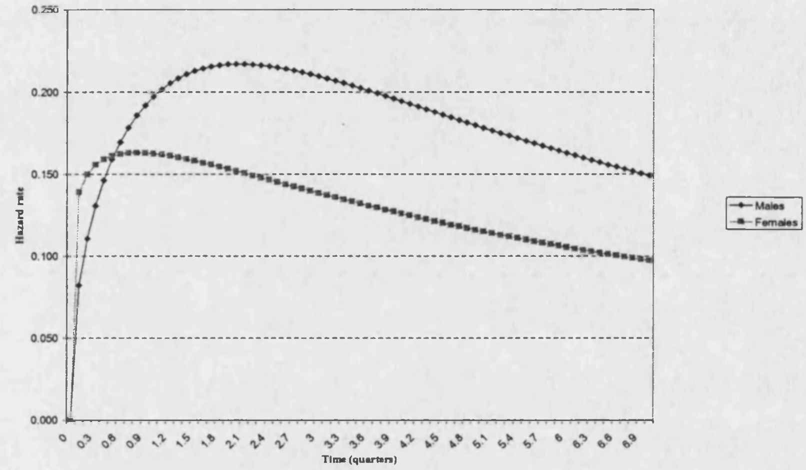
Absolute value of z statistics in parentheses
significant at 10%; ** significant at 5%; *** significant at 1%

Table 4.7: Expected duration by level of benefit

Level of unempl. benefit	Expected duration (months)*
No benefit	1.77
Minimum benefit	7.407
Median benefit	8.727
90th perc. benefit	10.249

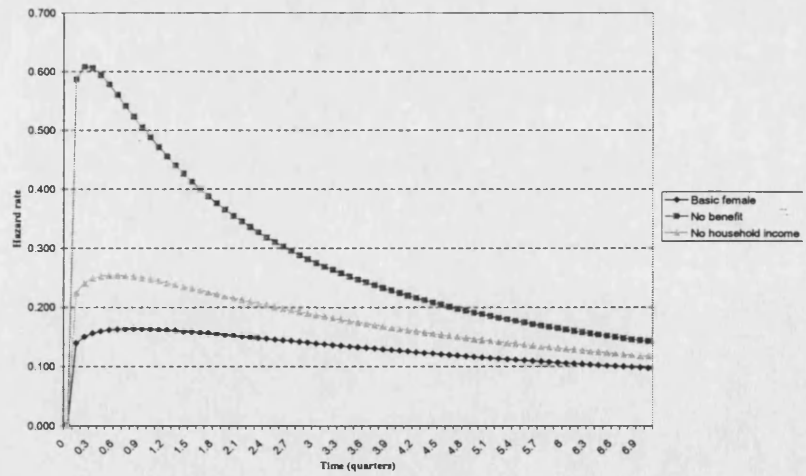
4.7.2 Figures

Figure 4.1: Hazard rates for males and females



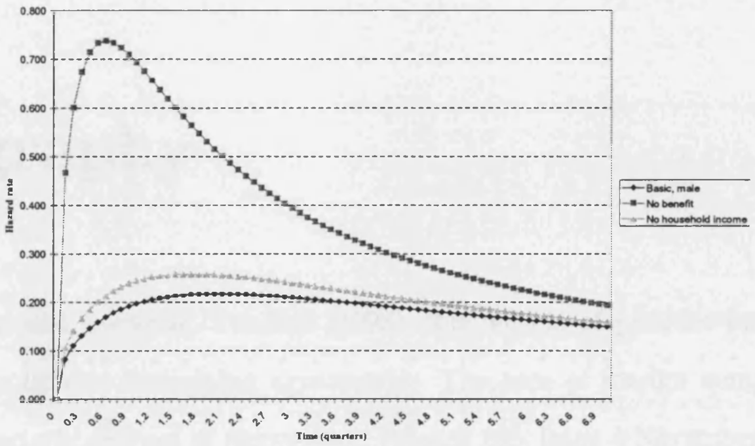
Computed for a representative individual in 1992 at mean benefit and household income and for the base categories

Figure 4.2: Effect of withdrawing benefit/household income on hazard rates of females



Computed for a representative individual in 1992 at mean benefit and household income and for the base categories

Figure 4.3: Effect of withdrawing benefit/household income on hazard rates of males



Computed for a representative individual in 1992 at mean benefit and household income and for the base categories

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