Does product market competition increase wage inequality?

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PRELIMINARY. COMMENTS WELCOME.

23rd April 2003

Abstract

This paper identifies increased product market competition as a source of wage inequality. 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 between high and low skilled workers. I develop a stylised model of that very general mechanism that relies only on two basic assumptions: that (at least some) product markets are imperfectly competitive and that workers are heterogeneous. I then test the main hypothesis: that skills are more highly rewarded (in relative terms) in highly competitive industries. Using an individual panel of UK workers for the period 1982-1999 the hypothesis is confirmed after controlling for a number of effects in the basic fixed effects specifications and also when I analyse two different natural experiments that are associated with an increase in product market competition. These natural experiments are used as instrumental variables for the true underlying measure of competition and the results are again confirmed.

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

*I would like to thank Steve Nickell, Vicente Cuñat, Marco Manacorda and Alan Manning for their encouragement and excellent suggestions throughout the thinking and writing of this paper. I also benefited from very good comments by Heski Bar-Isaac, Michela Cella, Maia Güell, Steve Pischke, Steve Redding, Mark Shankerman, Julia Shvets and participants at various LSE seminars. Thanks also to Jonathan Haskel and Ralf Martin for providing the concentration data. Support from the Banco de España is gratefully acknowledged. Any remaining errors are my sole responsibility.

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), Rose (1987), Hirsch (1988), Borjas and Ramey (1995), Abowd and Lemieux (1993)). There will be 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[1].

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

[1] 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.

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.

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 ommitted 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 in the reduced form specifications and then allow us to provide 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)) 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 are 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 (2001) 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[2] 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. 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.

2 The economic 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 this to be true is that profits[3] 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.

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

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

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

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

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

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 the 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.

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 (that we can take as exogenous or endogeneise it). 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 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 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 $\widetilde{\pi}(d_i, \theta)^4$, 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[5].

Once workers are allocated to firms production occurs and in the second stage firms compete in the product market where they sell their products. 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 compete for workers of different abilities. They bid for them through the wage offers. Firms maximise net profits $\pi(d_i; \theta)^6$ (net of wages) subject to the participation constraint of workers. This constraint says they will only accept a wage offer if it is above their reservation utility b and the wage that any other firm may offer them.

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

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

[4] $\pi^*(d_i, \theta)$ is "profit" prior to paying the worker's wages.

[5] 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.

[6] 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: $\pi(d_i; \theta) = \pi(d_i, q^*(d_i, \theta); \theta)$

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.

$$\begin{aligned} \widetilde{\pi}(d_i) - w_i(d_i) &\geq \widetilde{\pi}(d_j) - w_i(d_j), \text{ for all } i,j \quad (2) \\ \widetilde{\pi}(d_i) - w_i(d_i) &\geq \widetilde{\pi}(d_i) - w_j(d_i), \text{ for all } i,j \quad (3) \end{aligned}$$

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

$$P(d_i) - w(d_i) \geq P(d_j) - w(d_j), \text{ for all } i,j \quad (4)$$

In equilibrium we will have that:

$$\widetilde{\pi}(d_i,\theta) - w(d_i,\theta) = \widetilde{\pi}(d_j,\theta) - w(d_j,\theta) = \widetilde{\pi}_N(d_N,\theta) - b \quad (5)$$

$$w(d_i,\theta) = \widetilde{\pi}(d_i,\theta) - \widetilde{\pi}_N(d_N,\theta) + b \quad (6)$$

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 another firm would come along and 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) 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

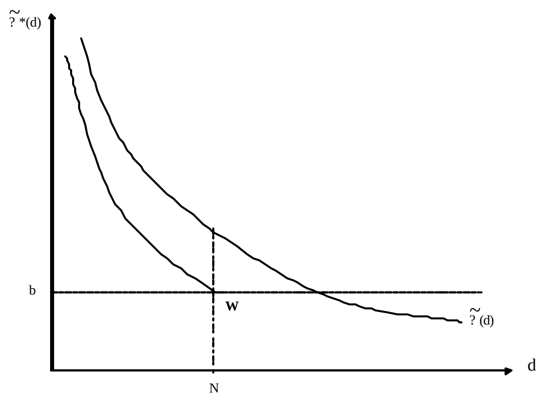

Figure 1: Equilibrium revenue and wage schedules

revenue schedule but it is shifted down by $\widetilde{\pi}_N(d_N, \theta) + b$. It has a lower bound given by b.

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. With free entry, firms will enter until the last firm makes zero profits.

$$\widetilde{\pi}_N(d_N, \theta) - b = 0 \tag{7}$$

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 and increase in wage dispersion. This is:

$$\frac{d^2 w(d_i, \theta)}{dd_i d\theta} = \frac{d^2 \widetilde{\pi}(d_i, \theta)}{dd_i d\theta} < 0 \tag{8}$$

Which is a single crossing condition.

Figure 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

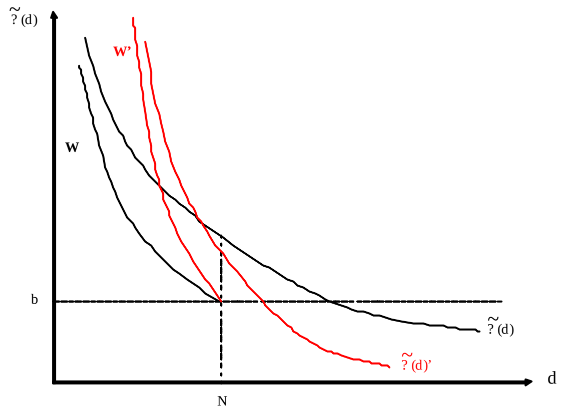

Figure 2: Comparative statics of a change in product market competition

zero profits, then the $\widetilde{\pi}$ function and the wage schedule would overlap and the same comparative statics would result.

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 wether wages will increase or fall for the different types, this was only a relative statement). 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 wether 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 and hence they produce different amounts of the good). 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 (8):

$$\frac{d^2(\widetilde{\pi}(d_i,\theta)/\widetilde{\pi}(d_j,\theta))}{d\theta d(d_i/d_j)} < 0 \tag{9}$$

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.

2.2.1 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[7] (Dixit Stiglitz 1977) implies that

$$Y_i = (\frac{p_i}{p})^{-\theta} * \overline{Y} \tag{10}$$

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

$$p_i = \frac{\theta d_i}{\theta - 1} \tag{11}$$

Hence

$$\widetilde{\pi}(d_i) = \overline{Y}(p/\theta)^{\theta}(d_i/(\theta-1))^{1-\theta} \tag{12}$$

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

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

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).

$$\frac{\widetilde{\pi}(d_i)}{\widetilde{\pi}(d_j)} = \frac{\overline{Y}(p/\theta)^{\theta}(d_i/(\theta-1))^{1-\theta}}{\overline{Y}(p/\theta)^{\theta}(d_j/(\theta-1))^{1-\theta}} = (\frac{d_i}{d_j})^{1-\theta} \tag{13}$$

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

$$\frac{d(\widetilde{\pi}(d_i,\theta)/\widetilde{\pi}(d_j,\theta))}{d\theta d(d_i/d_j)} = (1-\theta)(\frac{d_i}{d_j})^{-\theta} < 0 \tag{14}$$

Which proves condition (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

$$\ln w(d_j) - \ln w(d_i) = (1-\theta)[\ln d_j - \ln d_i] \tag{15}$$

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

2.2.2 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:

$$\underset{Y_i}{Max}\widetilde{\pi}(d_i) = (P(\sum_{j=1}^{N} Y_j). - d_i) * Y_i \tag{16}$$

The first order condition yields:

$$Y_i = (1 - \frac{d_i}{P})\eta \sum_{j=1}^{N} Y_j \tag{17}$$

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

$$\widetilde{\pi}(d_i) = (P(\sum_{j=1}^{N} Y_j). - d_i) * (1 - \frac{d_i}{P})\eta \sum_{j=1}^{N} Y_j \tag{18}$$

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

$$\begin{aligned} \frac{\widetilde{\pi}(d_i)}{\widetilde{\pi}(d_j)} &= \frac{(P - d_i)^2}{(P - d_j)^2} \\ &= \frac{(P/d_j)^2 + (d_i/d_j)^2 - (2Pd_i/d_j{}^2)}{(P - d_j)^2/d_j^2} \end{aligned} \tag{19}$$

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

$$\begin{aligned} d(\frac{\widetilde{\pi}(d_i)}{\widetilde{\pi}(d_j)})/d(\frac{d_i}{d_j}) &= \frac{2(d_i/d_j) - (2P/d_j)}{(P/d_j)^2 + 1 - (2P/d_j)} \\ &= \frac{2d_j[d_i - P]}{(P - d_j)^2} \end{aligned} \tag{20}$$

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:

$$\frac{d(\widetilde{\pi}(d_j)/\widetilde{\pi}(d_i))}{dNd(d_j/d_i)} = \frac{d(\widetilde{\pi}(d_j)/\widetilde{\pi}(d_i))}{dPd(d_j/d_i)} \frac{dP}{dN} < 0 \tag{21}$$

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 (9).

2.2.3 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.

2.2.4 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. The argument is 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.

3 Specification and identification strategy

The identification of the main effect in this paper exploits the differential returns to skill in sectors as their degree of competition changes 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 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 7 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 8 and 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 4 to 6 bring theses two trends together and show the cross sectional and time series relationship between competition and inequality. Figure 4 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 6 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.

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:

$$\ln(w_{ijkt}) = \alpha + \theta_k C_{jt} + \beta C_{jt} + X'_{ijkt}\gamma + d_t + d_k + d_j + v_{ijkt} \tag{22}$$

$$v_{ijkt} = d_{kt} + d_{kj} + \eta_i + \varepsilon_{ijkt} \tag{23}$$

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 (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 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[8]. 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

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

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 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 underlying 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. But only the experiments reflect exogenous changes in competition. Hence one can use the experiments as instruments of 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.

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.

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 is 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.

3.4 Returns to unobserved ability

In the above specification, I look estimates of the returns to observed skill interacted with competition. However it is 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. We can then potentially rank workers according to their predicted wages. Taking different quintiles 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 $q > q'$. This would indicate that high skilled workers (as measured by wages) are relatively more highly rewarded in competitive sectors.

4 Estimates of the impact of competition on the wage structure

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 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[9]. 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[10] that provides imports and exports by 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

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

[10] Available online on the ONS website.

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.

4.2 Empirical results

4.2.1 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[11]. 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.

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[12], 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.

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

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

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 3 presents the results for the basic specification. The dependent variable is log 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 fixed effects specification that one expects to provide more accurate and reliable estimations.

Tables 4*a* for CR5 output and 4*b* 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 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 4a and 4b, 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 5 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 6 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 11a and 11b presents 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 (C_{jt}) 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.

4.2.2 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 8 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 7.

Table 7 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. The specification 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.

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 8 presents the two stage least squares of instrumenting concentration with the SMP variable. Note though 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).

4.2.3 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 **??** 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 10 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 9 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 regressions are specified as:

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

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), $openess_j$ is the relevant openness measure (note it is computed as the mean openness measure over the years 1993 to 1995 (when 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. 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 10. 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 that in the basic specification that probably was subjected to measurement error.

4.2.4 Contribution to changes in wage inequality

The analysis above indicates that product market competition increases 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.

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.

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6 Appendices

6.1 Cournot model

Part 1:

I prove that

$$\frac{d(\pi^*(d_j)/\pi^*(d_i))}{dPd(d_j/d_i)} > 0 \tag{24}$$

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

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)

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

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

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

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 $\frac{\eta N \overline{d}_N}{(\eta N - 1)} > d_N$, hence

$$
\begin{aligned}
\eta N \overline{d}_N - (\eta N - 1) &> 0 \\
N &< \frac{\overline{d}_N}{\eta(d_N - \overline{d}_N)}
\end{aligned}
\tag{25}
$$

The right hand side depends on the pattern of d.

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

$$
\begin{aligned}
\frac{P_{N-1}}{P_N} &= \frac{\eta(N-1)\overline{d}_{N-1}}{\eta(N-1) - 1} * \frac{\eta(N-1)}{\eta N \overline{d}_N} \\
&= \frac{\eta(N-1)(N\overline{d}_N - \overline{d}_N)}{(N-1)(\eta(N-1) - 1)} * \frac{\eta(N-1)}{\eta N \overline{d}_N}
\end{aligned}
\tag{26}
$$

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 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 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.

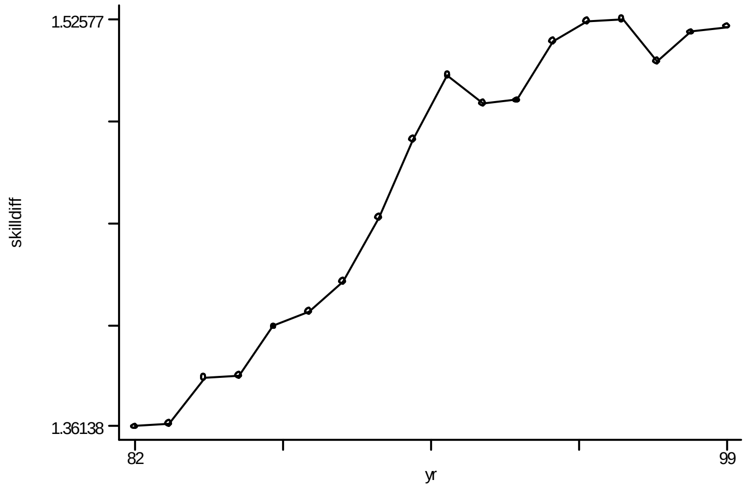


Figure 3: High to low skill wage differential in the manufacturing sector 1982-1999

6.2 Data Appendix

6.2.1 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)

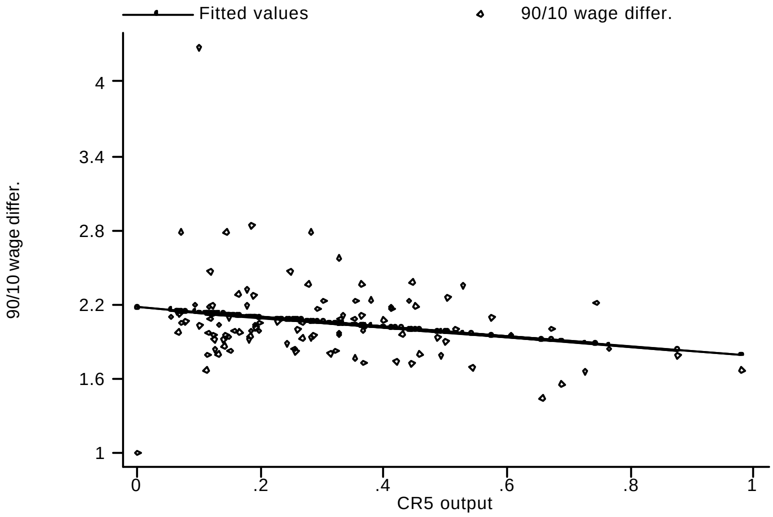


Figure 4: Between sector correlation CR5 output and wage dispersion

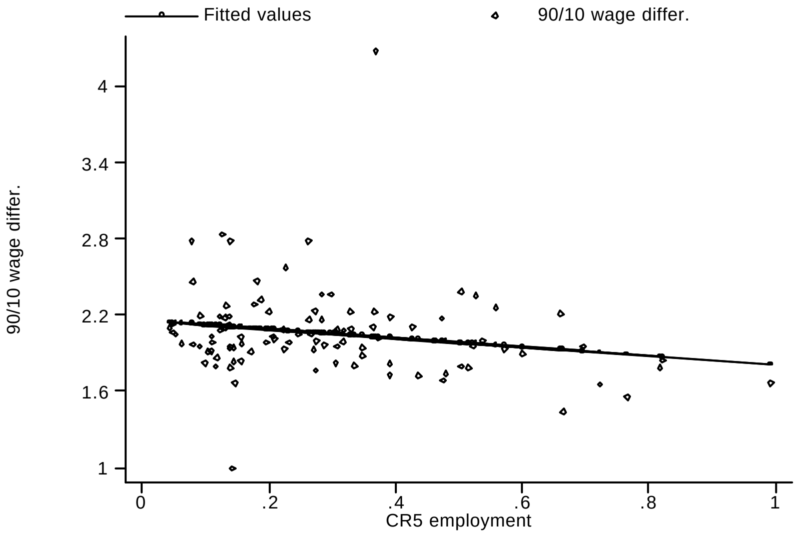


Figure 5: Between sector correlation CR5 employment and wage dispersion

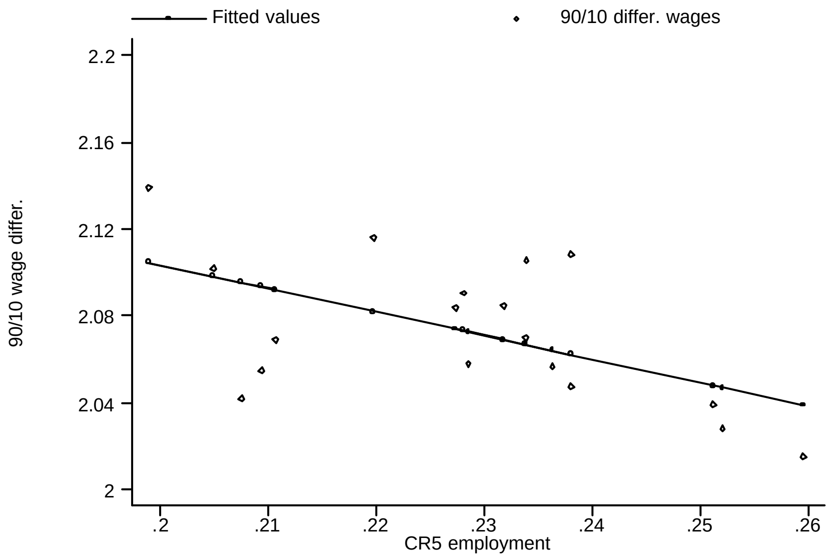


Figure 6: Time series correlation between CR5 employment and wage dispersion

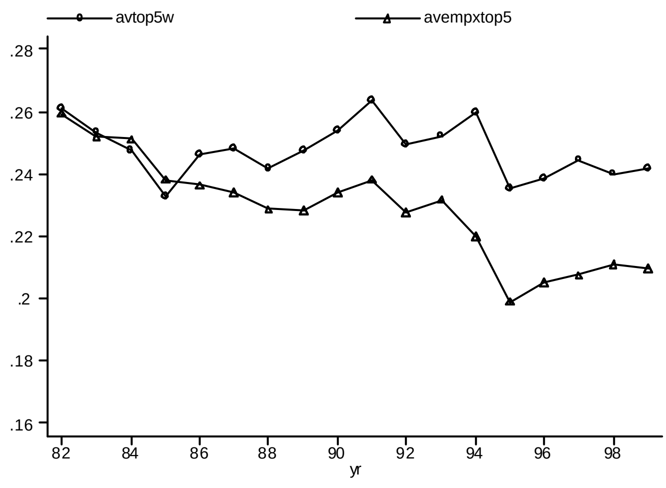


Figure 7: Employment and output concentration ratios for the UK manufacturing sector (SIC 151 to 372)

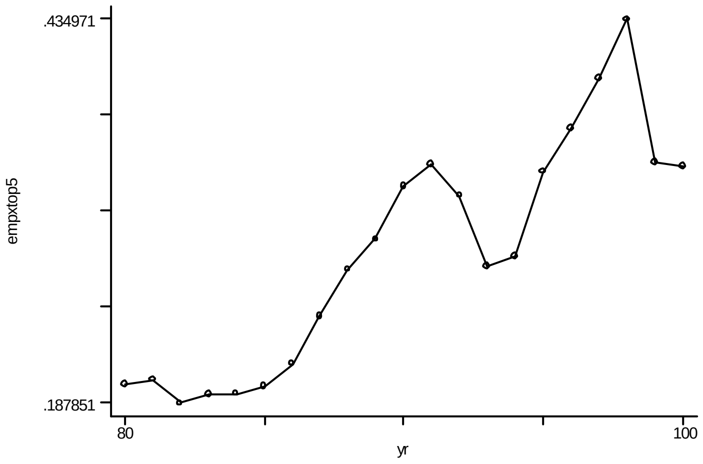


Figure 8: Employment concentration ratio (top5) for prepared animal feeds (SIC code 157)

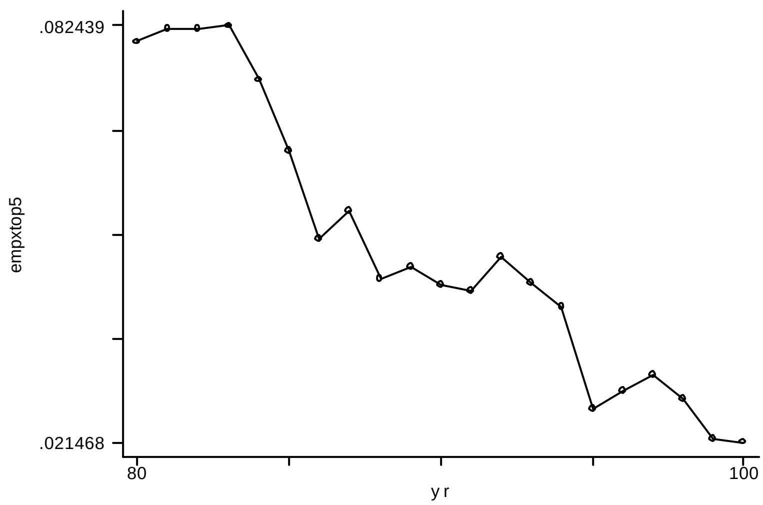
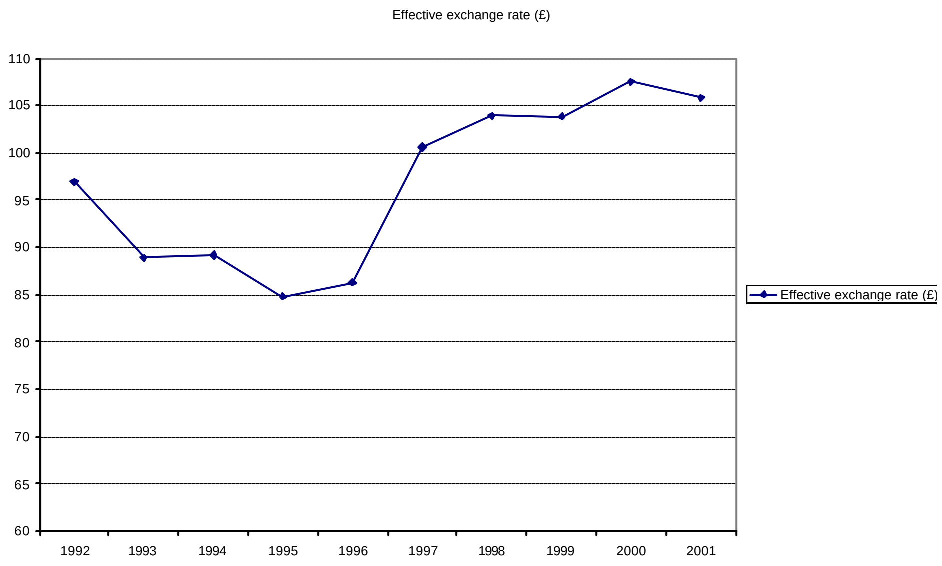


Figure 9: Employment concentration (top 5) for Printing (SIC code 222)

7 Tables and figures

7.1 Figures



Effective exchange rate, Pound Sterling

7.2 Tables

7.2.1 Descriptive statistics

Table 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)
Openness	0.705 (0.515)	**based on 174135**		
Export openness	0.339 (0.247)			
Import penetration	0.238 (0.141)			
Observations	449551	191597	178822	79111

Table 2: Coeff. of correlation 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	0.24	0.408
CR5 employment	0.133	0.244	0.405

7.2.2 Results

Table 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 4a: 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 4b: 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 5: 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
$R^2(overall)$	0.3174	0.872

Table 6a: Top5 output concentration ratio 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

Includes age and age squared as regressors

Table 6b: Top5 employment concentration ratio 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 7: 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	yes
Sector dummies	yes
Observations	415306

Table 8: 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 9: Reduced form estimates for exchange rate experiment
absolute t-values in parenthesis, clustered s.e.

ln real wages	Traded sectors (1)
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 10: 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 11a: Quantile regressions with CR5 output
absolute t-values in parenthesis

	10th percentile	25th percentile	50th percentile	75th percentile	90th perc
Med. skill	0.127 (83.81)	0.132 (105.5)	0.140 (116.16)	0.158 (107.2)	0.182 (90
High skill	0.413 (203.8)	0.455 (276.2)	0.504 (323.2)	0.572 (304)	0.660 (25
Concentration	-0.033 (2.64)	-0.032 (2.99)	-0.029 (2.86)	-0.055 (4.46)	-0.082 (4
Year dum.	yes	yes	yes	yes	yes
Sector dum.	yes	yes	yes	yes	yes
Observations	449551	449551	449551	449551	449551

Table 11b: Quantile regressions with CR5 employment
absolute t-values in parenthesis

	10th percentile	25th percentile	50th percentile	75th percentile	90th perc
Med. skill	0.127 (83.12)	0.132 (113.62)	0.140 (119.87)	0.158 (109.41)	0.182 (94
High skill	0.413 (202.4)	0.455 (297.34)	0.504 (333.06)	0.573 (309.8)	0.660 (27
Concentration	-0.049 (3.14)	-0.062 (5.21)	-0.064 (5.33)	-0.110 (7.35)	-0.144 (7
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