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How Does Product Market Competition Shape Incentive Contracts?

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Abstract
This paper studies the effect of product market competition on the explicit compensation packages that firms offer to their CEOs, executives and workers. We use a large sample of both traded and non-traded UK firms and exploit a quasi-natural experiment associated to an increase in competition. The sudden appreciation of the pound in 1996 implied different changes in competition for sectors with different degrees of openness. Our difference in differences estimates show that a higher level of product market competition increases the performance pay sensitivity of compensation schemes, in particular for executives.

JEL classification: J32, J33, M12, J41, J49
Keywords: Performance-related pay, Product market competition

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1 Introduction

The use of performance-related pay among executives has increased considerably over the past twenty years (Murphy 1999, Hall and Liebman 1998). However, it is still not clear what the causes of this phenomenon are or whether this trend also extends to lower layers of a firm's labor force. At the same time, there has been a trend towards increasing product market competition associated with the spread of information technologies, decreasing transport costs, numerous deregulation waves and reductions in trade barriers. There is empirical evidence that increased competition makes firms become more productive and aggressive when exposed to higher competition levels. These papers show that more competition leads to higher effort provision (Nickell, 1996; Griffith, 2000), productivity (Galdon-Sanchez and Schmitz, 2002) and innovation (Blundell, Griffith and Van Reenen, 1999). However, there is little work surrounding whether firms use other instruments, such as performance related pay, to increase the productivity of their workers following an increase in competition[1]. A number of theoretical papers (Schmidt, 1997; Raith, 2003; Vives, 2004) illustrate the relationship between these two elements. Two counteracting effects are at work. On the one hand, more competition raises the reward for market stealing activities, increasing the marginal return to managerial and workers' effort. For this reason firms may introduce steeper incentive packages to induce their workers to work harder. On the other hand, the residual demand that a firm faces may shrink, making market stealing less attractive. On top of these two effects an implicit discipline effect may also be at work. If a higher competition level increases the threat of going bankrupt when the firm underperforms, this may provide an implicit incentive to exert effort, thus reducing the need for additional incentive schemes. Overall, the total effect of competition on the performance pay sensitivity is to a large extent ambiguous. In spite of the interest of the question and the ambiguity of the theoretical results, the number of articles exploring this matter at an empirical level is very limited and generally restricted to top executives. The aim of this paper is to evaluate how the slope of performance-related-pay changes for the highest paid director, other directors and workers, following changes in product market competition. We estimate the slope of performance-related pay directly from the data using a panel of UK firms that contains information about highest paid director's pay, average directors' pay and average salaries of 22,183 firms in the manufacturing sector. These firms range from the biggest firms in the UK economy to small ones of only five employees. This is an important advantage of our sample, as previous studies have concentrated mainly on top executive compensation in large firms. The UK perspective is also interesting, since it has been reported that the pay-performance sensitivity of top executives in the UK dropped significantly in the late 80s (Gregg, Machin and Szymanski, 1992). However, there is evidence showing that this trend might have been reversed in the 90's (Conyon and Murphy, 2000). It is unclear whether the evolution of the competitive environment had any influence on this change. The measure of competition used in the analysis is an important issue. While most economists would agree on the definition of a monopoly or perfect competition, agreeing

[1] See Lazear (2000) and Booth and Frank (1999) for empirical evidence on the increases in productivity associated with steeper performance-related-pay contracts.

on an empirical measure of the degree of competition is more controversial. At the same time, many of the most commonly used measures, such as concentration ratios, are subject to numerous caveats because it is often unclear what they are actually measuring and because of the endogeneity of market structure (Schmalensee, 1989). Similarly, if different compensation packages may induce the firms to act more or less aggressively, the degree of competition in the industry may be endogenous to the compensation package.[2]

To identify the causal effect of competition on performance-related pay and avoid possible endogeneity problems, we exploit a quasi-natural experiment. This is the sharp appreciation of the Pound Sterling in 1996 that implied a sudden change in the relative costs and prices between UK manufactures and foreign products. It primarily had a negative effect on producers in sectors that exported a significant share of their output, or that faced a significant level of imports in the local market. The appreciation can therefore be seen as an exogenous change in competition such that the increase in competitive pressure was higher for firms in more open sectors. We therefore use it to identify the causal effect of competition on performance related pay through a difference in differences approach. This allows us to distinguish it from a general time trend in performance-related pay, or cross-sectional differences in contracts.

The results show that competition increased the steepness of performance-related-pay. This effect holds, with different intensities, for the highest paid director, and other directors, and it is robust to using different openness measures as an index of exposure to the appreciation. At the same time firms increased the slope of performance contracts, they reduced the fixed component of pay. For workers, the effect of competition is weaker, mostly not significant, and the estimated baseline sensitivities are small.

The structure of the rest of the paper is as follows. In Section 2 we discuss the existing theoretical and empirical literature on the topic. Section 3 presents the identification strategy used. Section 4 contains a description of the data. Section 5 shows the results of the estimation and Section 6 concludes.

2 Related Literature

Our aim in this article is to measure how the implicit incentives provided by product market competition interact with the explicit and implicit contracts that firms have with

[2] See among others Fershtman and Judd (1987), Sklivas (1987) and Salas Fumas (1992) for theoretical contributions to this topic.

their managers and workers. The theoretical literature that underlies the empirical analysis is based on principal agent theory, where in the presence of asymmetric information on the agent's effort, it is optimal for principals to offer performance-related-pay.

In the spirit of this literature, the theoretical papers by Schmidt (1997) and Raith (2003) investigate how the change in the distribution of profits induced by changes in product market competition affects the optimal incentive scheme that principals provide. Vives (2004) generalizes the analysis to any fixed expense that reduces future marginal costs and to different competitive regimes. In all these papers, compensation agreements are the result of a two-stage game with multiple players (firms) where, in the first stage the structure of compensation is specified (the investment decision made in Vives, 2004), and in the second stage production occurs and firms sell their product in the imperfectly competitive product market. In Schmidt's paper, the explicit contracting between the shareholders of a firm (principal) and an employee (agent) is affected by the implicit conditions that the competitive environment imposes on the worker. The employee is explicitly modeled as a manager, but the implications of the model could also apply to any other worker.

Competition has two different types of effects on the incentives to exert effort or behave in the interest of the shareholders. On the one hand, a higher level of competition means that the elasticity of the firm's market share to an increase in productivity (cost reduction, increase in quality, etc.) increases. Therefore the returns to the effort of the employee grow, which implies that in the face of an increase in competition, shareholders will provide more high-powered incentives in order to adjust to this new sensitivity. On the other hand, a higher level of competition means lower prices for the firm "caeteris paribus", so that a given share of the market becomes less valuable. Furthermore, more competition may imply a higher risk of bankruptcy. As long as the employee of the firm wants to keep her job, the threat of bankruptcy implicitly disciplines her. This allows shareholders to reduce the steepness of the incentives provided. Overall, these mechanisms partially counteract each other, and the net effect of competition is ambiguous: it can generate steeper or flatter explicit incentives.

In Raith (2003), higher product market competition is modelled as an increase in the elasticity of substitution between goods in a Salop model with endogenous entry and exit of competitors. After an increase in competition, prices and profits fall, leading to the exit of some unprofitable firms. The endogenous exit of these firms is what restores the original profit level, eliminating the counteracting effects of the fall in profits present in Schmidt's

paper. Therefore, the prediction is that more competition should unambiguously lead to steeper explicit incentives.

Vives (2004), in a more general model, shows that the net effect of an increase in competition on cost reduction effort will still depend on the relative size of the same two types of effects. A higher elasticity of the residual demand that firms face and a lower size of this residual demand. The net effect of these two forces is still ambiguous, although the elasticity effect tends to dominate for most of the different competitive specifications.

A related strand of literature considers how the optimal incentive package may change according to whether competition among firms is in strategic complements or substitutes. Fershtman and Judd (1987), Sklivas (1987), Salas Fumas (1992) and Aggarwal and Samwick (1999) show that principals can commit to compete more or less aggressively in the product market through the compensation packages they provide. They will vary the degree of relative performance evaluation to motivate workers to behave in a particular way. Note that, in this setting, the degree of competition is in some sense endogenous to the compensation package. In our empirical analysis, we address this issue. By using an exogenous shock in competition we ensure the causality is going only in one direction -from product market structure to performance-related-pay. In addition, we will also assess the extent of relative performance evaluation as a robustness check.

Firms can relate pay to performance either through explicit written contracts or through implicit contracts(agreements which are not written but sustained on the basis of repeated interaction). Theoretical results show that in fact it is probably optimal to use a combination of both types of performance-related-pay (Baker, Gibbons and Murphy ;1994). Our empirical approach does not allow us to distinguish between these two alternative types of deal.[3] This is an empirical limitation of our data, but the contribution of the paper to the literature is still relevant as the theoretical arguments behind our approach do not rely on incentive-pay being provided necessarily through an explicit contract. Throughout the rest of the paper we use the term "contract" referring to both implicit and explicit contracts.

Finally, it must be noted that incentive contracts are not the only way that firms may use to motivate their workers or ensure effort exertion. This is particularly true for workers low in the firm hierarchy. Other types of mechanisms such as direct monitoring or efficiency wages are possible. Most of these operate through fixed wages and are not performance-

[3] **We are also not able to distinguish whether firms change their compensation agreements as competition changes or whether these compensation agreements are flexible enough to adapt to new competitive environments.**

related. Our empirical approach does not allow us to distinguish between a higher propensity to use incentive pay versus the use of steeper contracts on the same set of workers. From the point of view of principal agent theory this should not pose a problem. A worker that receives zero performance-related-pay can be seen as a particular case of performance related pay with no slope. However, there may be other factors that affect the use of performance-related-pay. For example MacLeod and Malcomson (1998) show that the likelihood of using incentive pay versus efficiency wages should be higher when skilled workers are in short supply and the threat of firing is therefore less harmful for these workers. While these considerations are important in determining the use of performance-related-pay, they are likely to be uncorrelated with our quasi-natural experiment, and should not affect our identification strategy.

Similarly, it is likely that in cases where team-work is important, firms may decide not to give incentive pay because workers will have an incentive to free ride. However, firms may overcome this problem by providing group incentives (Holmstrom, 1982) that would still be captured in our regressions. In any case, it is likely that some firms decide not to provide performance related pay, and therefore what we estimate is the average propensity to increase sensitivities without being able to disentangle whether it is because firms decide to start providing incentive contracts, or because they increase the sensitivity of the existing ones.

The evidence regarding the relationship between competition and incentive pay is still very limited. Hubbard and Palia (1995) use the deregulation of the commercial banking industry in the 80s to explain the increase in performance-related pay among CEOs in commercial banking. Even though it seems that deregulation increased the fixed part of CEO pay, they find no significant effect on the slope of the contracts. Burgess and Metcalfe (2000) use cross-sectional questionnaire data in which managers are asked to declare whether they use some kind of performance-related pay, and a self-reported measure of competition. Their results show that the likelihood of having performance-related pay among UK workers increases with competition.[4] However, given the cross sectional nature of their dataset, they are not able to control for unobserved heterogeneity, or calculate the actual sensitivities of performance-related pay contracts[5].

[4] Their definition of performance-related pay includes pay associated to observable variables such as sales (individual or group ones) but explicitly excludes profit related pay.

[5] Santalo (2001) uses a similar cross section of Canadian retail stores and finds a non-monotonic, U-shaped relationship between the use of performance-related pay among middle managers and competition. Both

Aggarwal and Samwick (1999) explore the effect of the strategic interaction between firms on executive compensation. Their identification strategy involves the use of Herfindahl indices to disentangle whether firms use their compensation packages as a way to encourage either aggressive competitive strategies or tacit collusion between firms.[6] Even though they do not directly address the issue of how the sensitivity of their own performance measure should be affected, some of their results can be interpreted along this line. In general, their results remain ambiguous with respect to own performance. If anything, the paper tends to find that sectors with lower Herfindahl indices are associated with flatter incentive schemes.

A related stream of literature investigates the effects of product market competition on CEO turnover. DeFond and Park (1999) find that higher levels of product market competition lead to higher CEO turnover, and that the use of relative performance evaluation to dismiss a CEO is more intense in highly competitive sectors, while low competition sectors rely more on absolute performance measures.[7] These results seem to indicate that the implicit incentives provided by the threat of dismissal are intensified in more competitive sectors.

This article extends the existing literature in several dimensions. To begin, we use a quasi-natural experiment as a measure of an exogenous change in product market competition. This change affects different sectors with varying intensity. This allows us to use a difference in differences methodology to disentangle the causal effect of interest from a time trend or from cross-sectional differences that could endogenously arise across sectors. Secondly, we can estimate actual performance-pay sensitivities for the highest paid director, other directors and workers. Most of the existing literature concentrates on CEOs or contains only qualitative measures of the use of performance-related pay schemes within firms. Finally, we use a broad sample of UK firms. This allows us to estimate sensitivities that are hard to capture in small samples, as well as to reveal new results in a literature that has typically used much smaller samples of large firms.

articles have the natural limitations of survey data.

[6] See also Kedia (2003) and Joh (1999) for evidence on the effect of strategic interaction on performance pay.

[7] See also Oxelheim and Randoy (2002) who find lower CEO average tenure in more competitive sectors. Hubbard and Palia (1995) also find a higher CEO turnover rate among derregulated banks.

3 Estimation Procedure and Identification Strategy

To estimate the influence of product market competition on the sensitivity of performance-related pay we use a sample of UK firms for which we have data on total compensation of the highest paid director, average executive compensation and average worker compensation. Total compensation for each group of workers in firm f, in sector j, in year t, can be written as $W_{fjt} = A_{fjt} + B_{fjt}(Perf_{fjt}) + u_{fjt}$ which contains a fixed component A_{fjt} and a variable component $B_{fjt}(Perf_{fjt})$, that is a function of performance. Both the level of pay and its sensitivity to performance will vary across firms and sectors with different features. We explicitly model the major determinants of these coefficients in our empirical analysis assuming linear relationships as:

$$\begin{aligned} W_{fjt} &= A_{fjt} + B_{fjt} Perf_{fjt} + u_{fjt} \\ A_{fjt} &= a_0 + a_1 C_{jt} + \sum a_z X_{fjt} \;\; ; B_{fjt} = b_0 + b_1 C_{jt} + \sum b_z Z_{fjt} \end{aligned}$$

Where $Perf_{fjt}$ is the performance measure, C_{jt} is the competition measure that has an effect both on the levels and on the slope of compensation. The variables X_{fjt} and Z_{fjt} are control variables, such as firm size, which influence either the fixed or the variable component of pay. It is important to realize that the sensitivity changes according to sector and firm characteristics. Given the assumed compensation structure, the estimation of the compensation equation should include terms where the performance measures interact with competition and other variables. The specification we obtain is the following reduced form:

$$\begin{aligned} W_{ifjt} &= a_0 + a_1 C_{jt} + b_0 Perf_{fjt} + b_1 C_{jt} Perf_{fjt} \\ &\quad + \sum a_z X_{ifjt} + \sum b_k Z_{fjt} Perf_{fjt} + d_t + \eta_f + \epsilon_{fjt} \end{aligned} \tag{1}$$

Where d_t are time dummies, η_f are firm permanent unobserved components (that also capture sector effects because firms do not change sectors) and ϵ_{fjt} is a white noise. Our main interest is in the sign and magnitude of the coefficient b_1, which measures the change in the performance sensitivity of compensation (the change in B) as competition changes.

Next, it is important to discuss the actual competition measure used, C_{jt}, as this will have a bearing on how the equation must be specified. Our competition measure exploits as a quasi-natural experiment a change in the competitive environment that affected firms with different intensities.

The quasi-natural experiment is the sudden appreciation of the British Pound in 1996[8]. Figure 1 shows the effective exchange rate of the British Pound against all currencies weighted by their relative importance in British imports and exports. There are clearly two different regimes of low and high effective exchange rate before and after 1996. These will be the two periods exploited. What follows is a discussion on why it can be used as an experiment for an increase in product market competition.

The appreciation was hardly predictable by the firms in our sample. Its direct effect was to reduce the prices that foreign competitors could offer in the UK market, as well as the relative price of UK exports. Another way of seeing this is that the appreciation actually reduces the costs of foreign firms relative to UK costs so that some foreign firms that were not competitive enough at the old relative costs can now start selling in the UK. Furthermore, this reduction in costs has an effect on equilibrium prices, which reflects the extent of the increase in competition. Dornbusch (1987) develops this argument. Under the Cournot, Dixit-Stiglitz and Salop models of competition, he shows that as the domestic currency appreciates, the relative costs of domestic firms increase, domestic prices fall, and they do more so in sectors with high import penetration[9]. Thus, in the short-run an appreciation will have a larger impact on prices in sectors with high levels of import penetration. In this situation, high cost domestic firms are more likely to go bankrupt. This increases the pressure on domestic sectors where import penetration is important. The appreciation can therefore be used as a measure of an exogenous change in competitive pressure.

Beyond these immediate effects on competition via relative costs and prices, several papers examine the theoretical relationship between structural changes in competition and exchange rates. In particular Baldwin (1988), Dixit (1989) and Baldwin and Krugman (1989), show that a large appreciation may permanently reshape the competitive structure of the local market. These papers have as their starting point a situation in which foreign firms that would want to sell in the local market, do not do so because they would have to spend entry costs in the form of R&D, creating distribution channels, or building up a reputation. These sunk costs have to be paid in order to sell in the local market for the first time. The appreciation of the local currency gives foreign firms a window of years in which they are relatively more competitive than local firms. This advantage will make

[8] Empirically, Bertrand (1999) and Revenga (1992) also use an identification for changes in competition based on international trade variables. They both use import penetration at industry level as a measure of competition and instrument it using exchange rate fluctuations.

[9] A symmetric argument can be done on exports and the importance of domestic firms in foreign markets.

them enter and incur the entry cost. After the effects of the appreciation disappear, either because there is a subsequent depreciation, or because the local prices of factors adjust to reestablish the competitiveness of local firms, the original competitive configuration is not restored. This is because foreign firms that have already entered do not leave and possibly because some local firms that closed do not reopen. A symmetric argument may be made for exporting firms that decide to stop exporting (or simply close) during the appreciation and do not resume operations later on. Under this perspective, the appreciation is like a temporary fall in entry barriers that has permanent effects on the competitive configuration of the industry.

Depending on the period chosen, the magnitude of the appreciation ranges between 21% to 25% -already indicating that it may have had an important impact on UK firms that were exposed to foreign competition. Although we cannot provide a direct test of its effect on competition, results like the impact on quantities, prices and profits, can be used as suggestive evidence to assess the validity of the appreciation to measure competition.

First, the appreciation generated a significant shock on UK exports and imports. Table 2 shows the aggregate effect on the balance of trade in goods. Notice first that, overall, the value of imports increases and the value of exports falls, but these magnitudes do not take into account the fact that prices of foreign goods are falling. Accounting for this (since the pound appreciation was above 20%), the actual increase in the volume of imports is much higher: the market share and the number of foreign competitors in the UK increases. In 1997 there is a small positive effect on the balance of trade. This is a natural effect if there is some inertia on the quantities exported and imported; the appreciation meant higher export prices and lower import prices, so the balance of payments can initially improve. However, from 1998 onwards the quantity effect dominates and the balance of trade nearly doubled its previous deficit.

Second, there is evidence of the effect of the appreciation on prices. Gagnon (2003) estimates that UK firms absorbed about 40% of the impact by reducing their prices.[10] The rest of the impact was absorbed by quantities. Both the reduction in markups and the fall in sales had a strong impact on their profits. Coutts and Norman (2002) perform a detailed sector by sector analysis of the long run impact of foreign prices on UK manufacturing prices. The first interesting result demonstrates that after 1996, the prices at which foreign firms

[10] Martin (1997) estimates that over the 1951-91 period, the average impact on UK prices of a change in foreign prices was about 25%.

sold their products fell between 8% and roughly the full size of the appreciation, depending on sectors. This means that foreign firms kept their markups constant or increased them by up to 13%. On the other hand, UK firms reduced their markups or kept them constant. This meant a sharp break in the trend of markups, which had been steadily growing in the UK during the 80s and early 90s. Coutts and Norman (2002) also indicate that following the 1996 appreciation, firms absorbed a large amount of the impact through non-price initiatives. While downsizing was the most likely option for multinationals that could produce elsewhere, UK firms relied on reorganizations and a redefinition of products.

Third, we can assess the effect the appreciation had on profits. Within our sample the effect can be seen in Figure 2, which shows the evolution of median profits for a subsample that contains the balanced panel of our dataset.[11] We evaluate the differential effect of the appreciation for firms with openness (import penetration + export share) above or below the sample median. The effect is quite strong for both subsamples. There is a general slowdown in profit growth after the depreciation. For the very open firms the effect is much more severe, even though in 1997 they do slightly better (an example is the improvement in the aggregate case where, if export firms had signed contracts prior to 1997 for goods that were delivered afterwards, the appreciation was to their benefit). After 1997 the reaction in quantities has a strong impact on open firms. The effect is much less important for firms that belong to relatively closed sectors. In fact, after the initial shock, they are able to partially return to their old profit growth rates.

To distinguish between sectors that were highly exposed to this appreciation from sectors that were relatively shielded from it we interact the experiment (the dummy $Post97_t$ takes value one from 1997 onwards) with a "treatment" variable that is a measure of the openness of the sector ($Open_j$). The competition variable, which we called C_{jt} in the previous equation, is now constructed by interacting the two variables and becomes $Open_j \; Post97_t$. In the empirical analysis we use two different measures of openness for $Open_j$, namely import penetration (import at a sector level as a proportion of total output plus net imports) and the share of exports in total output (sector exports divided by sector output). Since import penetration and export openness may be changing endogenously with exchange rate fluctuations, we take the mean of the relevant openness measure in the period prior to 1996 to avoid this endogeneity. Because most of our firms are not publicly traded and no stock

[11] This balanced subsample contains 58,300 observations. We do not include 1992 in the balanced sample as there are only 2,071 observations on that particular year, and because it would greatly reduce the subsample.

market information exists for them, the measure of performance used is accounting profits $Profit_{fjt}$. The first specification we present is:

$$\begin{aligned} W_{ifjt} &= a_0 + a_1 Open_j \ Post97_t + b_0 \ Profit_{fjt} + b_1 Open_j \ Post97_t \ Profit_{fjt} \\ &\quad + \sum a_z X_{ifjt} + \sum b_z Z_{fjt} \ Profit_{fjt} + d_t + \eta_f + d_j \ t + \epsilon_{fjt} \end{aligned} \tag{2}$$

b_1 captures the differential effect of the appreciation of the pound between sectors that were highly exposed to this appreciation, and sectors that were relatively shielded from it. A positive b_1 would mean that sectors suffering a higher increase in competition increased more (or decreased less) the steepness of their performance-related-pay after the appreciation of the pound. Note however, that this specification, even though it provides a full "difference in differences" estimator for the effect of competition on the level of pay a_1, only yields a standard "difference" estimator for the effect of competition on the slope of pay to performance b_1.

For a difference in differences specification on the slope of incentive pay, two additional variables are necessary. The first is an interaction between $Post97_t$ and profit. This accounts for the fact that firms in all sectors may have increased their slope after the appreciation. The second variable is the interaction between exposure ($Open_j$) and profits, which accounts for the fact that different sectors may have had different slopes throughout the analysis. This is the standard specification needed to obtain a difference in differences estimator for the slope. This identification allows us to disentangle the effect of competition from a general change over time in performance-related pay, or persistent cross-sectional differences between sectors.

$$\begin{aligned} W_{ifjt} &= a_0 + a_1 Open_j \ Post97_t + b_0 Profit_{fjt} + b_1 Open_j \ Post97_t \ Profit_{fjt} + b_2 Open_j \ Profit_{fjt} \\ &\quad + b_3 Post97_t \ Profit_{fjt} + \sum a_z X_{ifjt} + \sum b_z Z_{fjt} \ Profit_{fjt} + d_t + \eta_f + d_j \ t + \epsilon_{fjt} \end{aligned} \tag{3}$$

The specification also accounts for biases arising from the correlation between any permanent unobserved component of the wage equation and the included regressors by introducing firm fixed effects in all specifications. Given that firms do not change sector, these fixed effects should also capture the existence of any sector fixed effects.[12] We also introduce year dummies (d_j) and sector specific time trends ($d_j \ t$) in all the regressions. The year

[12] We cannot identify the identity of the individual in the CEO data. The average director compensation and the average firm wage by definition are not individual magnitudes, so individual fixed effects are not feasible.

dummies control for any general evolution of salaries in the economy and the sector specific trends for deviations at a sector level from this evolution.

One potential caveat to the interpretation of b_1 as the differential effect of competition on performance pay sensitivities would be the presence of another mechanism that is affected after the appreciation. For instance if the appreciation causes firms to choose more capital intensive technologies, and firms using more capital intensive technologies also use more performance related pay, then the effect of competition is mediated by the change in technology and investment and is not really the direct result of competition per se. To address the issue we checked whether firms in different sectors were altering their behavior in terms of investment, employment and asset accumulation in a differential way according to their degree of openness. For this purpose we ran difference in difference regressions of the variables of interest (investment, employment and assets) on the experiment. The results were by and large insignificant. Although this is by no means an exhaustive test, the fact that we found no significantly different behavior in sectors with more exposure to the appreciation relative to those with less exposure indicates that it is unlikely that this sort of effects is at work.[13]

In a related paper, Guadalupe (2004) uses the same experiment and shows that the returns to skill widened with the increase in competition. This is an interesting result, as the demand for higher skills or higher effort can be seen as substitutes in a framework like Vives (2004). However, changes in wage levels or returns to skill would not be captured by our coefficients of interest given the set of controls on wage levels. We also checked for the presence of pre-existing differences or changes correlated with the experiment in unionization levels and skill composition. The results show that unionization was more intense in relatively open sectors, but there was no significant impact of the appreciation on this differential. With respect to skill composition, there does not seem to be a pre-existing differential across sectors and the appreciation reduced the presence of high skilled workers in more open sectors.[14] Given that performance-related-pay is more prevalent among high skilled workers, this compositional change is likely to go against the results found in section 5. This reinforces the validity of our identification strategy.

We also run a number of robustness checks on the basic specification. These include allowing for the slope of performance pay to vary with firm size and for its curvature to

[13] The results are available from the authors upon request.

[14] The data used for these tests are those in Guadalupe (2004), namely the New Earnings Survey and the UK Labour Force Survey from 1993 to 1999. Pre-existing differences/correlations are evaluated in 1995.

change after the experiment. Finally we allow for the possibility of relative performance evaluation to be a part of compensation contracts, and to change with competition.

4 Data description

We use the FAME-BVD database, which contains balance sheets, profit and loss statements, and complementary information of UK firms of all sizes. Firm size ranges from the largest UK firms to firms of five employees only. Median assets are roughly 1.5 million pounds and most firms are not quoted. The database, which covers the years 1992-2000, is an unbalanced panel of 22,183 manufacturing firms. Information on average salaries is available for 83,530 firm-year observations, 82,779 observations have information on average directors' wage and 24,982 observations on the highest director's pay.

Three different compensation measures are used as dependent variables. These are derived from the annual company statements. The first one is total compensation of the highest paid director, and contains all of the firm's payments to the highest paid director in a particular year, including both fixed and variable compensation elements, such as stock options.[15] Although occasionally it may be the chairman, in most cases the highest paid director is the CEO.[16] This is the only publicly available measure of top executive pay for the UK, and the one used in virtually all related studies.[17] In fact the amount of information provided on each company varies, in particular many firms do not report pay to the highest paid director explicitly.

Secondly, we use a measure of average executive pay, which contains the average remuneration received by the board members. Given that individual data is not available, this measure is calculated as the ratio of total board compensation over the number of directors. These include the top executives of the firm including the CEO, but also a proportion of non-executive directors of the firm. Ideally one would like to separate these two different types of directors, as their roles are not exactly the same. However, this is not possible in our sample. In any case, even though non-executive directors do not make direct man-

[15] Options in most company statements are valued at their exercise price. Ocasionally, for quoted firms options are valued at their Black Scholes value when granted. In any case, given that less than 1% of the firms in our sample are quoted, options are likely to have a smaller impact than in most of the existing studies that concentrate on large quoted firms.

[16] In fact in 27% of UK listed companies, both positions are held by the same individual. This number is likely to be larger in small and medium sized firms (Conyon, 1997)

[17] With the notable exception of Conyon and Murphy (2000) who use direct information from the annual reports of a cross section of firms in 1997.

agement decisions, they do influence the strategic decisions of the firm, and can be seen as agents of the shareholders, in a way similar to executive directors. Furthermore, the presence of non executive directors in the UK is quite low when compared with the US. Previous studies estimate that the proportion of non-executive directors on the board is about 40-50% for large quoted firms. However among non quoted firms, the percentage of firms with at least one non-executive director is between 33% and 47% for large firms, and 19% for small and medium sized firms (less than 50 employees). Given the predominance of small and medium sized firms in our sample, it is likely that the proportion that do not have any non-executive director represents more than three quarters of the total number of firms.[18] The pay measure is the average total remuneration of all board members, so it includes the total remuneration that executive directors receive for their executive and board activities, and the remuneration associated with being a member of the board for non-executive directors.

Finally, we use average wage in the firm constructed as total wages paid over total number of employees.[19] The density of information on these three compensation variables is not constant. For the variable covering the highest paid director there is an average of 2.1 observations per firm, while for the variables on average executive pay and average wages there is a mean of 3.7 and 4.1 observations per firm respectively. We exclude from the sample firms with less than 5 employees in which CEOs and directors are hardly comparable with the rest of the sample. We also drop observations where the pay variable is zero because this appears to come from mis-coding**.** Table 2 contains the summary statistics of the relevant variables.

Most of the firms in the sample are not publicly traded. This has the advantage that it is a very broad sample of firms, representative of the whole economy. It also implies that one cannot use stock market based performance measures and therefore our measure of performance is earnings before interests and taxes. Much existing literature focuses on executive compensation of publicly traded companies and uses stock market returns as their measure of performance. The fact that the vast majority of our firms are not listed on the

[18] See Conyon (1994) and Li and Wearing (2003) for the numbers on quoted firms and Berry and Perren (2000) for the proportions of firms with at least one non-executive director. Using Berry and Perren´s detailed stratification by firm size we can predict that 75.7% of the firms in our sample have a board that is fully composed by executive directors. Non-executive directors are generally a small minority within their boards among the remaining 24.3% of firms.

[19] The wage variable does not contain any stock option packages held by workers. Their improrttance is likely to be small considering the size of the firms included.

stock market implies that the only performance measure we can use is accounting based. Existing research supports that accounting profits are a relevant measure of performance when examining compensation packages (Bushman and Smith, 2001).

Incentive contracts often exhibit non-linearities, such as a minimum profit level needed to qualify for a bonus, maximum wage caps or the non-linear nature of stock options. We include a measure of profits squared in all the regressions to allow for the presence of any non-linearities. Size is computed by the logarithm of total assets. Year dummies, firm fixed effects and a sector-specific time trend (at 3 digit SIC) are also included in all the regressions.

The measures of openness are import penetration and export share of output measured at a sector level defined by the SIC classification at three digits. These are measured as import as a proportion of total output plus net imports and exports over total output respectively. Since openness itself may be endogenous to changes in the exchange rate, the measures of openness are defined at a sector level as the average openness in the years before 1996 (1993 to 1995), which is kept constant for the whole sample.[20] All the monetary variables are in constant 1987 pounds.

Finally, the distribution of total pay is highly skewed to the left and contains several extreme values. For this reason we eliminate as outliers observations whenever the pay variable exceeds the value of the top 99% percentile of the sample.[21]

5 Results

Table 3 presents the results for highest director pay as dependent variable. The first column estimates the raw sensitivity of CEO pay to firm profits, controlling for firm size, year dummies, sector specific time trends and firm fixed effects (these controls are present in all the specifications). The estimated sensitivity is 0.10 pounds per thousand. This seems a relatively small number, although it is comparable with the low sensitivities found in other studies. However, given the size of the firms in our sample it is hard to find a

[20] These were obtained from the "Imports and exports data: MQ10 dataset", elaborated by the Office for National Statistics (ONS). The dataset provides seasonally adjusted imports and exports by three digit SIC92 code at current prices (in million pounds), derived from the balance of payments. The data are available yearly from 1990. To construct import penetration and export share, we use total production from the UK census of manufactures ARD dataset. These data were provided by the ONS.

[21] The results including all observations are qualitatively the same but more unstable. The estimated sensitivities are slightly higher and the R-squared is lower.

truly comparable study with UK firms that could be used as a benchmark.[22] Smaller firms could have smaller pay-performance sensitivities because agency costs may be smaller among them. At the same time there is abundant empirical evidence that identifies that the proportion of profits devoted to performance-related-pay of executives is larger among smaller firms.[23]

Column two includes the first competition variable, namely export share times a post 1997 dummy. The variable is introduced both in levels and interacted with profits. The coefficient associated with the effect of the increase in competition on the slope of performance-related-pay (Export share∗Post 97∗Profit) has a clear positive sign and it is highly significant; evaluated at the average export share it accounts for an increase in performance-related-pay of 0.11 additional pounds per thousand.

Column three shows the difference in differences specification. To allow for a change in the basic slope after 1997, we include the interaction between profit and the Post 1997 dummy (Profit∗Post 97), as well as a variable that interacts the export share index with profits (Export share∗Profit). These two variables guarantee that the coefficient of our variable of interest (Export share∗Post 97∗Profit) truly captures the differential change in slope by degree of openness. In the difference in differences specification, the test consists in evaluating whether the coefficient on the variable Export share∗Post 97∗Profit is statistically different from zero.

In economic terms, we test whether the performance-pay sensitivity of top director's pay increased more in sectors with a higher export share relative to sectors with low export share. This means that we have to control for the average change in slope (Profit∗Post 97) and for the cross sectional differences in slope prior to the experiment (Export share∗Profit). The result shows a very significant effect. The value of the relevant coefficient is 1.09 pounds per thousand. Evaluated at the average export share (0.30) it accounts for a change in slope of 0.33 pounds per thousand, which is fairly large considering the average overall pay-performance sensitivity. The differential effect between a firm in the tenth percentile of Export share with respect to a firm in the ninetieth percentile is 0.61 pounds per thousand pounds. This indicates that after the appreciation, firms in sectors with more exposure to exchange rate fluctuations reacted by increasing the sensitivity of performance-related-pay offered to their top executive relative to the firms that were less exposed to competition. In

[22] See Conyon, Gregg and Machin (1995) for a survey of similar results on UK firms.

[23] See for example Jensen and Murphy (1990). We did not find significant differences in the results when using subsamples of firms of different sizes.

terms of competition, this indicates that an increase in product market competition makes the implicit and explicit contracts that firms offer to their employees more contingent on the performance of the firm. This is the prediction in Raith (2003). In terms of Schmidt (1997) and Vives (2004), it means that the effect of increased elasticity of returns to effort (or to market stealing activities) dominates the reduction in size of the residual demand and the disciplining effect of the potential reduction in profits.

Columns four and five replicate the specifications in columns two and three, but as a measure of exposure to the experiment they use the degree of import penetration. The results are qualitatively identical to the previous ones. The coefficients associated with the experiment are slightly larger, but the average proportion of import penetration is 0.21. In particular, the effect of the difference in differences estimator evaluated at the average level of import penetration is 0.37 pounds per thousand. It is interesting to point out that the average sensitivity for all sectors also went up. Sensitivity went up by 0.17 pounds per thousand when evaluated at the average export share and by 0.21 pounds per thousand when evaluated at the average import penetration.[24] The difference is statistically significant at 1%.

The change in the average sensitivity after 1996 is actually positive and statistically significant in all the specifications, including some of the workers regressions, reported later on, where the individual coefficients are not statistically significant. This is important because even though our identification strategy relies on the differential effect of the experiment across sectors, it is likely that competition went up as a whole in the economy and the results show that the overall effect goes in the same direction as the effect of the experiment.

Table 4 corresponds to the same specifications as in Table 3, but uses the average director's pay as a dependent variable. The sensitivity of pay to profits before conditioning on any competition measure is now 0.02 pounds per thousand. This seems again a quite small figure although it is consistent with the result on CEO pay, and it is statistically significant. Columns two and three correspond again to the effect of the experiment using the share of exports as a proportion of total output as the treatment variable. Again, the effect is positive, statistically significant and economically sizeable. When evaluated at the mean export share, the effect is 0.027 pounds per thousand for the specification in

[24] The effect can be calculated as the coefficient on Profit*Post 1997 plus the coefficient of the experiment Open*Post 1997*Profit times the average openness measure.

column two and 0.025 pounds per thousand for the specification in column three. The equivalent results when using the import penetration share are shown in columns four and five. Once again the coefficients associated with the experiment are positive and statistically significant. Their effect at average exposure levels is 0.033 pounds per thousand and 0.027 pounds per thousand depending on the specification.

The coefficient of the effect of the experiment on the level of pay for directors and highest paid directors (Export share∗Post 97 and Import penetration∗Post 97) is negative which may suggest that firms substituted away from fixed to variable (performance-related) pay and changed the whole structure of contracts. However, the coefficient is not statistically significant, so it cannot be interpreted as strong evidence in this direction.

Table 5 shows the results of the regressions using average wages of all workers as the dependent variable. The estimated overall sensitivity is 0.0012 pounds per thousand, that is, less than one pence per thousand pounds of profit. Evaluated at the average number of employees per firm within our sample it amounts to 0.54 pounds per thousand profits paid by firms as performance-related pay. In the other regressions relative to workers pay, this sensitivity rises up to 1.73 pounds per thousand dollars of profits. This is a relatively small number when compared with a similar figure of 41 dollars per thousand reported by Rayton (2002) on a sample of US manufacturing firms. To our knowledge, there is no recent paper that estimates the sensitivity of UK workers wages to contemporaneous firm profits on such a comprehensive sample of firms.[25]

It is also documented that most workers do not get any performance-related pay at all.[26] Thus, the effect we estimate is the composition of many workers with zero sensitivity, and some workers with sensitivities that are much larger at an individual level than the ones reported here. Unfortunately, given the nature of our data we cannot disentangle between the two, and the estimated effect reflects the average estimated sensitivity of pay to performance. Columns two and three (four and five) show the effect of the increase in competition using the export share (import penetration). The effect on the slope of performance-related-pay is positive, and statistically significant for the differ-

[25] Hildreth and Oswald (1997) estimate the sensitivity of pay to a long series of profit lags of 329 companies and 58 UK establishments finding small or insignificant results on contemporaneous profits.

[26] Burgess and Metcalfe (2000) report that, on average, only 18% of the UK workers in their sample receive some kind of performance related pay. This number is 21% among managers. Blanchflower and Oswald (1988) report that 25% of private sector workers of firms of more than 25 employees had some kind of profit-sharing agreement. See also Rayton and Seaton (1999).

ences specification using both openness measures. When evaluated at the average export share, it represents 0.0011 pounds per thousand for export share and 0.0013 pounds per thousand for import penetration. However the difference in differences specification of column three and five yield insignificant treatment effects. This could be due to the fact that after 1997 all sectors increased their slopes, (the coefficient on Profit*Post 97 is positive although not statistically significant). Overall, the results in columns 3 to 5 show an increase in performance-related pay after 1997, but the difference in difference results for the slopes are not significant. The effect of competition on the fixed component of workers' pay is positive but statistically not significant throughout all the specifications.[27]

Tables 6 to 8 present a number robustness checks. The baseline specification for all the regressions is the full difference in differences specification of columns three and five of tables 3 to 5. In addition, we include additional control variables to assess the robustness of the results. These additional controls may also help to elicit the channels through which competition is acting.

The first two columns of each table include the measure of profit squared interacted with the experiment; we introduce this variable because the results of the experiment may be capturing changes in the convexity of performance-pay. The inclusion of this variable does not alter the results of the regressions with respect to the variables of interest except in one of the regressions relative to average workers pay where the experiment is now positive and statistically significant. The coefficient on profit squared was negative in all the difference in differences specifications of Tables 3 to 5. The coefficient on the profit squared variable interacted with the experiment is negative in all the regressions of Tables 6 to 8, indicating an increase in the concavity of the instruments used. However the coefficient is statistically significant in only two out of six regressions.

Columns three and four of each table introduce the interaction of firm size with profits (this should capture the size effect on slope) and the result on the effect of the experiment is not altered. The variable itself has a positive coefficient that is highly significant in the

[27] As a robustness check of this first set of results we also estimated the experiment year-by-year in search of pre-existing trends prior to the experiment in the differential use of performance-related-pay between relatively open or closed sectors finding no significant patterns prior to 1996 and a sudden increase in 1996 for both highest paid directors and average directors pay. The results are available from the authors upon request.

regressions on the average director's pay, rounding significance in highest director pay, and insignificant in the workers regression.[28]

Columns five and six include a measure of the average profitability of the sector to which the firm belongs in order to assess the robustness of our result to the presence of relative performance evaluation. Aggarwal and Samwick (1999), Kedia (2003) and Joh (1999) suggest that firms may commit to particular compensation structures depending on the type and degree of competition. If firms design incentive pay on own and relative performance, pay is set as $y = a$ (own profit) $+b$(own profit $-$ rival profit). We estimate $y = \alpha$ (own profit) $+ \beta$ (rival profit) so that one can retrieve the parameters of interest as $a = \alpha + \beta$ and $b = -\beta$. Therefore the coefficient on rival profits should be interpreted as the inverse of the weight given to relative performance, while the coefficient on own performance plus the coefficient on rival profits should be interpreted as the weight given to own performance.[29] The variable (called RPE) is first generated by calculating the average return on assets of the other firms that operate in the sector (at 3 digits SIC) where the firm belongs. This average return on assets is multiplied by the assets of the firm. The variable can be interpreted as the profit of a fictitious firm that had the average profitability of the rival firms, but the same size as the relevant firm. Given that our performance measure is in thousand pounds, this measure of the profitability of rival firms can be compared to own performance.

The results on the effect of competition on performance pay sensitivities are not affected by allowing for RPE and we still find that they increased significantly after the appreciation for directors and highest paid director.

As far as the results on the RPE variables are concerned, they are statistically not significant for workers and directors, which suggests the absence of relative performance evaluation. On the other hand, the results for highest paid director are negative and statistically significant. This indicates that firms may be using some degree of relative performance

[28] This contradicts some preexisiting results that show that smaller firms tend to have steeper incentive contracts (see for example Baker and Hall 1998). Several factors may be driving this difference. First, we use a sample of UK firms, while most of the existing work is performed on US firms. Second, the size of the average firm in our sample is much smaller than the one of preexisting studies. Finally, the inclusion of the profit squared variable (that presents a negative coefficient throughout the paper) may be partially capturing this negative size effect.

[29] The variable is introduced in a differences specification. A specification as difference in differences had similar results on the experiment, but presented some evidence of possible multicolinearity problems within the RPE control variable

evaluation. The size of the coefficient is however one full order of magnitude smaller than the sensitivity to own profits. Aggarwal and Samwick (1999) find a positive coefficient on rivals' performance and interpret it as evidence of strategic complementarities between firms actions. The coefficient on the experiment interacted with the RPE variable is positive and significant at 10% only in one of the regressions.[30]

6 Conclusions

Changes in the competitive environment alter the distribution of profits that firms can realize and at the same time create new implicit incentives for workers. These changes in competition should therefore alter the design of compensation packages that firms offer to their employees.

We identify the effects of changes in product market competition on the slope of performance-related-pay of CEOs, directors and workers on a large sample of quoted and non-quoted UK firms using a quasi-natural experiment as the source of increased competition. The quasi-natural experiment used is the strong and unexpected appreciation of the pound in 1996 that affected sectors in different degrees depending on their exposure to trade. The exogeneity of the experiment as a source of increased competition solves the possible endogeneity problems that arise when using more standard measures. Our results indicate that sectors that were more exposed to foreign competition through the appreciation increased the slope of their performance-related pay contracts post-appreciation substantially more than sectors that were relatively shielded from it. This is true for highest paid directors and average directors pay, regardless of specification. For workers, although we find significant pay-performance baseline sensitivities, the effect of competition is weaker and in particular it becomes not significant in the full difference in differences specification. We also perform a number of robustness checks including allowing for the possibility of relative performance evaluation.

Overall, the results suggest a causal effect from increased product market competition to increased sensitivity of pay to performance in contracts. However, given competition in product markets has increased for reasons other than this particular appreciation, the actual effect of changing competition on com-

[30] This suggests that the experiment might have led the firms that were highly affected by the appreciation to use less standard relative performance evaluation on their highest paid director. However the validation of this result would need a more detailed analysis that is beyond the scope of this article.

pensation structures over the past thirty years may have been substantial. It is left to future research to evaluate the extent of such changes.

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7 Figures and tables

Figure 1: Effective Exchange Rate of the GBP Measured against a basket of all currencies, weighted by their participation in UK imports and exports. Source: Bank of England

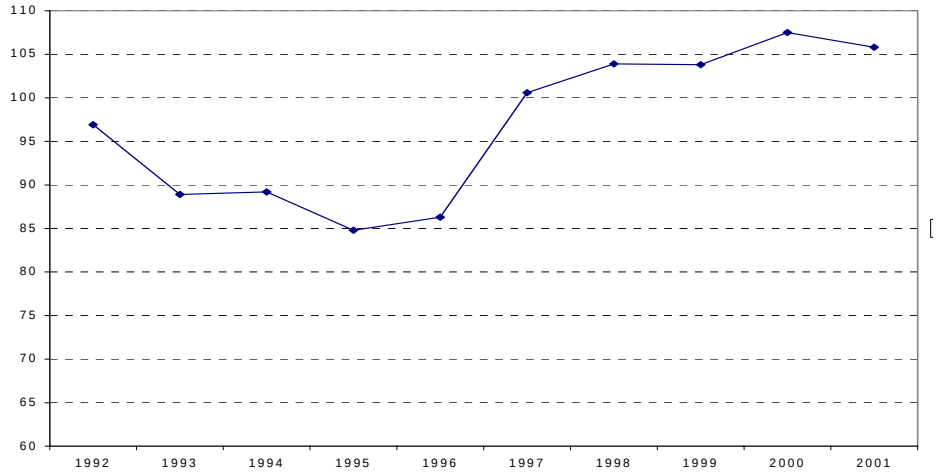

Figure 2: Median profits of a balanced sample of firms. High (low) imports corresponds with firms with import penetration above (below) the median

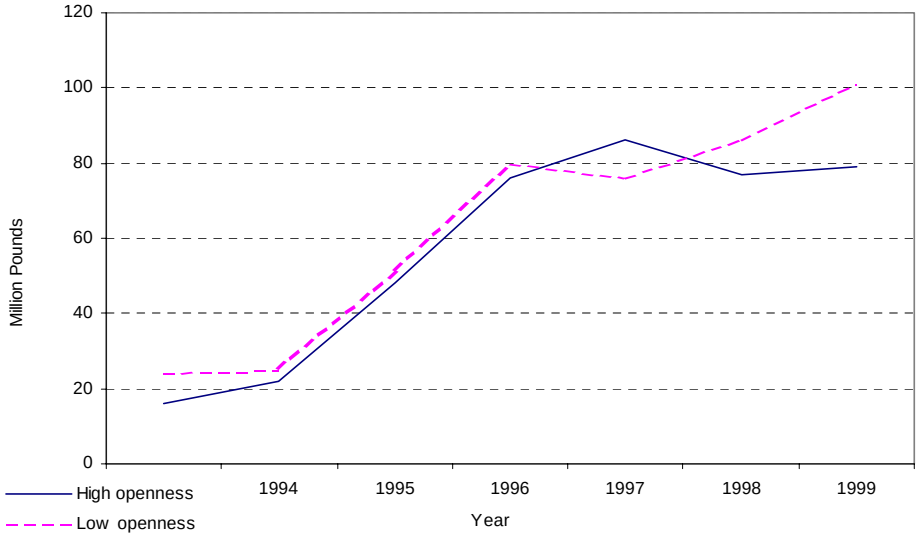

Table 1: Goods Trade Balance All monetary variables in real terms (base 1987) Source ONS

Periods	Exports	Imports	Balance
1992	107863	120913	-13050
1993	122229	135295	-13066
1994	135143	146269	-11126
1995	153577	165600	-12023
1996	167196	180918	-13722
1997	171923	184265	-12342
1998	164056	185869	-21813
1999	166166	195217	-29051
2000	187936	220912	-32976

Table 2: Summary Statistics. All monetary variables in real terms (base 1987). Pay variables in pounds. Profit and assets in thousand pounds.

	mean	median	standard dev.	10%	90%
Profit (thousand pounds sterling)	1328	29	28707	-250	10380
Highest paid director's pay (Pound sterling)	88501	54319	165189	19335	170000
Directors pay (Pound sterling)	23444	14460	38628	3399	47856
Workers pay (Pound sterling)	12878	11271	20749	6745	20395
Log assets	7.3	7.2	1.9	4.9	20.3
Export share	0.30	0.25	0.26	0.03	0.59
Import penetration	0.21	0.21	0.14	0.02	0.39
RPE - Rival firms profit (rescaled by size)	147	22	55586	-51	485

Table 3: The effect of the experiment on the total compensation of the highest paid director.

	Basic	Export share		Import Penetr.	
	1	2	3	4	5
Profit	0.1019	0.0645	0.2466	0.0770	0.2684
	[3.57]***	[1.42]	[2.32]**	[1.64]	[2.42]**
Export share* Post 97* Profit		0.3270	1.0907		
		[2.94]***	[3.53]***		
Export share* Post 97		-4512	-5336		
		[0.88]	[1.04]		
Import penetr.* Post 97* Profit				0.4709	1.7731
				[2.36]**	[3.24]***
Import penetr.* Post 97				-14547	-15727
				[1.58]	[1.71]*
Profit* Post 97			-0.1520		-0.1542
			[1.29]		[1.24]
Import penetr.* Profit					-1.4309
					[2.90]***
Export share* Profit			-0.8244		
			[2.89]***		
Log assets	11127	11095	11040	11109	11035
	[9.24]***	[9.21]***	[9.16]***	[9.22]***	[9.15]***
Profit squared		-1.53E-07	-1.60E-07	-1.41E-07	-1.52E-07
		[3.25]***	[3.26]***	[2.99]***	[3.04]***
Observations	23743	23743	23743	23743	23743
Number of firms	11653	11653	11653	11653	11653
R-squared	0.07	0.07	0.07	0.07	0.07

Absolute value of t statistics in brackets.

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

All regressions include firm fixed effects and sector specific time trends. Profit: profit before interest and taxes; Log assets is the natural log of total assets; Export share: share of exports in the sector's total inputs; Post 97 is a dummy variable that takes value zero in 1996 and before; Import penetration is the share of imports in sector total output.All monetary variables in real terms (base 1987). Pay variables in pounds. Profit and assets in thousand pounds.

Table 4: The effect of the experiment on average directors pay

	Basic	Export share		Import penetration	
	1	2	3	4	5
Profit	0.0223	0.0081	0.0400	0.0070	0.0300
	[5.13]***	[1.68]*	[3.58]***	[1.45]	[2.58]***
Export share* Post 97* Profit		0.0914	0.0865		
		[6.66]***	[2.85]***		
Export share* Post 97		-735	-753		
		[1.26]	[1.29]		
Import penetr.* Post 97* Profit				0.1657	0.1371
				[7.08]***	[2.57]**
Import penetr.* Post 97				-1059	-1016
				[1.03]	[0.98]
Profit* Post 97			0.0199		0.0219
			[1.70]*		[1.83]*
Import penetr.*Profit					-0.1474
					[2.81]***
Export share* Profit			-0.1132		
			[3.96]***		
Log assets	5129	5115	5108	5111	5106
	[36.32]***	[36.23]***	[36.20]***	[36.21]***	[36.18]***
Profit squared		2.09E-09	-2.03E-08	1.14E-09	-1.68E-08
		[0.28]	[2.33]**	[0.15]	[1.86]*
Observations	80620	80620	80620	80620	80620
Number of firms	22056	22056	22056	22056	22056
R-squared	0.04	0.04	0.04	0.04	0.04

Absolute value of t statistics in brackets.

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

All regressions include firm fixed effects and sector specific time trends. Profit: profit before interest and taxes; Log assets is the natural log of total assets; Export share: share of exports in the sector's total inputs; Post 97 is a dummy variable that takes value zero in 1996 and before; Import penetration is the share of imports in sector total output. All monetary variables in real terms (base 1987). Pay variables in pounds. Profit and assets in thousand pounds.

Table 5: The effect of the experiment on the structure of average workers pay.

	Basic	Export share		Import penetration	
	1	2	3	4	5
Profit	0.0012	0.0025	0.0037	0.0024	0.0027
	[2.57]**	[3.52]***	[2.65]***	[3.46]***	[1.85]*
Export share* Post 97* Profit		0.0036	0.0041		
		[2.68]***	[1.46]		
Export share* Post 97		103	102		
		[0.87]	[0.86]		
Import penetr.* Post 97* Profit				0.0065	0.0027
				[2.43]**	[0.53]
Import penetr.* Post 97				277	286
				[1.32]	[1.36]
Profit* Post 97			0.0004		0.0013
			[0.32]		[1.14]
Import penetr* Profit					-0.0020
					[0.35]
Export share* Profit			-0.0039		
			[1.21]		
Log assets	353	353	353	353	353
	[13.06]***	[13.06]***	[13.05]***	[13.06]***	[13.06]***
Profit squared		-1.63E-09	-1.83E-09	-1.53E-09	-1.81E-09
		[4.48]***	[4.70]***	[4.32]***	[4.55]***
Observations	83375	83375	83375	83375	83375
Number of firms	19916	19916	19916	19916	19916
R-squared	0.11	0.11	0.11	0.11	0.11

Absolute value of t statistics in brackets

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

All regressions include firm fixed effects and sector specific time trends. Profit: profit before interest and taxes; Log assets is the natural log of total assets; Export share: share of exports in the sector's total inputs; Post 97 is a dummy variable that takes value zero in 1996 and before; Import penetration is the share of imports in sector total output. All monetary variables in real terms (base 1987). Pay variables in pounds. Profit and assets in thousand pounds.

Table 6: The effect of the experiment on the total compensation of the highest paid director. Robustness Checks

	Profit squared interaction		Size interaction		Rival Profits	
Openness measure:	Export share	Import penetr.	Export share	Import penetr.	Export share	Import penetr.
	1	2	3	4	5	6
Profit	0.2576	0.2834	-0.4077	-0.3002	0.1963	0.2174
	[2.41]**	[2.55]**	[1.08]	[0.79]	[1.82]*	[1.94]*
Openness* Post 97* Profit	1.1955	2.0190	1.0644	1.7118	1.1578	1.8869
	[3.74]***	[3.61]***	[3.44]***	[3.12]***	[3.71]***	[3.43]***
Openness* Post 97	-5544	-16081	-5200	-15408	-5756	-15891
	[1.08]	[1.75]*	[1.01]	[1.67]*	[1.12]	[1.73]*
Profit* Post 97	-0.1761	-0.1866	-0.1142	-0.1172	-0.1058	-0.1069
	[1.48]	[1.48]	[0.96]	[0.92]	[0.89]	[0.85]
Openness* Profit	-0.8250	-1.4357	-0.7532	-1.3036	-0.7228	-1.2586
	[2.90]***	[2.91]***	[2.62]***	[2.61]***	[2.48]**	[2.51]**
Log assets	11032	11019	11111	11096	11005	11000
	[9.15]***	[9.14]***	[9.21]***	[9.20]***	[9.13]***	[9.13]***
Profit squared.	-9.31E-08	-7.02E-08	-2.29E-07	-2.10E-07	-4.04E-07	-3.96E-07
	[1.30]	[1.11]	[3.68]***	[3.37]***	[5.28]***	[5.08]***
Openness* Post 97* profit sqd.	-3.79E-07	-9.74E-07				
	[1.28]	[2.13]**				
Log assets* Profit			0.044	0.038		
			[1.81]*	[1.56]		
RPE					-0.0716	-0.0678
					[3.57]***	[3.91]***
Openness.* Post 97* RPE					0.0934	0.1380
					[1.41]	[1.67]*
Observations	23743	23743	23743	23743	23741	23741
Number of firm	11653	11653	11653	11653	11652	11652
R-squared	0.07	0.07	0.07	0.07	0.07	0.07

Absolute value of t statistics in brackets.

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

All regressions include firm fixed effects and sector specific time trends. See tables 3 to 5 for the definition of the variables. RPE corresponds to the profit of a firm of the same size with return of assets equal to the average return of rival firms. All monetary variables in real terms (base 1987). Pay variables in pounds. Profit and assets in thousand pounds.

Table 7: The effect of the experiment on average director's pay. Robustness Checks

	Profit squared interaction		Size interaction		Rival Profits	
Openness measure:	Export share	Import penetr	Export share	Import penetr	Export share	Import penetr
	1	2	3	4	5	6
Profit	0.0402	0.0295	-0.0698	-0.0884	0.0410	0.0306
	[3.60]***	[2.54]**	[1.53]	[1.87]*	[3.62]***	[2.63]***
Openness* Post 97* Profit	0.1145	0.1601	0.0869	0.1363	0.0911	0.1423
	[3.38]***	[2.86]***	[2.87]***	[2.55]**	[2.89]***	[2.63]***
Profit* Post 97	-780	-1034	-752	-1000	-767	-1027
	[1.34]	[1.00]	[1.29]	[0.97]	[1.32]	[0.99]
Openness* Profit	0.0216	0.0245	0.0240	0.0262	0.0182	0.0204
	[1.83]*	[2.02]**	[2.02]**	[2.16]**	[1.46]	[1.65]*
Openness* Post 97	-0.1169	-0.1483	-0.1045	-0.1201	-0.1161	-0.1497
	[4.08]***	[2.82]***	[3.63]***	[2.24]**	[4.03]***	[2.85]***
Log assets	5102	5102	5114	5113	5109	5107
	[36.14]***	[36.14]***	[36.24]***	[36.22]***	[36.20]***	[36.18]***
Profit squared.	-1.83E-08	-1.52E-08	-2.35E-08	-1.90E-08	-2.06E-08	-1.68E-08
	[2.09]**	[1.66]*	[2.67]***	[2.09]**	[2.36]**	[1.86]*
Openness* Post 97* profit sqd.	-8.66E-08	-1.01E-07				
	[1.84]*	[1.36]				
Log assets* Profit			0.0070	0.0074		
			[2.49]**	[2.58]***		
RPE					-0.0020	-0.0024
					[0.46]	[0.55]
Openness* Post97* RPE					-0.0079	-0.0058
					[0.62]	[0.31]
Observations	80620	80620	80620	80620	80614	80614
Number of firm	22056	22056	22056	22056	22055	22055
R-squared	0.04	0.04	0.04	0.04	0.04	0.04

Absolute value of t statistics in brackets.

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

All regressions include firm fixed effects and sector specific time trends. See tables 3 to 5 for the definition of the variables. RPE corresponds to the profit of a firm of the same size with return of assets equal to the average return of rival firms. All monetary variables in real terms (base 1987). Pay variables in pounds. Profit and assets in thousand pounds.

Table 8: The effect of the experiment on the structure of average workers pay. Robustness Checks

	Profit squared interaction		Size interaction		Rival Profits	
Openness measure:	Export share	Import penetr	Export share	Import penetr	Export share	Import penetr
	1	2	3	4	5	6
Profit	0.0030	0.0023	0.0042	0.0031	0.0037	0.0027
	[2.08]**	[1.51]	[0.74]	[0.54]	[2.65]***	[1.86]*
Openness* Post 97* Profit	0.0071	0.0049	0.0040	0.0027	0.0042	0.0030
	[2.06]**	[0.84]	[1.44]	[0.51]	[1.48]	[0.57]
Openness* Profit	98	283	102	286	99	285
	[0.82]	[1.35]	[0.86]	[1.36]	[0.84]	[1.36]
Profit* Post 97	0.00001	0.0013	0.0004	0.0013	0.0003	0.0013
	[0.01]	[1.10]	[0.33]	[1.14]	[0.29]	[1.11]
Openness* Post 97	-0.0026	-0.0008	-0.0040	-0.0022	-0.0040	-0.0022
	[0.79]	[0.14]	[1.20]	[0.36]	[1.23]	[0.38]
Log assets	353	353	353	353	353	354
	[13.03]***	[13.05]***	[13.04]***	[13.06]***	[13.06]***	[13.07]***
Profit squared.	-9.50E-10	-1.32E-09	-1.82E-09	-1.80E-09	-1.84E-09	-1.82E-09
	[1.36]	[1.84]*	[4.57]***	[4.50]***	[4.73]***	[4.58]***
Openness* Post 97* profit sqd.	-2.95E-09	-3.15E-09				
	[1.50]	[0.80]				
Log assets* Profit			-3.08E-05	-2.94E-05		
			[0.09]	[0.08]		
RPE					-0.0001	-0.0001
					[0.49]	[0.40]
Openness.* Post 97* RPE					-0.0002	-0.0001
					[0.18]	[0.12]
Observations	83375	83375	83375	83375	83366	83366
Number of firm	19916	19916	19916	19916	19915	19915
R-squared	0.11	0.11	0.11	0.11	0.11	0.11

Absolute value of t statistics in brackets.

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

All regressions include firm fixed effects and sector specific time trends. See tables 3 to 5 for the definition of the variables. RPE corresponds to the profit of a firm of the same size with return of assets equal to the average return of rival firms. All monetary variables in real terms (base 1987). Pay variables in pounds. Profit and assets in thousand pounds.

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