Universidad de San Andrés

Departamento de Economía

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Market Competition and the Adoption of HRM Practices

Autor: Augusto Ospital

Legajo: 22183

Mentor: Christian Ruzzier

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Augusto Ospital[1]
Universidad de San Andrés
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Abstract

This paper studies the effect of competition on the adoption of human resources management (HRM) practices that in theory display positive complementarities among each other. We use a panel sample of firms that is representative of almost every sector of the economy in Great Britain. First, a k-means partition cluster procedure is used to identify the combinations of HRM policies that are empirically most common. Second, the sudden and unexpected depreciation of the Sterling Pound in 2008, that affected sectors in different degrees depending to their exposure to foreign trade, is exploited as a quasi-natural experiment in order to identify the effect of reduced competition on the adoption of these HRM practices. Overall, results show that a reduction in competition caused an increase in the use of profit-contingent pay for workers not in a managerial position. On the contrary, less competition had a negative effect in the use of competency tests in recruiting, in the application of training programs on communication skills, and in the presence of employees that are trained to do other jobs than their own.

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1. Introduction

In their 1990 paper Milgrom and Roberts described patterns of simultaneous choices that were often found in technologically advanced firms encompassing marketing, production, engineering and organizational variables. They argued and modeled that this clustering was no accident, but a result of the adoption of a coherent business strategy that exploits complementarities. The cross effects among those choices made it profitable for a firm that adopted some of these characteristics to adopt more, and then an optimal strategy should consistently fit these with one another and with the exogenous determinants of the business environment. Moreover, these decision variables presented a quality of non-convexity, which worked against any smooth distribution of the practices. Then, any shift in performance did not occur as a result of small independent adjustments at each of different margins, but as a result of coordinated and discrete changes on a wide range of the firm´s activities.

Ichniowski, Shaw and Prennushi (1997) investigated the effect a set of human resource management (HRM) practices have on performance for observations on one very specific type of steel finishing process. Their results were consistent with the conclusion that groups or clusters of complementary HRM practices have large effects on productivity, while changes in individual practices have little or no effect. The narrow focus of their examination eliminates many possible sources of heterogeneity, but also limits the extension of these conclusions beyond that particular industry.

The aim of this work is to test how one particular variation of the business environment, the level of competition, affects the adoption of HRM practices. In a more general level, the idea is to complement the link studied by Ichniowski et al. (1997), and to do it for a sample covering a much wider array of industries. In that way the pretension is to indirectly contribute to the understanding of the relation between competition and productivity through changes in organizational design. In order to do this we will follow an empirical work by Cuñat and Guadalupe (2005). They exploit a quasi-natural experiment to identify the effect of product market competition on the slope of performance-related pay in the United Kingdom. This experiment is the 15% to 24% appreciation of the Sterling Pound in 1996, which increases the pressure on

domestic sectors where import penetration is stronger. Between 2007 and 2008 the Pound depreciated its value in a magnitude between 24% and 32%, so we can utilize this exchange rate shock as a source of exogenous reduction in competition that affected more those firms that where exposed to foreign trade.

The effect of competition is estimated using a panel of observations from a national survey of managers. This study is conducted every six years at the workplace level on a representative sample of the UK business sector, and contains questions on workplace characteristics, recruitment and training, communication, pay determination and payment systems, workforce flexibility, and many others. This wide selection of questions allows creating variables for a set of practices that are identified as important in incentive contract theory. The empirical grouping of these choice variables is studied using a k-means clustering procedure.

The results show that a reduction in competition affected the adoption of four different practices in two opposite ways. One the one hand it increased the adoption of profit-contingent pay schemes for workers. On the other hand it decreased the use of competency tests in recruiting, training on communication skills and the presence of employees formally trained to do jobs other than their own.

The structure of the rest of the paper is as follows. In section 2 the theoretical literature on the topic is discussed. Section 3 describes the data and the empirical strategy followed. Section 4 presents the results and section 5 concludes.

2. Literature

2.1. Complementarities among HRM practices and productivity

Milgrom and Roberts (1990) developed a theoretical model of the strategic choice and organizational design of the firm based on complementarities among the elements of the firm's strategy, non-convexities in deciding these elements and non-concavities between this choice and performance. In its most simple sense, two choice variables are complements if choosing more of one increases the returns of choosing more of the other. If we now consider many choice variables then complementarity is to be understood

in a broader sense, as a relation between groups of choices. The defining characteristics of these groups is that if the levels of any subset of practices are increased, then the return to increases in any or all of the remaining practices increases as well. The idea that Milgrom and Roberts model is that strategy and structure need to fit with one another and with the business environment, and that this leads to the existence of different coherent patterns of choice variables. It is the complementarity that gives rise to these coherent patterns, and the non-convexity and non-concavity that give rise to the existence of multiple distinct patterns and explain why modern manufacturing methods might not be a marginal decision.

In this work we will focus on one group of the choice variables faced by firms: employment practices.

In the context of incentive contract theory there are different considerations that complicate the design of optimal employment policies. Theoretical work suggests that sets of complementary HRM practices could be effective in dealing with these kinds of issues. Ichniowski, Shaw and Prennushi (1995) classified the interaction effects between employment practices according to the problems they try to overcome: free riding, subjective evaluations and obtaining private information from workers. In the next paragraphs we define where could complementarities exist among employment practices guided by this classification.

A free riding problem arises when there is an incentive contract contingent on output and only the output of an entire unit can be measured. Firms can overcome this by developing a "culture" of high effort among workers. One could argue that if the worker possesses a "high effort" cultural trait, that is tends to respond to mandates by investing high effort, the monitoring costs involved in the contract are reduced. Kandel and Lazear (1992) argue that this culture of high effort can be maintained among groups of employees through peer pressure from members who feel shame or guilt from deviating from the norm. Therefore for incentive pay to be most effective it should be coupled with a careful recruitment process, as well as any expenditure that helps to create "loyalty and team spirit". On top of that, any practices that actively provide workers with the opportunity to monitor each other and their work, like for

example quality circles and work teams, should have the same positive complementarity.

Another problem of contract design is the measure on which to make a contract contingent on. Most of the times the one that is most readily available, like the quantity or value of output, is very limited and managers would like to reward for other dimensions of performance that are hard to measure. These might be for example the degree of initiative, the willingness to cooperate or the loyalty of an employee. The core problem here is one of trust or reputation. Management expects workers to expend effort in return for uncertain expected future rewards. Then any practices that raise the value of the relationship and make the pledges of participation on the increased value of the relationship more credible should be complements. For example an employee will only put an effort in team quality circles if he expects that the value generated will be reflected in future performance related pay or in a reduced probability of getting fired.

The third problem arises because employees usually have private information that is valuable to management, but lack incentives to share it. In particular, employees may face a tradeoff between increasing productivity and the elimination of jobs, so employment security may be a necessary complement to implementing problem-solving teams. As Milgrom and Roberts (1995) argue, a commitment to longer-term relationships in turn makes other practices more valuable. If as a manager you plan to keep an employee, it is relatively more beneficial to conduct extensive screening in the recruitment process (as bad hires have long lasting effects) and to invest in skills development. It is also more efficient to apply job rotation schemes as an alternative to layoffs when facing demand shocks. All of these practices would in turn make the long-term employment pledge more credible. Moreover, the simultaneous combination of all the above reduces the risk and increases the value of communication and information sharing with employees, as they expect a lasting relationship and are equipped with the skills and mechanisms to transform information into increased value.

As made evident by these three main threads of complementarity and their ramifications, the interaction effects reinvigorate each other in a multiplier

effect as we add practices. On top of these there are other more obvious sources. Complementarity as we understand it occurs when the adoption of a practice increases the return of the adoption of another practice. This return could be thought of as composed by benefits and costs, and the relationships previously described mostly concern the benefits of adopting a certain practice. There could also be complementarities through costs: for example the same HHRR personnel could be used to implement tests during recruitment and to manage training programs and then the cost of implementing one of the two is relatively lower when the other policy is already being put into practice.

2.2. The effect of competition

In Milgrom and Robert's (1990) model of organizational design, strategy and structure need to fit with one another and with the business environment. The degree of product market competition is one of the qualities of the business environment and the one that is object of this study.

The previous section outlined a link between the simultaneous application of a set of innovative HRM practices and productivity. Increased competition could result in an increased minimum level of productivity that firms have to achieve in order to survive. Then to gain productivity firms could recur to innovative HRM practices. Conversely, although arguably less likely, it could happen that a reduction in the number and profits of local firms caused by increased foreign competition increases the negotiation power in employment matters (be it with unions or with individual employees) of local firms. As there are less employment alternatives, the possibility of being fired provides sufficient incentives for an employee to exert effort and firms do not need to appeal to "innovative" human resources practices. Symmetrical arguments can be developed for a reduction in competition: a lower minimum level of productivity would make unconventional practices redundant, or reduced competition in job markets would dilute the incentive power of layoffs and make these HRM schemes more valuable.

For the particular case of incentive pay Cuñat and Guadalupe (2005) argue that two mechanisms that partially counteract each other could be in operation, resulting in an ambiguous net effect. On one hand, higher competition would make a firm's market share more elastic to increases in productivity,

resulting in increased returns to employee's effort and then for the provision of more aggressive incentives to be optimal. On the other hand, a higher degree of competition means lower prices for the firm ceteris-paribus. Then a given market share becomes less valuable with higher competition and firms might want to offer flatter incentive schemes.[2]

From the brief preceding discussion it follows that there is not a clear prediction on the direction of the effect of competition. Then the impact of competition on the adoption of HRM practices is a question to be answered empirically.

2.3. Tight and Loose Coupling

One last consideration is a feature of the discussion of complementarities and non-convexities in the decision of the firm, what Roberts (2004) calls "tight and loose coupling". For a static context and a given environment the optimization process consists of identifying complementarities across choice variables and adjusting them in the way that maximizes performance. However, in a dynamic context where the adjustment in organizational design is costly the optimal choice could be a cluster of features that performs relatively well for a set of possible environments, even if it is not the optimum arrangement for the current environment. Uncertainty, then, introduces a trade-off in the design problem between tightly coupled and loosely coupled systems. Or to put it in other terms, a trade-off between performance and resilience in organizational design.

One implication of this argument about optimal choices in dynamic contexts is that an unexpected shock to the business environment, no matter its magnitude, may not be enough to justify a change in organizational design if firms do not expect the new conditions to last. This point is relevant to our empirical strategy and will be revisited in section 3.3.

3. Data and Empirical Strategy

3.1. Data Description

The Managers Questionnaire (MQ), a part of the Workplace Employment Relations Study (WERS), is a national survey conducted every six years at the

[2] This argument is originally discussed in Schmidt (1997).

workplace level on a representative sample of the UK business sector.[3] Its main advantage is that it provides large-scale, statistically reliable evidence about a broad range of employment relations and practices across almost every sector of the economy in Great Britain. The data used comes from:

- cross-sectional data available for WERS conducted on years 1998, 2004 and 2011;
- a panel sample with observations for 2004 and 2011;
- a sub sample of the 2004 cross section that includes an extra set of answers on financial matters.

The issued 2004-2011 panel was the full set of achieved cases from the 2004 WERS cross-section that continued in existence in 2011, and that had more than five employees in both periods.

The sample used for estimations is the 2004-2011 panel, and the others are used for complementary calculations or extra descriptive analysis. The surveys in the WERS series are based on stratified samples in which the sampling fractions vary across the strata of the sampling matrix, so these design features will be accounted for during analysis.[4]

The MQ is an interview with the most senior manager who deals with employment relations, human resources or personnel and staff at the selected workplace. The deposited data has a large set of answers to a wide range of questions at the establishment level. This information was used to code a set of dummy variables that measure work practices on seven areas of personnel management that arise as important from the theory discussed in section 2. Table 1 provides the definition and means of these variables.

[3] A workplace is defined as comprising the activities of a single employer at a single set of premises. A branch of a bank, a factory and the head office of a local council are all considered to be workplaces (Deepchand et al., 2013). Throughout this work the words "workplace" and "establishment" are used interchangeably.

[4] Because of these design features the achieved sample of workplaces is unrepresentative of the population. Furthermore, variable rates of non-response can cause the achieved sample to depart in additional ways from the population it is intended to represent. Weights equal to 1/(probability of selection & response) are provided with the database for use in the analysis to bring the profiles of the achieved samples of workplaces into line with the profiles of the respective populations, thereby removing known biases introduced by the sample selection and response process. The details on how these design features are accounted for are in section 3.3.

Table 1. Definition and Mean Values of HRM Variables

HRM Variable name		Panel	2004 subsample	Dummy Variable Description
1. Incentive Pay	profitsh	0.16	0.21	Are non-managerial occupations participating in a profit-related pay scheme?
	profitpay	0.25	0.30	Do any employees at this workplace receive profit-related payments or profit-related bonuses?
	lineincent	0.42	0.45	Do any of the employees in this establishment get paid by results? Includes any method of payment where he pay is determined by the amount done or its value, rather than just the number of hours worked. It includes commission, and bonuses that are determined by individual, establishment or organization productivity or performance. It does not include profit-related pay schemes.
2. Recruiting and Selection	comptest	0.66	0.62	When filling vacancies at this workplace, do you ever conduct any type of performance or competency test?
	pertest	0.37	0.34	When filling vacancies at this workplace, do you ever conduct any type of personality or attitude test? (note: both managerial and non managerial vacancies)
3. Teamwork	problemsolv	0.33	0.35	Do you have groups of non-managerial employees at this workplace that solve specific problems or discuss aspects of performance or quality? They are sometimes known as problem-solving groups or quality circles or continuous improvement.
	formalteam	0.75	0.71	Do most employees (more than 60% of largest occupational group) at this workplace work in formally designated teams?
4. Job Rotation	formaljobrot	0.76	0.76	Are workers in the largest occupational group formally trained to do jobs other than their own?
	jobrot	0.71	0.71	Do workers in the largest occupational group actually perform jobs other than their own at least once a week?
5. Skills Training	mosttrain	0.59	0.54	Have more than 60% of the workers in the largest occupational group been given time off from their normal daily work duties to undertake training over the past 12 months?
	train_teamwork	0.45	0.44	Did this training cover teamwork skills?
	train_problemsolv	0.24	0.24	Did this training cover problem-solving methods?
	train_comm	0.37	0.27	Did this training cover communication skills?
6. Communication	infosh	0.84	0.83	Does management regularly give employees, or their representatives, any information about the financial position of the establishment?
	briefroup	0.72	0.69	Do you have meetings between line managers or supervisors and all the workers for whom they are responsible? (These are sometimes known as 'briefing groups' or 'team briefings').
	meetunion	0.51	0.48	Does management normally negotiate, consult or inform unions about rates of pay, training of employees, health and safety or grievance and disciplinary procedures?
7. Employment Security	jobsecurity	0.16	0.17	Is there a policy of guaranteed job security or no-compulsory redundancies for managerial and/or non-managerial employees?

Notes: columns 3 and 4 report the mean values of each HRM variable on the 2004-2011 panel sample and on the 2004 cross sectional subsample with financial information. The 2004-2011 panel has 1978 observations and the 2004 cross section sub-sample has 725 observations.

3.2. Identifying HRM Systems

The first step of the empirical exercise is to identify the systems of HRM practices that appear in the data. We will use the 17 dummy variables described in table 1 that cover seven areas of HRM practices that arise as important from the theoretical work on complementarities and incentive contracts discussed in section 2.

Ichniowsky et al. (1995) pursue four alternative approaches for identifying a set of HRM practice combinations that empirically are the most common in their sample of steel finishing lines. The first one is examination of the detailed HRM variables they generate. The second one is using an index composed of the sum of the values of dummies that represent a "high" or "low" ranking in that particular HRM area, and based on this index break the observations into groups. Finally they use two multivariate classification procedures, Nominate scaling and Guttman scaling.

The first two approaches are hard to implement when we move apart from detailed knowledge of a very homogenous sample. There are no evident patterns that arise from simply examining the data. It seems arbitrary as well to define "high" and "low" implementations of each practice. The last two procedures seem more promising for our purposes. However, the final partition is determined by "natural" break points in the scores, so the limitation on the visual identification of patterns is still operative.

We follow another multivariate procedure: k-means partition cluster analysis. We need to specify ex ante the k number of groups we want to divide the sample in, and then the algorithm chooses *centers* for each groups as well as the membership of each observation to each group so that the "distance" between each observation and the center is minimized. The notion of distance chosen is the simple matching binary similarity coefficient, which is the proportion of matches between two observations.[5] The idea is that each group

[5] For comparing observations i and j, so that

		obs. j	
		1	0
obs. i	1	a	b
	0	c	d

should include establishments that implement (or do not implement) the same pattern of HRM practices. In its most simple sense, two choice variables are complements if choosing more of one increases the returns of choosing more of the other. It then follows that for dummies constructed to reflect these selected practices, complementarity means that they should in most cases either appear both "on" or both "off". Then this coefficient allows grouping together those establishments that tend to have the same practices "on" or "off". Out of the examination of the resulting groupings we should learn the most common patterns of practices across the sample.

3.3. The Effect of Competition

In order to construct a competition variable this work follows Cuñat and Guadalupe (2005) and exploits as a quasi-natural experiment a change in the competitive environment in the United Kingdom that affected firms with different intensities. This experiment is the sudden depreciation of the British Sterling Pound in 2008.[6] Figure 1 shows the end quarter effective exchange rate index, which is calculated by weighting together bilateral exchange rates by their participation on trade flows in manufactured goods and services. It measures changes in the price competitiveness of traded goods and services and so the weights reflect trade flows in manufactured goods and services. The shaded regions indicate those quarters during which the WERS questionnaires where conducted.[7] There are two regimes of high and low exchange rate divided by a sharp depreciation, and the timing of the WERS enables to exploit these two periods as an experiment for a decrease in product market competition. Because of the argument of "loose coupling" in the optimal choice of organizational design

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where a is the number of variables where observations i and j both had ones, and d is the number of variables where observations i and j both had zeros. The number of variables where observation i is one and observation j is zero is b, and the number of variables where observation i is zero and observation j is one is c. Then the simple matching binary similarity coefficient is defined as
$(a + d)/(a + b + c + d)$.

[6] Cuñat and Guadalupe (2005) exploit the appreciation of the pound in 1996 to study the effect of competition on incentive contracts. Bertrand (2004) and Revenga (1992) also use trade variables to identify changes in competition.

[7] The dates of fieldwork for the 2004 WERS were from February 2004 to April 2005. For the 2011 WERS they were from March 2011 to June 2012. The questions mostly asked about employment relations practices at the time of the interview, and that is the case for the questions used in this paper, but some questions asked about the 12-month or 2-year period prior to the interview. Thus, in all cases the answers can be considered to refer to one of the distinct exchange rate regimes.

Figure 1. End Quarter Effective exchange rate index, Sterling (Jan 2005 = 100)

Source: Bank of England

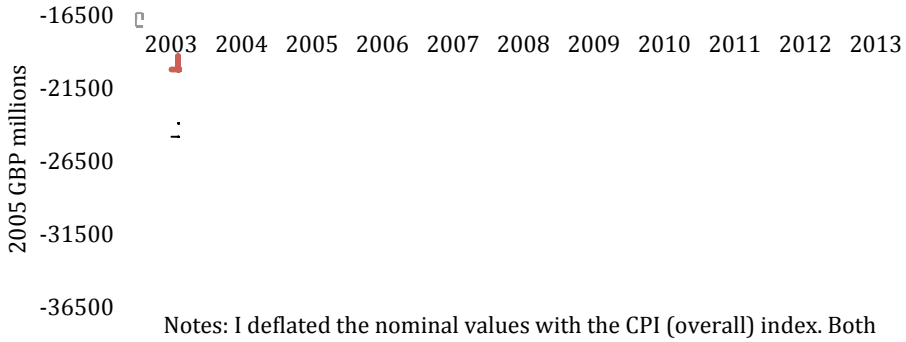
discussed earlier, it is relevant that we are observing two different regimes and not just a shock that adjusts back to the same trend later on. Firms in 2011 had already lived two years or more of the "new" exchange rate regime when managers were interviewed.

The direct effect of a depreciation of the currency is an increase in the costs of foreign firms relative to UK costs, so it becomes harder for overseas firms to compete in the local market. Moreover, this increase in costs has an effect on equilibrium prices. As relative costs fall, domestic prices increase and they do so more in sectors where foreign products and services are important. Then the depreciation has a larger impact on prices in more exposed sectors, and companies in those sectors become "shielded" from the competition of foreign firms. This reduces the pressure on domestic sectors that are exposed to overseas competition, and therefore can be used as measure of an exogenous reduction in competitive pressure.[8]

It is safe to say that firms interviewed in 2004 could not have predicted the changes that would occur three to four years later. The magnitude of the

[8] Other than these immediate effects, some papers study the structural effects that an appreciation of the exchange rate has on competition. Baldwin (1988), Dixit (1989) and Baldwin and Krugman (1989) argue that in a situation where foreign firms need to pay entry costs to sell in the local market, the appreciation provides overseas firms with a period where they are relatively more competitive than local firms. Then they incur in the costs to start selling in the domestic market, and some local firms that used to be competitive cease to be so and close. When the appreciation is reversed with a subsequent depreciation, or if the local factor prices adjust and restore the competitiveness of local firms, foreign firms that entered do not leave and local companies that closed do not reopen. We can reverse this argument for a case like ours with a sufficiently large depreciation. However, there could also be an indirect effect with opposite sign: the reduction in competition makes it more attractive for new firms to enter the market to *produce*, rather than as importers. It seems reasonable to assume, as we will, that the direct effect will dominate and the depreciation has the effect of a reduction in product market competition.

Figure 2. Balance of Payments: Trade in Goods & Services



Notes: I deflated the nominal values with the CPI (overall) index. Both series from the Office for National Statistics. The horizontal black lines indicate the pre- and post-2008 averages.

depreciation was 24.4% from the last day of 2007 to the last one of 2008. This suggests that the impact on the firms exposed to foreign competition might have been very important.[9] Although we do not test its effect on competition, there is evidence that supports the validity of this measure. Figure 2 presents the balance of trade in goods and services and conveys that the shock to the exchange rate generated a significant shock to UK exports and imports.[10] There was a sharp reduction in the deficit between 2007 and 2009. That means a reduction in the value of imports relative to exports, which translates into a decrease in the market share and number of foreign competitors in the UK. Although the deficit increases again in 2010, the periods after the depreciation present in average a smaller deficit level (yet with higher volatility) than the periods before. Notice that with the sudden depreciation the prices of the imported products rise relative to the price of local ones. Then the observations after 2008 underestimate the reduction in the volume of imported goods and services and the actual decrease must have been larger than what the monetary measures suggest. Overall, workplaces in 2011 faced a very different landscape in relative value of imports and exports than they did in 2004.

[9] As a reference, the appreciation exploited by Cuñat and Guadalupe (2005) was of 15% with this same index from the last day of 1995 to the last day of 1996. Figure A1 in the Appendix extends the time frame of Figure 1 back to March 1992 to provide a visual idea of the relative magnitudes.
[10] Cuñat and Guadalupe (2005) present data on the balance of trade in goods only. However, given the relative importance of services in the UK economy and the fact that the sample includes both goods producers and service providers, the balance of trade in goods and services provides a better picture of the trade environment faced by workplaces. Moreover imports and exports in services suffered less important variations than trade in goods at the time of the depreciation, so the same conclusions hold or are even stronger for the balance of trade in goods on a stand-alone basis.

To evaluate the differentiated effect of the competition shock we interact a post-2008 dummy with a measure of exposure to foreign competition before the shock at the workplace level. The measure of the degree of exposure to the depreciation was constructed with a question in the MQ that asks whether the establishment faces competition from overseas-based suppliers for its main product or service, and if it is "a lot" or "little" competition. The binary exposure variable, $exposed_i$, is then built to distinguish workplaces that were open to foreign competition before the shock from those that weren't and therefore were shielded from its effect. This distinction between no competition and competition is better than a variable that distinguishes degrees of competition because of its more objective quality. It is less likely that managers have the same conception of what is "a lot" and what is "a little" competition than of what is to face or not to face competition.[11]

The specification used for the estimations, for establishment *i* and period *t*, is as follows:

$$hrm_{it} = \alpha X_{it} + \gamma_i + \mu_t + \beta exposed_i \, post08_t + \varepsilon_{it}, \qquad (1)$$

where

$$exposed_i = \begin{cases} 1 \; if \; establishment \; i \; faces \; overseas \; competition \; in \; 2004, \\ 0 \; if \; it \; faces \; no \; overseas \; competition \; in \; 2004. \end{cases}$$

Here hrm_{it} is one of the practice dummy variables described in table 1 or one of the HRM systems that arise from the clustering procedure. The dummy $post08_t$ equals one if the year is 2011. X_{it} is a vector of firm characteristics such as size and α a vector of matching coefficients, μ_t are year dummies and γ_i are establishment fixed effects. The coefficient of interest, β, captures the differential effect of the depreciation on workplaces according to their trade exposure in 2004. ε_{it} is an error term.

There are some design considerations that should be taken into account. WERS surveys are based on stratified samples with unequal selection probabilities per establishment. In 2004 the population was stratified by workplace size and industry sector, and random samples were then drawn from

[11] In addition, because of the distribution of the answers, using the variable that distinguishes between degrees of competition reduces the number of "treated" establishments relative to the "control" group. Since the sample is designed to be representative of the population there is a loss when the analysis is constrained to a small subsample of observations.

the population within each cell of the resulting sampling matrix of 108 strata. All cases that produced productive interviews in 2004 were released to the field in 2011.[12] The two design features that have a biggest effect on standard errors (and therefore p-values and confidence intervals) are the survey weights and the stratification. These can be accounted for by using sampling weights that equal $1/(probability\ of\ selection\ and\ response)$ and taking into account the 2004 strata identifiers for the variance estimation.

Cluster-robust standard errors that allow for correlation between observations for the same establishment are computed for our base fixed effects model. However, it is possible that errors from workplaces in the same stratum, determined by establishment size and industry sector, are correlated. As a consequence we have a case of nested clustering of the error term by strata and by establishment.

Finally, the limitation of having only two time observations for each establishment creates a problem for interpreting causal relations out of the results. The identification strategy as it is does not enable us to separate the effect of competition from a general trend. That is, any result could be simply caused by different trends in the adoptions of HRM practices for establishments exposed to foreign competition and for those not exposed. Ideally we should be able to ensure that there are no differential pre-existing trends in organizational variables that may be correlated with the initial exposure level.[13] To address this we can take advantage of the 1998 and 2004 cross sections.

In the next section we assess the organizational response to this quasi-natural experiment.

4. Results

[12] Of the 2295 productive workplaces from WERS 2004, 2286 were issued to the field. Those that continued to be in existence and had five or more employees were approached for interview. A total of 989 panel interviews were achieved in 2011/12, representing an overall yield from the selected sample of 43.3% with 17.7% defined as ineligible or out of scope. (Deepchand et al., 2013). An extra concern with our panel could be that the loss of establishments between the base stage and the final stage is not independent from our dummy of exposure to trade $exposed_i$. An implication of random attrition is that the rates of dropouts from the sample should be equal in the group exposed to foreign trade and in the group that is not. If we take the full sample of 2295 productive interviews in 2004 the attrition rates are of 62.5% in the exposed group and 60.1% in the unexposed, and we cannot reject the null hypothesis that they are equal.

[13] Although there is a 1998-2004 panel, the set of questions is very limited and it does not include the one used to generate our treatment variable or any other that is similar.

4.1. Identifying HRM Systems

Table 2 presents simple correlations between the variables that provide the first evidence of complementarities among the practices.

Table 2. Pairwise Correlation of HRM Variables (Over the 2004-2011 Panel Sample)

		profitsh	profitpay	lineincent	comptest	pertest	problemsolv	formalteam
Incentive Pay	profitsh	1.0000						
	profitpay	0.7411***	1.0000					
	lineincent	0.1720***	0.2569***	1.0000				
Recruiting	comptest	0.0280	0.0119	0.0960***	1.0000			
	pertest	0.0993***	0.1210***	0.1534***	0.3110***	1.0000		
Teamwork	problemsolv	0.0425*	0.0614***	0.0762***	0.1687***	0.2191***	1.0000	
	formalteam	-0.0140	-0.0251	0.0736***	0.2425***	0.2003***	0.1957***	1.0000
Flexible Job Assignment	formaljobrot	0.0954***	0.1150***	0.0899***	0.1577***	0.1737***	0.1752***	0.1740***
	jobrot	0.0842***	0.1118***	0.0930***	0.0941***	0.1420***	0.1497***	0.1222***
Training	mosttrain	-0.0212	-0.0476**	0.0266	0.1781***	0.1333***	0.1449***	0.2192***
	train_teamwork	-0.0304	-0.0257	0.0148	0.0995***	0.1391***	0.1236***	0.1058***
	train_problemsolv	0.0087	0.0089	0.0642***	0.0862***	0.1116***	0.1875***	0.0943***
	train_comm	-0.0047	0.0041	0.0187	0.0600**	0.1061***	0.0668***	0.0526**
Communication	briefgroup	0.0100	0.0483**	0.1047***	0.2193***	0.2284***	0.1914***	0.3186***
	infosh	0.0883***	0.0824***	0.0878***	0.2260***	0.2181***	0.2117***	0.1981***
	meetunion	-0.0881***	-0.1353***	-0.0283	0.2945***	0.2384***	0.2559***	0.2763***
Job security	jobsecurity	-0.0276	-0.0597***	-0.0530**	0.0305	0.0206	0.0417*	0.0543**

	formaljobrot	jobrot	mosttrain	train_teamwork	train_problemsolv	train_comm	briefgroup	infosh	meetunion
formaljobrot	1.0000								
jobrot	0.6377***	1.0000							
mosttrain	0.0933***	0.0262	1.0000						
train_teamwork	0.0859***	0.0802***	0.1476***	1.0000					
train_problemsolv	0.0726***	0.0171	0.1182***	0.3767***	1.0000				
train_comm	0.0568**	0.0251	0.1248***	0.4012***	0.5631***	1.0000			
briefgroup	0.1978***	0.1259***	0.1783***	0.1352***	0.1001***	0.0912***	1.0000		
infosh	0.2016***	0.1387***	0.1407***	0.1201***	0.1152***	0.0944***	0.2579***	1.0000	
meetunion	0.1263***	0.0811***	0.2063***	0.0501**	0.0803***	0.0180	0.2333***	0.2717***	1.0000
jobsecurity	0.0337	0.0119	0.0525**	0.0646***	0.0152	-0.0306	0.0614***	0.0734***	0.1705***

***correlation coefficients significant at the 1% level; **at the 5% level; *at the 10% level.

To interpret these results we need to exclude the correlations between variables in the same area of HRM policy.[14] This leaves a total of 122 correlations, of which 93 are statistically different from zero and positive and only three are statistically different from zero and negative.

The pattern of correlations between six of the seven areas of policy reflect the expected complementarities. Correlations are positive and significant among all variables capturing practices of extensive recruiting, team-based work structures, labor-management communication, flexible job assignment, skills training and employment security (with the exception of this last variable and recruiting and job rotation).

The majority of correlations that cannot be distinguished from zero at a 10% level are between one of the variables that capture incentive pay schemes and a variable from another area. Notably the only positive and significant correlation between training and incentive pay is between training in problem-solving methods and payment by results other than profit. Moreover, all three of the negative relationships found include incentive pay as one of the pair. Two of these are between *meetunion* (which measures communication with unions) and *profitsh* (which measures if any non-managerial occupations face a profit-related pay scheme), and between *meetunion* and *profitpay* (which measures if any occupation faces profit-related pay schemes). The remaining is between *profitpay* and *jobsecurity*, which captures if there is an employment security policy in place. The negative relationship observed between communicating with unions and the variables capturing incentive pay schemes can be explained by the negative relationship of the latter with the unionization of workers. In our sample the correlation between the proportion of employees who belong to a trade union or independent staff association and any of the three incentive pay variables is negative and significant at the 1% level. Then if establishments that tend to have unionized workers also tend not to use performance related pay, it

[14] The fact that correlations are strong and vey significant between pairs of practices that were classified into the same policy areas supports the idea that these variables are measuring similar things. This is trivial in some cases, for example if there is a policy of profit-related pay for non-managerial occupations in place (*profitsh* equals 1), this policy is in place for any occupation (*profitpay* equals 1). In other cases it is not obvious: the fact that briefing groups exist does not necessarily mean that managers communicate with unions (*briefgroup* and *meetunion* respectively).

follows that they are less likely to have an union counterpart to communicate with. Regarding profit-related pay and employment security, an effect with the opposite direction of the one we mentioned earlier could be in operation. We said that guaranteed job security increases the value of the employment relationship, but the probability of getting fired is a basic market source for incentives and a policy of this type reduces that probability. This effect would be expected to prevail especially if job security is not accompanied by the other complementary practices. This is precisely the case according to our data: it displays correlations not statistically different from zero with all variables capturing careful recruitment processes as well as with job rotation. On top of that the correlations are relatively weak and less significant with teamwork variables and with training variables. We also notice that job security is not a widely adopted practice in our panel sample, at 16% of establishments according to table 1.

Besides the cases pointed out in the previous paragraph, incentive pay practices do display positive complementarities with other HRM policies. They are correlated with extensive training, although the use of competency tests is only positively related with payment by results excluding profit related pay (as captured by *lineincent*). Incentive pay schemes are also positively and significantly related to flexible job assignment, as well as with the existence of problem-solving teams. In particular for this last relationship only *lineincent* is correlated to formally determined teams. Finally all three performance-pay variables display positive correlations with the sharing of financial information, and profit related payments and payments by results do so with team briefings.

Overall, the pattern of the correlations in table 2 reflects the kinds of complementarities that are suggested in the reviewed theories for a large sub set of the variables. They help us get an initial understanding of the combinations of HRM practices that empirically are the most common. Next we will use the k-means clustering method to group the establishments in the sample according to their choice of HRM practices.

Figure 3. Means of HRM variables for each cluster generated by k-means method
(1677observations, 2004-2011 Panel Sample)

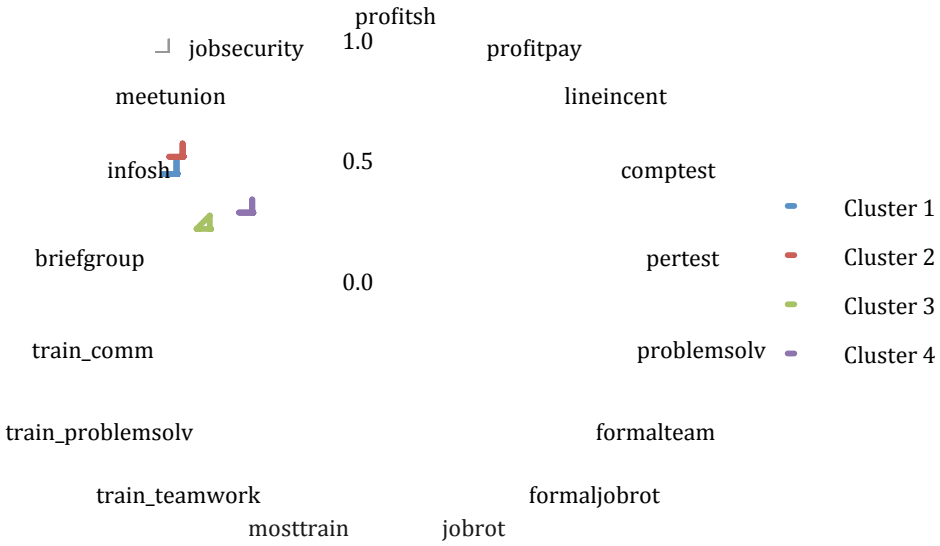


Figure 3 represents the mean value of each of the considered HRM practices in each of the four groups generated by the clustering method.[15] The data used to generate the graph is detailed in table A1 in the Appendix. 1677 observations where classified; 22.3% into the group labeled Cluster 1, 42.6% in Cluster 2, 12.6% in 3 and 22.5% in the remaining Cluster 4. The group labels are assigned based on the mean of the means of every practice in each group. This seems natural but it is important to note that these labels cannot be interpreted as in order from "more" to "less" innovative systems. More precisely, this classification is not a totally ordered set. While an establishment in Cluster 1 can sensibly be said to be more "innovative" than one in Cluster 4, this distinction cannot be made when we compare an establishment in Cluster 2 to another in Cluster 3.

Establishments in Cluster 4 can be seen as the "less innovative" base category. They do not employ many of the practices studied. Still, they are quite likely to adopt job rotation and use team briefings. Formal teamwork structures and training practices can also be seen, but with lower incidence.

The HRM system in Cluster 2 is an overall improvement (in terms of the practices in question) over Cluster 4, with the notable exception of two of the three incentive pay variables. All the means of HRM dummies but these two are

[15] There are two establishments that had all practices present (all variables equal to 1) in 2004, and none in 2011. No observation in the panel had all dummies equal to 0.

higher. The magnitudes of the relative improvements are greater in communication, flexible job assignments, teamwork and recruiting while the upgrades in training are relatively smaller.

Cluster 3 can also be seen as an improvement over Cluster 4 in training and communication practices, again excluding incentive pay and now also excluding job rotation. Against Cluster 2, system 3 shows lower adoption in all areas but training.

The workplaces in Cluster 1 have a similar pattern of practices as Cluster 2, except that they have further development in all policy areas but communication. The greater differences can be appreciated in training in the three specific skills of teamwork, problem solving and communication. Overall, Cluster 1 displays the most balanced and high adoption of HRM practices with further development in almost every area compared to all the other groups.

In the preceding description no mention was made of job security. Figure 3 illustrates that not only this is not a practice adopted by many workplaces in our sample, as it was already pointed out, but also that there is not much difference in the adoption among HRM clusters. Although as expected the adoption is relatively higher in Cluster 1 and 2 where workplaces tend to apply many of the other complementary practices, this difference is small. Employment security is rarely adopted, no matter the combination of other practices.

We must point out as well that, although not in a way as extreme as with job security, profit-related pay does not show neither high overall adoption nor marked differentiation between clusters, relative to what we can observe with other variables. For example clusters 1 and 4 share very similar levels of *profitsh* and *profitpay*, while they differ greatly in every other area. If the complementarity between one variable and all the rest is weak, then the differences in the adoption of the practice captured by that variable would only be weakly related to the joint choice of other practices that are complementary to each other. We would then expect to find cases, like the one mentioned above, where we have two clusters, one with high adoption of the group of complementary variables and the other with low adoption, with similar levels of adoption of the uncorrelated variable. This can be interpreted as evidence of a link between profit pay and other HRM areas (excluding job security, which is

not strongly related to any) that is weaker than the one the theory would suggest.

In the k-means partition clustering procedure the number of groups is set exogenously, in our case at k=4.[16] We repeated the procedure with k=3 and k=5. The characteristics of the resulting groupings can be consulted in the appendix.[17] The classification with k=3 captures a distribution similar to the one in figure 3 if we took away Cluster 3 and the differences in profit-pay adoption among clusters became even smaller. When we set k equal to 5 greater differentiation is allowed among clusters in the adoption of profit pay variables, but otherwise the relative distribution of patterns is very similar to our base case with 4 clusters.

4.2. The Effect of Competition

Table 3 reports the basic regression results of equation 1 for the four HRM practices that presented an effect significant at the 10% level, excluding coefficients associated with time and establishment fixed effects. The non-significant results for the other 13 practices can be consulted in tables A6 and A7 in the appendix. The variables with a significant effect belong to four of the seven areas of policy we study: incentive pay, recruiting, job rotation and training. No significant effect was found on practices related to teamwork, communication or employment security. Taking into account that at the moment of the exchange rate shock the UK was going through a period of recession and financial crisis it is important to include some control for performance. Due to privacy concerns, the WERS database does not include financial information except for a sub-sample in the 2004 cross section. As a substitute to this we use a question of the MQ that asks for an assessment about the financial performance relative to the industry for every establishment. The manager can rate whether the workplace is a lot better than average, better than average, average, below average or a lot below average, and these options are coded from 1 to 5. The validity of this measure can be tested by regressing profit per full-time equivalent employee on our index of relative performance in the 2004 sub-sample. This relationship is strongly positive and significant at the 1% level, suggesting that it is a good

[16] One possible extension to this work would be to employ some procedure in which the number of clusters is determined endogenously by the data.
[17] Figures A2, A3 and tables A2 and A3 in the appendix.

substitute.[18] We also included controls for ownership structure by adding a dummy that indicated if it was a single independent establishment and another dummy that indicated if it was part of a foreign organization. The base category is the group of workplaces that are one of a number of establishments belonging to the same UK organization. All regressions include controls for size. Dummies indicating public limited companies and government organizations were added as well.

Table 3. The Effect of the Experiment On Individual HRM practices: OLS with Fixed Effects and Clustering Errors by Workplace

	profitsh	comptest	formaljobrot	train_comm
exposed*Post08	0.2192*	-0.1895**	-0.2186**	-0.2738*
	(0.125)	(0.094)	(0.094)	(0.160)
Size	0.0003	0.0007*	0.0002	0.0004
	(0.000)	(0.000)	(0.000)	(0.000)
Size-squared	-0.0000	-0.0000*	-0.0000	-0.0000
	(0.000)	(0.000)	(0.000)	(0.000)
Public Company	0.0825	0.1202	0.0006	0.2385
	(0.090)	(0.120)	(0.122)	(0.147)
Government	-0.1255	-0.8720***	-0.1715	0.0641
	(0.137)	(0.190)	(0.122)	(0.179)
Relative Financial Performance	0.0179	-0.0330	0.0006	-0.0487
	(0.028)	(0.043)	(0.034)	(0.041)
Single workplace	0.0062	-0.0842	0.0670	-0.1317
	(0.059)	(0.085)	(0.123)	(0.121)
Foreign workplace	-0.0193	-1.3460***	-0.1024	-0.3782*
	(0.248)	(0.302)	(0.183)	(0.213)
Constant	0.1165	0.6535***	0.6045***	0.3851***
	(0.090)	(0.132)	(0.095)	(0.118)
Observations	960	955	948	839
R-squared	0.035	0.065	0.023	0.073

Clustered robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. LSDV models with establishment and time fixed effects. Sampling weights were used.

The coefficients are negative in the case of recruiting, job rotation and training, but positive in the case of incentive pay. The variable measuring incentive pay, *profitsh,* takes value 1 when non-managerial occupations participate in a profit-related pay scheme and 0 otherwise. The positive and significant coefficient for the variable of interest suggests that a reduction in the level of competition generated a growth in the adoption of this policy. In terms of the argument developed in Cuñat and Guadalupe (2005), who follow Schmidt (1997), this result is consistent with the dominance of the effect of the increase

[18] Results of the regression are reported in table A5 in the Appendix.

in the size of residual demand over the effect of a reduction in the elasticity of returns to effort (or to market stealing activities).[19] Aghion, Dewatripont and Rey (1999) argue that "by reducing the amount of slack that a manager can afford while keeping his firm active, competition, combined with the threat of liquidation, acts as a disciplinary device" (p. 826). Then incentive schemes may be substitutes for competition when a reduction in competitive pressure dilutes its disciplinary effect, which could explain an increased adoption in our case. It is interesting that the effect found is for non-managerial occupations, while the argument by Aghion et al. (1999) is for managers. Then our results suggest that the disciplinary effect of competition extends to workers other than managers.

The three variables that display negative coefficients are *comptest*, that indicates the use of performance or competency tests when fitting vacancies, *formaljobrot*, that signals establishments that have employees formally trained to do jobs other than their own, and *train_comm*, that captures the implementation of training covering communication skills. The two latter variables have the particularity that, although they where classified into job rotation and training, they show some overlay over other policy areas. The fact that a workplace has employees trained to do jobs other than their own can also be interpreted as a focus on both training and the value of human capital. Training in communication is skills training, but also denotes a focus on the importance of communication. The negative and significant coefficients suggest that a reduction in the level of competition leads to a reduction in the adoption of these three variables. More generally, we can interpret that the weakening of market competition reduces the use of innovative HRM practices on recruiting, training, job rotation and communication.

The complex design of our sample raises concerns on the correct way to estimate variances. To address this issue we can use Stata's complex survey data tools. This is the procedure recommended in the official documents

[19] Cuñat and Guadalupe's (2005) results show that a higher level of product market competition increases the performance pay sensitivity of compensation schemes, in particular for executives. At first sight the results are the opposite of our own, but we should take two issues into consideration. First, their difference-in-differences approach identifies the effect of competition on the *slope* of incentive pay, while in our case we are evaluating a binary choice. Second, the effect we found was for non-managerial occupations, and their results for workers other than highest paid and average directors pay were not statistically significant.

accompanying the WERS release. Design-adjusted standard errors are then calculated using the sampling weights and stratum identifiers, and establishment is set as the primary sampling unit. A relevant issue here is the fact that strata are not always balanced, so in some cases we end up with strata with only one sampling unit. Two different approaches were taken. The first approach was to simply group those strata with single sampling units into a bigger stratum. The second one was to treat the strata with single sampling units as centered at the grand mean instead of the stratum mean. They both yield standard errors that are almost identical. The variables that display a significant effect are the same, and in all cases the standard errors are slightly smaller.[20]

As our panel covers only two periods these results could be generated by spurious correlations associated with different dynamics in policy adoption for the group exposed to foreign competition and the one that was not. In order to study this issue we can use the cross-sectional data for years 1998 and 2004. With this information a linear model can be fitted for each of the groups, and we can then test whether the observed effects could be explained by different trends. Table 4 shows estimations of the following model for each workplace *i*, and *t*=1998 or 2004:

$$hrm_{it} = \beta_0 + \beta_1 overseas_i + \beta_2 year_t + \beta_3 overseas_i\ year_t + \epsilon_{it} \qquad (2)$$

Dummy $overseas_i$ takes value 1 for each establishment (in each year) that reported to face overseas competition.[21] All regressions include controls for size, legal status, relative financial performance, ownership structure and age. The intercept of the trend for establishments exposed to overseas competition is not significantly different from zero in any case. A negatively sloped trend can be observed for *profitsh* and *train_comm*. However since we cannot reject the null hypothesis that the coefficient on the interaction with dummy *overseas* is zero, this slope is not statistically different for the two groups of establishments. We can interpret results in table 4 as evidence of no differential pre-existing trends in organizational variables correlated with the initial exposure level.

[20] Full regression outputs can be consulted in tables A8, A9, A10 and A11 in the Appendix.

[21] Variables $overseas_i$ and $exposed_i$ are different in the sense that $overseas_i$ indicates the response to the relevant question for each establishment in the cross sections (where we are not able to identify responses from the same establishment in different years), while $exposed_i$ indicates the response in 2004 to the relevant question for establishments that are part of our panel covering years 2004 and 2011.

Table 4. Estimating Pre-Treatment Trends in the Adoption of HRM Practices Using Pooled OLS on the 1998 and 2004 Cross Sections

	profitsh	comptest	formaljobrot	train_comm
year*overseas	0.0099	0.0178	-0.0140	-0.0052
	(0.013)	(0.014)	(0.013)	(0.013)
year	-0.0237***	-0.0109	-0.0048	-0.0225***
	(0.007)	(0.007)	(0.007)	(0.008)
overseas	-19.6519	-35.4482	28.0975	10.3779
	(25.274)	(27.845)	(25.475)	(26.532)
Constant	47.8603***	22.3106	10.3861	45.48***
	(13.256)	(14.647)	(14.539)	(15.772)

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Sampling weights for each year were used. Coefficients for controls are reported in table A12 in the appendix.

What About Complementarities?

The theory of complementarities suggests that the impact of competition, if any, should have probably been in the same direction for variables in all seven policy areas. However, pairwise correlations in table 2 already pointed out that in our sample the link between incentive pay and the rest of the practices, especially training and communication, was not as expected. Moreover, cluster analysis resulted in systems with no strong overall levels of adoption and no considerable differentiation in profit-related pay, as illustrated in figure 3. Our results show a different impact of competition on profit-contingent pay and all other areas of HRM practices excluding job security and teamwork-related ones. The magnitude of the effects does not have a clear economic interpretation because of the nature of the variables, but it is similar (in absolute value) for all four practices. The lack of effect on job security was no surprise given the low adoption already discussed. In the case of teamwork it was not expected.

The fact that profit-related pay is the particular practice that displays a different behavior is important, since the theoretical complementarities between employment decisions were based on the incentive contract literature. However, we can still outline an explanation for the observed results that is consistent with this theory. Assume first that competition only affects incentive pay, and has no effect on any of the other types of practices. Since profit-related compensation can act as a substitute for the disciplinary effect of market competition, if the latter is reduced we would see an increase in this type of employment policy. [22]

[22] The disciplinary effect is one of many possible mechanisms that can explain the negative relationship between competition and incentive pay. It could also be the case, as it was

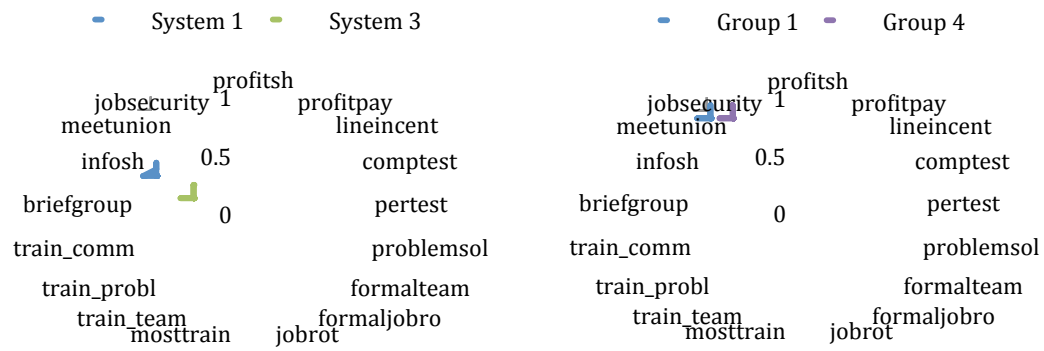
Because of positive complementarities, the return of adopting any of the practices in the other areas increases and we would thus expect an expansion in their adoption. Let us assume now the opposite case: competition affects all other practices but incentive pay. Weaker competition could result in a reduced minimum level of productivity that firms need to achieve in order to survive, so that the benefits provided by their application fall relative to their implementation costs. We would then see a reduction in the adoption of these practices. Positive complementarities mean that the return of profit-pay is also reduced, and as a consequence we would expect its adoption to fall. What this thought exercise is trying to illustrate is that although less competition as a result of the depreciation is pushing incentive pay in an opposite direction than the rest of the practices, this does not mean that the positive interactions are not working, and what we see in our results could be the net effect of these countervailing impacts of competition and the positive complementarities between incentive pay and the other employment practices.

Cluster analysis does show patterns of relatively high adoption of profit-contingent pay and low adoption of the other HRM practices, like in cluster number 4. Less competition could then be causing firms to move towards a pattern like the one displayed by establishments classified into Cluster 4, with reduced training, job rotation and extensive recruiting, but profit-pay schemes in place. Versions of model (1) were estimated to try and test for "movements" of establishments from one to another of the HRM systems described in figure 3, but no results significant at traditional levels could be found. In order to do this six dummies where constructed representing the six possible combinations between the 4 clusters; for example the variable called *cluster12* took value 1 if the establishment was classified into Cluster 1, value 0 if it was classified into Cluster 2, and reported missing values for all others. Each one of these dummies was used as the dependent variable for the estimation of (1).[23] We did get some

previously noted, that less competition results in an increased ceteris paribus value of the firms output, which means increased values of cost reductions or increased productivity, and then makes incentive schemes more valuable as well.

[23] We could think of these estimations as a "by hand" multinomial model with linear probabilities, where we are interested on how ceteris paribus changes on a competition variable affect the response probabilities for each of multiple outcomes. In this case we would be relying on the assumption of independence of irrelevant alternatives.

Figure 4. Means of HRM variables for two of the three clusters generated by k-means method. On the left, k=3. On the right, k=5.



significant results at the 10% level, however, when following the above procedure with either the clusters that resulted from setting the algorithm for k=3 groups or the ones that resulted from setting k=5. To avoid confusions, the clusters resulting from the classification into 3 clusters are labeled "Systems", and the ones into 5 clusters as "Groups". The significant coefficients where for *system13* and *group14*, and they were both negative.[24] From these we can interpret that competition made establishments to switch from a pattern of practices best classified as System 1 to one like System 3, or from one like Group 1 to Group 4. Figure 4 plots the means of every practice for the clusters in which we were able to identify a statistically significant effect.[25] As it can be appreciated in the graphs, with both classifications the establishments are "switching" from a cluster with higher mean adoption in every HRM practice but profit related pay, which does not show sizeable differences.

Our sample is representative of the whole business sector in the UK, which means that our results arise from a very heterogeneous group of workplaces. However, it is likely that the employment policy choices and the complementarities among them vary across different activities and industries. A natural next step would be to repeat our analysis for different industries. The dataset as released includes only broad classifications coded at *section* level of the Standard Industrial Classification (SIC) system due to privacy concerns,

[24] Regression outputs can be consulted in tables A13, A14 and A15 in the appendix. Models with dummies as dependent variables that take value 1 if an establishment belongs to a cluster and cero otherwise (that is, belongs to any of the remaining clusters) were also estimated. When using the classification with k=5, coefficients significant at the 5% level were found when estimating the effect on *group1* and *group4*, the first was negative and the second was positive.
[25] The figures with all the clusters can be consulted in the appendix. They are labeled A2 and A3.

which complicates the study of the patterns of practices and the estimation of the effect of competition specific to different industries.[26] We can nevertheless get some preliminary insights by focusing on the establishments that where classified into sector D, Manufacturing. They amount to 12.44% of our panel.[27] The k-means clustering algorithm with k=3 or k=4 (greater k does not make sense given the number of observations) produces patterns of practices that are similar to the original sample covering all industries, but with some particularities.[28] There is higher adoption and differentiation in incentive pay, most notably on variable *profitpay*; higher adoption of *problemsolv* in more "innovative" clusters; and the less "innovative" group displays higher adoption of job rotation. Regression results of equation (1) show effects in the same four HRM practices and with the same signs as the ones we found in the complete sample, only that the magnitudes are greater and the coefficient of interest with *profitsh* is significant at the 1% level. In addition a positive and significant at the 5% level effect appears when we use *profitpay* as the dependent variable, which indicates that the impact of competition is not only on profit related pay schemes for non-managerial occupations (as captured by variable *profitsh*) but includes those for managers. Surprisingly, we also find a positive effect on training as measured by *mosttrain* significant at the 10% level.[29] Taken together, these preliminary findings suggest that our general results hold if we consider only establishments in manufacturing, and that the positive effect of a reduction in competition is stronger and reaches managerial occupations.

5. Conclusions

The purpose of this work was to study the effect that changes in the competitive landscape have on the choice of employment practices by firms. In

[26] On top of that, if *division*, *group*, *class* or *subclass* classifications were available, or at least *division* level information, it could be used as a link with trade data disaggregated by sector in order to construct an alternative openness variable.

[27] The number of observations classified into 12 different industries at the SIC in 2003 can be consulted in table A16 in the appendix.

[28] See graphs A4 and A5, and tables A17 and A18 in the appendix.

[29] Regression output in tables A19 and A20 in the appendix. As it can be seen in table A21, we cannot find any significant differential pre-existing trends in organizational variables correlated with the initial exposure level when fitting linear models (2) on the pooled 1998 and 2004 cross sections of establishments in manufacturing according to the 1992 SIC system. Notice that this procedure could not be followed for *profitpay* because the question used to construct this variable did not exist in the 1998 WERS.

this way the intention was to contribute to the understanding of part of the link between competition and productivity of the economy.

The theory of complementarities postulates that the strategic choices of the firm may not be a marginal decision, that there are specific patterns or combinations of variables that could be optimal given a business environment while changes in single organizational features provide no gains in productivity or even losses. Theory on incentive contracts outlines how different human resources management policies like incentive pay, extensive recruiting, teamwork, job rotation, training and communication can display positive complementarities among them, and thus have positive effects on productivity when adopted together.

The sudden and unexpected depreciation of the Sterling Pound in 2008, that affected sectors in different degrees depending to their exposure to foreign trade, is exploited as a quasi-natural experiment in order to identify the effect of reduced competition on the adoption of these HRM practices. The exogeneity of the source of competition solves the important issue of endogeneity that arises when building any measure of competition. The effect is estimated on a panel sample of firms that is representative of almost every sector of the economy in Great Britain.

Overall, results show that a reduction in competition caused an increase in the use of profit-contingent pay for workers not in a managerial position. On the contrary, less competition had a negative effect in the use of competency tests in recruiting, in the application of training programs on communication skills, and in the presence of employees that are trained to do other jobs than their own. These outcomes, added to the combinations of practices that are empirically the most common in our sample according to a k-means clustering procedure, suggest that profit-related pay and the other areas of employment practices are not complements or at least have a weaker link than the one predicted by the theory. The positive effect on incentive pay is consistent with the understanding of these types of schemes as substitutes for the disciplinary power of competition.

Our sample includes a wide array of different activities and industries. While this is desirable in the sense that it provides data representative of the UK

business sector, the types of organizational choices we study most probably have industry specific determinants and patterns. Preliminary results from restricting our sample to those establishments in manufacturing suggest a stronger positive effect of competition on profit-related pay, and an extension of the impact to schemes for managerial occupations. A natural next step would be to study complementarities and the effect of competition in specific industries and activities.

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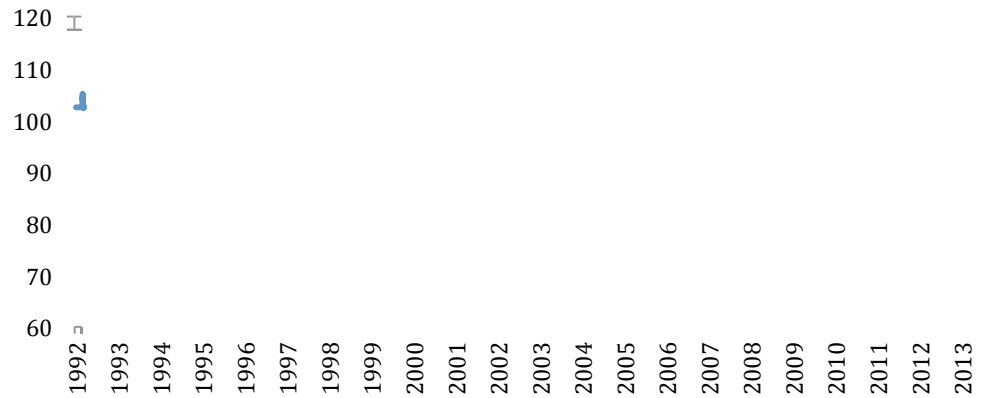
Appendix

Figure A1. End Quarter Effective exchange rate index, Sterling (Jan 2005 = 100)



Source: Bank of England

Table A1: Means of HRM variables for each cluster generated by k-means method (1677 observations, 2004-2011 Panel Sample)

	Cluster 1	Cluster 2	Cluster 3	Cluster 4
profitsh	0.24	0.12	0.04	0.24
profitpay	0.39	0.22	0.07	0.36
lineincent	0.57	0.45	0.24	0.39
comptest	0.89	0.83	0.41	0.34
pertest	0.70	0.49	0.10	0.07
problemsolv	0.60	0.42	0.13	0.10
formalteam	0.87	0.88	0.78	0.44
formaljobrot	0.93	0.88	0.61	0.62
jobrot	0.88	0.81	0.48	0.61
mosttrain	0.77	0.67	0.75	0.37
train_teamwork	0.86	0.31	0.80	0.10
train_problemsolv	0.69	0.04	0.42	0.02
train_comm	0.93	0.08	0.84	0.10
briefgroup	0.97	0.94	0.83	0.65
infosh	0.92	0.86	0.60	0.44
meetunion	0.67	0.77	0.27	0.10
jobsecurity	0.18	0.22	0.13	0.08
Observations	374	715	211	377
	22.3%	42.6%	12.6%	22.5%

Figure A2. Means of HRM variables for each cluster generated by k-means method, with k=3
(1699 observations, 2004-2011 Panel Sample)

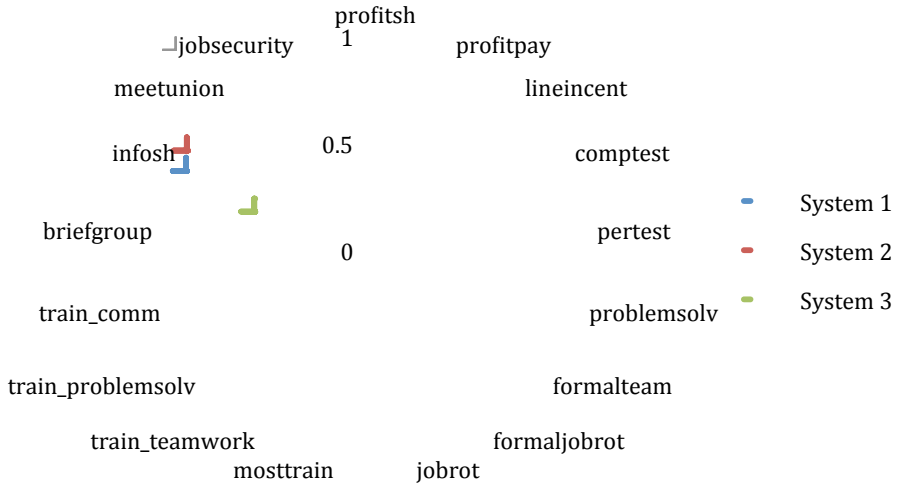


Table A2. Means of HRM variables for each cluster generated by k-means method, k=3 (1677 observations, 2004-2011 Panel Sample)

	System 1	System 2	System 3
profitsh	0.16	0.17	0.17
profitpay	0.28	0.27	0.26
lineincent	0.46	0.48	0.33
comptest	0.77	0.81	0.32
pertest	0.51	0.50	0.06
problemsolv	0.46	0.42	0.09
formalteam	0.86	0.88	0.45
formaljobrot	0.88	0.88	0.55
jobrot	0.79	0.82	0.54
mosttrain	0.75	0.68	0.43
train_teamwork	0.91	0.31	0.18
train_problemsolv	0.72	0.04	0.04
train_comm	0.97	0.12	0.17
briefgroup	0.95	0.95	0.63
infosh	0.85	0.87	0.41
meetunion	0.59	0.72	0.13
jobsecurity	0.18	0.20	0.09
Observations	471	783	423
	28.1%	46.7%	25.2%

Figure A3. Means of HRM variables for each cluster generated by k-means method, k=5 (1677 observations, 2004-2011 Panel Sample)

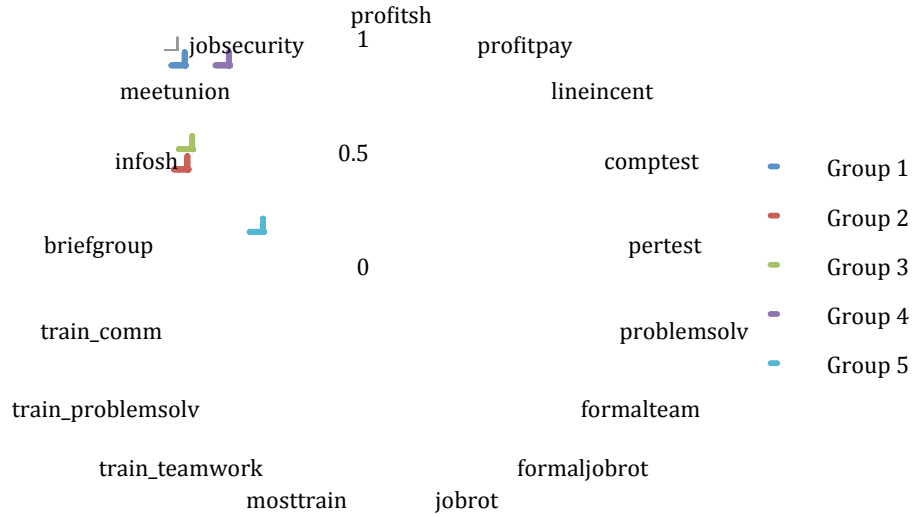


Table A3: Means of HRM variables for each cluster generated by k-means method, k=5 (1677 observations, 2004-2011 Panel Sample)

	Group 1	Group 2	Group 3	Group 4	Group 5
profitsh	0.71	0.01	0.00	0.71	0.00
profitpay	1.00	0.07	0.05	1.00	0.03
lineincent	0.76	0.37	0.40	0.57	0.27
comptest	0.88	0.75	0.82	0.41	0.32
pertest	0.82	0.45	0.46	0.12	0.07
problemsolv	0.61	0.44	0.41	0.10	0.10
formalteam	0.84	0.89	0.89	0.56	0.45
formaljobrot	0.95	0.85	0.86	0.80	0.49
jobrot	0.88	0.77	0.79	0.78	0.49
mosttrain	0.73	0.75	0.69	0.38	0.45
train_teamwork	0.62	0.93	0.30	0.19	0.19
train_problemsolv	0.34	0.72	0.04	0.06	0.04
train_comm	0.50	0.97	0.11	0.19	0.19
briefgroup	0.97	0.96	0.93	0.77	0.62
infosh	0.94	0.82	0.86	0.65	0.36
meetunion	0.53	0.64	0.77	0.17	0.14
jobsecurity	0.19	0.19	0.21	0.09	0.09
Observations	216	363	613	172	313
	12.9%	21.7%	36.6%	10.3%	18.7%

Table A5. Relationship Between Relative Perceived Financial Performance and Actual Performance (2004 subsample)

	Profit/surplus
Relative Financial Performance	-5.300***
	(1.990)
Constant	28.858***
	(5.840)
R-squared	0.026
Observations	571
Prob > F	0.0094

Robust standard errors in parentheses. *** p<0.01. Profit/surplus is per full-time equivalent at establishment level. Extreme high and low values were ignored by dropping the top and bottom 5% of observations.

Table A6. The effect of the experiment on individual HRM practices: OLS with Fixed Effects and Clustering Errors by Workplace. When taken together with tables 3 and A7 they show the effect on the full set of 17 practices studied.

	profitpay	lineincent	pertest	problemsolv	formalteam	jobrot	mosttrain
exposed*Post08	0.1665	0.0371	0.1954	-0.1427	-0.0065	-0.0652	-0.0263
	(0.126)	(0.073)	(0.185)	(0.147)	(0.114)	(0.065)	(0.095)
Size	0.0005*	0.0002	0.0006*	-0.0000	0.0001	0.0005**	-0.0001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Size-squared	-0.0000*	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	0.0000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Public Company	0.0944	0.2042**	0.0168	-0.0620	-0.2802**	-0.1353	-0.1114
	(0.108)	(0.096)	(0.075)	(0.112)	(0.129)	(0.139)	(0.125)
Government	-0.1584	-0.0059	-0.3023	-0.5165*	0.0186	-0.1233	-0.6153*
	(0.141)	(0.050)	(0.218)	(0.266)	(0.137)	(0.126)	(0.342)
Financial Performance	0.0128	-0.0455*	-0.0660*	-0.0871***	-0.0623	0.0013	-0.1313***
	(0.030)	(0.026)	(0.039)	(0.031)	(0.051)	(0.034)	(0.040)
Single	-0.0281	0.0448	-0.0116	-0.0718	-0.0856	0.0554	-0.1368
	(0.086)	(0.089)	(0.072)	(0.072)	(0.108)	(0.128)	(0.097)
Foreign	-0.1587	-0.8528**	-0.3326*	-0.0892	-0.2013	-0.2178	-0.1614
	(0.241)	(0.332)	(0.176)	(0.147)	(0.209)	(0.193)	(0.196)
Constant	0.2504**	0.4562***	0.3843***	0.4636***	0.8193***	0.6396***	0.8357***
	(0.098)	(0.078)	(0.102)	(0.101)	(0.134)	(0.102)	(0.115)
Observations	959	960	956	960	956	949	955
R-squared	0.027	0.034	0.051	0.057	0.049	0.012	0.074

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. LSDV models with establishment and time fixed effects. Coefficients on these are not reported. Sampling weights were used.

Table A7. The effect of the experiment on individual HRM practices: OLS with Fixed Effects and Clustering Errors by Workplace. When together with tables 3 and A6 they show the effect on the full set of 17 practices studied.

	train_teamwork	train_problemsolv	briefgroup	infosh	meetunion	jobsecurity
exposed*Post08	0.1075	-0.0330	-0.0535	-0.0328	0.0734	0.0456
	(0.119)	(0.127)	(0.147)	(0.094)	(0.045)	(0.100)
Size	0.0003	0.0001	0.0006*	-0.0006	0.0003	0.0001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Size-squared	-0.0000	-0.0000	-0.0000*	0.0000	-0.0000	-0.0000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Public Company	-0.0525	0.1300	-0.0744	-0.0236	0.0374	0.0519
	(0.075)	(0.083)	(0.131)	(0.087)	(0.025)	(0.073)
Government	0.1466	0.0976	-0.5611**	-0.3180**	0.1176	0.0142
	(0.240)	(0.063)	(0.284)	(0.146)	(0.125)	(0.129)
Financial Performance	-0.0640	-0.0789*	0.0038	-0.0544	-0.0083	-0.1187***
	(0.063)	(0.044)	(0.039)	(0.038)	(0.016)	(0.030)
Single	-0.0945	-0.0269	-0.0130	0.0450	-0.0369	0.0529
	(0.122)	(0.099)	(0.095)	(0.118)	(0.027)	(0.048)
Foreign	-0.1590	0.1108	-0.3789*	-0.6804***	-0.1761	0.0536
	(0.163)	(0.177)	(0.211)	(0.252)	(0.124)	(0.103)
Constant	0.5742***	0.4052***	0.7389***	0.8561***	0.1203***	0.3262***
	(0.169)	(0.116)	(0.117)	(0.109)	(0.043)	(0.080)
Observations	839	839	958	960	958	953
R-squared	0.043	0.099	0.038	0.054	0.025	0.151

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. LSDV models with establishment and time fixed effects. Coefficients on these are not reported. Sampling weights were used.

Table A8. The effect of the experiment on individual HRM practices: OLS with Fixed Effects, Complex Survey Data Analysis (strata with single sampling unit are merged into a single stratum). Taken together, this table and table A9 collect the effects on the full set of 17 practices.

	profitsh	profitpay	lineincent	comptest	pertest	problemsolv	formalteam	formaljobrot	jobrot
exposed*Post08	0.2192*	0.1665	0.0371	-0.1895**	0.1954	-0.1427	-0.0065	-0.2186**	-0.0652
	(0.122)	(0.123)	(0.072)	(0.092)	(0.186)	(0.149)	(0.110)	(0.092)	(0.064)
Size	0.0003	0.0005*	0.0002	0.0007*	0.0006*	-0.0000	0.0001	0.0002	0.0005**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Size-squared	-0.0000	-0.0000*	-0.0000	-0.0000*	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Public Company	0.0825	0.0944	0.2042**	0.1202	0.0168	-0.0620	-0.2802**	0.0006	-0.1353
	(0.089)	(0.109)	(0.097)	(0.121)	(0.074)	(0.112)	(0.128)	(0.123)	(0.140)
Government	-0.1255	-0.1584	-0.0059	-0.8720***	-0.3023	-0.5165*	0.0186	-0.1715	-0.1233
	(0.137)	(0.141)	(0.049)	(0.190)	(0.215)	(0.265)	(0.137)	(0.121)	(0.125)
Financial Performance	0.0179	0.0128	-0.0455*	-0.0330	-0.0660*	-0.0871***	-0.0623	0.0006	0.0013
	(0.028)	(0.030)	(0.026)	(0.043)	(0.039)	(0.031)	(0.051)	(0.035)	(0.035)
Single	0.0062	-0.0281	0.0448	-0.0842	-0.0116	-0.0718	-0.0856	0.0670	0.0554
	(0.058)	(0.086)	(0.088)	(0.085)	(0.071)	(0.071)	(0.107)	(0.121)	(0.128)
Foreign	-0.0193	-0.1587	-0.8528***	-1.3460***	-0.3326*	-0.0892	-0.2013	-0.1024	-0.2178
	(0.251)	(0.241)	(0.325)	(0.296)	(0.172)	(0.146)	(0.207)	(0.183)	(0.192)
Constant	-0.2877*	-1.2609*	1.0889***	1.2563***	0.9264***	0.4047**	1.1873***	1.1343***	-0.4792
	(0.153)	(0.749)	(0.096)	(0.141)	(0.221)	(0.189)	(0.164)	(0.118)	(0.630)
Observations	960	959	960	955	956	960	956	948	949
R-squared	0.696	0.700	0.732	0.671	0.645	0.577	0.635	0.647	0.616

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. LSDV models with establishment and time fixed effects. Coefficients on these are not reported. Sampling weights were used.

Table A9. The effect of the experiment on individual HRM practices: OLS with Fixed Effects, Complex Survey Data Analysis (strata with single sampling unit are merged into a single stratum). Taken together, this table and table A8 collect the effects on the ful set of 17 practices.

	mosttrain	train_teamwork	train_problemsolv	train_comm	briefgroup	infosh	meetunion	jobsecurity
exposed*Post08	-0.0263	0.1075	-0.0330	-0.2738*	-0.0535	-0.0328	0.0734	0.0456
	(0.092)	(0.121)	(0.122)	(0.152)	(0.150)	(0.093)	(0.045)	(0.091)
Size	-0.0001	0.0003	0.0001	0.0004	0.0006*	-0.0006	0.0003	0.0001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Size-squared	0.0000	-0.0000	-0.0000	-0.0000	-0.0000*	0.0000	-0.0000	-0.0000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Public Company	-0.1114	-0.0525	0.1300	0.2385	-0.0744	-0.0236	0.0374	0.0519
	(0.125)	(0.074)	(0.084)	(0.147)	(0.131)	(0.088)	(0.025)	(0.074)
Government	-0.6153*	0.1466	0.0976	0.0641	-0.5611**	-0.3180**	0.1176	0.0142
	(0.338)	(0.243)	(0.062)	(0.178)	(0.282)	(0.146)	(0.125)	(0.128)
Financial Performance	-0.1313***	-0.0640	-0.0789*	-0.0487	0.0038	-0.0544	-0.0083	-0.1187***
	(0.040)	(0.062)	(0.044)	(0.041)	(0.039)	(0.038)	(0.016)	(0.031)
Single	-0.1368	-0.0945	-0.0269	-0.1317	-0.0130	0.0450	-0.0369	0.0529
	(0.096)	(0.126)	(0.099)	(0.123)	(0.095)	(0.118)	(0.026)	(0.048)
Foreign	-0.1614	-0.1590	0.1108	-0.3782*	-0.3789*	-0.6804***	-0.1761	0.0536
	(0.194)	(0.165)	(0.174)	(0.212)	(0.210)	(0.255)	(0.123)	(0.104)
Constant	1.4254***	0.3940	-0.1068	-0.7332	-0.5100	1.2234***	0.9410***	-0.2950
	(0.146)	(0.566)	(0.510)	(0.758)	(0.981)	(0.138)	(0.061)	(0.536)
Observations	955	839	839	839	958	960	958	953
R-squared	0.644	0.703	0.624	0.665	0.618	0.677	0.863	0.645

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. LSDV models with establishment and time fixed effects. Coefficients on these are not reported. Sampling weights were used.

Table A10. The effect of the experiment on individual HRM practices: OLS with Fixed Effects, Complex Survey Data Analysis (strata with single sampling unit are centered at the grand mean instead of stratum mean). Taken together, this table and table A11 collect the effects on the ful set of 17 practices.

	profitsh	profitpay	lineincent	comptest	pertest	problemsolv	formalteam	formaljobrot	jobrot
exposed*Post08	0.2192*	0.1665	0.0371	-0.1895**	0.1954	-0.1427	-0.0065	-0.2186**	-0.0652
	(0.122)	(0.123)	(0.072)	(0.092)	(0.186)	(0.149)	(0.110)	(0.092)	(0.064)
Size	0.0003	0.0005*	0.0002	0.0007*	0.0006*	-0.0000	0.0001	0.0002	0.0005**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Size-squared	-0.0000	-0.0000*	-0.0000	-0.0000*	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Public Company	0.0825	0.0944	0.2042**	0.1202	0.0168	-0.0620	-0.2802**	0.0006	-0.1353
	(0.089)	(0.109)	(0.097)	(0.121)	(0.074)	(0.112)	(0.128)	(0.123)	(0.140)
Government	-0.1255	-0.1584	-0.0059	-0.8720***	-0.3023	-0.5165*	0.0186	-0.1715	-0.1233
	(0.137)	(0.141)	(0.049)	(0.190)	(0.216)	(0.265)	(0.137)	(0.121)	(0.125)
Financial Performance	0.0179	0.0128	-0.0455*	-0.0330	-0.0660*	-0.0871***	-0.0623	0.0006	0.0013
	(0.028)	(0.030)	(0.026)	(0.043)	(0.039)	(0.031)	(0.051)	(0.035)	(0.035)
Single	0.0062	-0.0281	0.0448	-0.0842	-0.0116	-0.0718	-0.0856	0.0670	0.0554
	(0.058)	(0.086)	(0.088)	(0.085)	(0.071)	(0.071)	(0.107)	(0.121)	(0.128)
Foreign	-0.0193	-0.1587	-0.8528***	-1.3460***	-0.3326*	-0.0892	-0.2013	-0.1024	-0.2178
	(0.251)	(0.241)	(0.325)	(0.296)	(0.172)	(0.146)	(0.207)	(0.183)	(0.192)
Constant	-0.2877*	-1.2609*	1.0889***	1.2563***	0.9264***	0.4047**	1.1873***	1.1343***	-0.4792
	(0.153)	(0.749)	(0.096)	(0.141)	(0.221)	(0.189)	(0.164)	(0.118)	(0.629)
Observations	960	959	960	955	956	960	956	948	949
R-squared	0.696	0.700	0.732	0.671	0.645	0.577	0.635	0.647	0.616

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. LSDV models with establishment and time fixed effects. Coefficients on these are not reported. Sampling weights were used.

Table A11. The effect of the experiment on individual HRM practices: OLS with Fixed Effects, Complex Survey Data Analysis (strata with single sampling unit are centered at the grand mean instead of stratum mean). Taken together, this table and table A10 collect the effects on the ful set of 17 practices.

	mosttrain	train_teamwork	train_problemsolv	train_comm	briefgroup	infosh	meetunion	jobsecurity
exposed*Post08	-0.0263	0.1075	-0.0330	-0.2738*	-0.0535	-0.0328	0.0734	0.0456
	(0.092)	(0.121)	(0.122)	(0.152)	(0.150)	(0.093)	(0.045)	(0.091)
Size	-0.0001	0.0003	0.0001	0.0004	0.0006*	-0.0006	0.0003	0.0001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Size-squared	0.0000	-0.0000	-0.0000	-0.0000	-0.0000*	0.0000	-0.0000	-0.0000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Public Company	-0.1114	-0.0525	0.1300	0.2385	-0.0744	-0.0236	0.0374	0.0519
	(0.125)	(0.075)	(0.084)	(0.147)	(0.131)	(0.088)	(0.025)	(0.074)
Government	-0.6153*	0.1466	0.0976	0.0641	-0.5611**	-0.3180**	0.1176	0.0142
	(0.338)	(0.243)	(0.062)	(0.178)	(0.282)	(0.146)	(0.125)	(0.128)
Financial Performance	-0.1313***	-0.0640	-0.0789*	-0.0487	0.0038	-0.0544	-0.0083	-0.1187***
	(0.040)	(0.062)	(0.044)	(0.041)	(0.039)	(0.038)	(0.016)	(0.031)
Single	-0.1368	-0.0945	-0.0269	-0.1317	-0.0130	0.0450	-0.0369	0.0529
	(0.096)	(0.126)	(0.099)	(0.123)	(0.095)	(0.118)	(0.026)	(0.048)
Foreign	-0.1614	-0.1590	0.1108	-0.3782*	-0.3789*	-0.6804***	-0.1761	0.0536
	(0.194)	(0.165)	(0.174)	(0.212)	(0.209)	(0.255)	(0.123)	(0.104)
Constant	1.4254***	0.3940	-0.1068	-0.7332	-0.5100	1.2234***	0.9410***	-0.2950
	(0.146)	(0.566)	(0.510)	(0.757)	(0.980)	(0.138)	(0.061)	(0.535)
Observations	955	839	839	839	958	960	958	953
R-squared	0.644	0.703	0.624	0.665	0.618	0.677	0.863	0.645

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. LSDV models with establishment and time fixed effects. Coefficients on these are not reported. Sampling weights were used.

Table A12. Estimating Linear Trends for the pre-treatment period using Pooled 1998 and 2004 Cross Sectional Samples.

	profitsh	comptest	formaljobrot	train_comm
year*overseas	0.0099	0.0178	-0.0140	-0.0052
	(0.013)	(0.014)	(0.013)	(0.013)
year	-0.0237***	-0.0109	-0.0048	-0.0225***
	(0.007)	(0.007)	(0.007)	(0.008)
overseas	-19.6519	-35.4482	28.0975	10.3779
	(25.274)	(27.845)	(25.475)	(26.532)
Size	0.0000	0.0002***	0.0001***	0.0001**
	(0.000)	(0.000)	(0.000)	(0.000)
Age	-0.0007**	-0.0004	-0.0003	-0.0002
	(0.000)	(0.000)	(0.000)	(0.000)
Public Company	0.1323***	0.0442	0.0822*	0.0529
	(0.040)	(0.043)	(0.043)	(0.042)
Government	-0.2824***	0.2082***	0.0669	0.1298*
	(0.057)	(0.073)	(0.065)	(0.077)
Financial Performance	-0.0424**	-0.0521**	-0.0670***	-0.0488**
	(0.018)	(0.021)	(0.020)	(0.021)
Single	-0.1895***	0.0039	-0.0326	-0.0792*
	(0.035)	(0.041)	(0.042)	(0.041)
Foreign	-0.0314	0.0331	-0.0252	-0.0727
	(0.114)	(0.120)	(0.105)	(0.104)
Constant	47.8603***	22.3106	10.3861	45.4800***
	(13.256)	(14.647)	(14.539)	(15.772)
Observations	2,516	2,513	2,487	2,164
R-squared	0.136	0.036	0.047	0.066

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Sampling weights for each year were used.

Table A13. The effect of the experiment on HRM clusters: OLS with Fixed Effects and Clustering Errors by Workplace

	cluster1	cluster2	cluster3	cluster4	cluster12	cluster13	cluster14	cluster23	cluster24	cluster34
exposed*Post08	0.0415	-0.0046	0.0706	-0.1075	-0.0548	0.1024	-0.0312	0.0471	0.0296	0.1784
	(0.079)	(0.064)	(0.065)	(0.106)	(0.159)	(0.128)	(0.169)	(0.134)	(0.114)	(0.129)
Size	0.0003	-0.0000	0.0003	-0.0006*	0.0005	-0.0018	0.0003	-0.0003	0.0007	0.0096
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.001)	(0.000)	(0.000)	(0.006)
Size-squared	-0.0000	0.0000	-0.0000**	0.0000*	-0.0000	0.0000	0.0000	0.0000**	-0.0000*	-0.0000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Public Company	0.0081	-0.0392	0.0708	-0.0398	0.1797	-0.1548	-0.0028	-0.1234	-0.0073	0.0816
	(0.073)	(0.115)	(0.087)	(0.138)	(0.133)	(0.370)	(0.134)	(0.105)	(0.143)	(0.127)
Government	-0.5798*	0.0620	0.7102***	-0.1923	0.5071**	-0.9498***		-0.0267	0.7222***	0.7026***
	(0.329)	(0.192)	(0.253)	(0.201)	(0.240)	(0.095)		(0.099)	(0.203)	(0.192)
Financial Performance	-0.0697**	-0.0406	-0.0332	0.1436***	-0.0894**	0.0559	-0.1265*	-0.0253	-0.1363*	-0.0871
	(0.029)	(0.047)	(0.031)	(0.049)	(0.044)	(0.051)	(0.070)	(0.055)	(0.072)	(0.070)
Single	0.0012	-0.0137	-0.2201*	0.2325**	0.2295	-0.3523	0.0125	0.3978	-0.1479	-0.3093**
	(0.061)	(0.124)	(0.129)	(0.112)	(0.419)	(0.284)	(0.106)	(0.361)	(0.099)	(0.152)
Foreign	-0.2206*	-0.0164	-0.2912*	0.5282**	-0.0900	0.1086	-0.3836		-0.5929*	2.1514
	(0.121)	(0.237)	(0.155)	(0.204)	(0.222)	(0.127)	(0.323)		(0.319)	(2.133)
Constant	0.3295***	0.3610***	0.2498***	0.0596	0.2645*	0.5246***	0.5447***	0.5685***	0.6214***	0.4937**
	(0.092)	(0.132)	(0.082)	(0.139)	(0.154)	(0.189)	(0.186)	(0.144)	(0.202)	(0.208)
Observations	812	812	812	812	433	260	405	407	552	379
R-squared	0.081	0.009	0.079	0.094	0.105	0.392	0.152	0.063	0.120	0.135

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. LSDV models with establishment and time fixed effects. Sampling weights were used. Variable *clusterN* takes value 1 of the establishment was classified into Cluster N, 0 otherwise. variable *clusterNM* takes value 1 if the establishment was classified into Cluster N, and 0 if it was classified into Cluster M.

Table A14. The effect of the experiment on HRM clusters: OLS with Fixed Effects and Clustering Errors by Workplace

	system1	system2	system3	system12	system13	system23
exposed*Post08	-0.0862	-0.0558	0.1419	0.1151	-0.3460*	0.0064
	(0.110)	(0.102)	(0.139)	(0.128)	(0.194)	(0.133)
Size	0.0004*	0.0002	-0.0005	0.0005**	-0.0005	0.0006
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Size-squared	-0.0000	-0.0000	0.0000	-0.0000*	0.0000	-0.0000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Public Company	0.0767	-0.2496*	0.1728	0.2824*	-0.0767	-0.1563
	(0.094)	(0.130)	(0.113)	(0.167)	(0.156)	(0.135)
Government	0.0102	-0.0105	0.0003	0.1006	-0.1250	0.2542
	(0.100)	(0.186)	(0.171)	(0.162)	(0.091)	(0.429)
Financial Performance	-0.0936***	-0.0110	0.1046**	-0.1105**	-0.1131**	-0.1221*
	(0.035)	(0.056)	(0.046)	(0.053)	(0.055)	(0.068)
Single	-0.0869	-0.0436	0.1306	-0.0898	-0.1057	-0.0710
	(0.102)	(0.105)	(0.129)	(0.193)	(0.159)	(0.116)
Foreign	-0.2954**	-0.1715	0.4669**	-0.2684	-0.3282	-0.5279*
	(0.143)	(0.243)	(0.212)	(0.210)	(0.367)	(0.281)
Constant	0.4407***	0.4589***	0.1004	0.5447***	0.5974***	0.6549***
	(0.094)	(0.149)	(0.133)	(0.153)	(0.163)	(0.185)
Observations	812	812	812	527	476	621
R-squared	0.051	0.046	0.090	0.103	0.095	0.119

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. LSDV models with establishment and time fixed effects. Sampling weights were used. Variable *systemN* takes value 1 of the establishment was classified into System N, 0 otherwise. Variable *systemNM* takes value 1 if the establishment was classified into System N, and 0 if it was classified into System M.

Table A15. The effect of the experiment on HRM clusters: OLS with Fixed Effects and Clustering Errors by Workplace

	group1	group2	group3	group4	group5	group12	group13	group14	group23	group24	group34
exposed*Post08	-0.0880**	-0.0565	-0.0167	0.2878**	-0.1265	-0.3053	-0.1648	-0.3543*	-0.0724	-0.0184	-0.0847
	(0.042)	(0.097)	(0.093)	(0.138)	(0.165)	(0.234)	(0.140)	(0.180)	(0.164)	(0.136)	(0.169)
Size	0.0002	0.0004**	-0.0002	0.0000	-0.0004	0.0001	0.0006*	-0.0027	0.0009**	-0.0014	0.0005
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.003)	(0.000)	(0.002)	(0.001)
Size-squared	-0.0000	-0.0000**	0.0000	-0.0000	0.0000	-0.0000	-0.0000*	0.0000	-0.0000***	0.0000	-0.0000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Public Company	0.0366	-0.0616	-0.0687	-0.0072	0.1009	0.1766	0.2785	-0.2274	0.0164	-0.2218	-0.2549
	(0.061)	(0.051)	(0.126)	(0.124)	(0.114)	(0.145)	(0.243)	(0.148)	(0.190)	(0.136)	(0.174)
Government	-0.0660*	0.0231	0.0922	-0.1345	0.0853	-0.1785	0.0167	-0.3690	-0.0064	0.0213	0.7490***
	(0.035)	(0.096)	(0.185)	(0.176)	(0.062)	(0.170)	(0.232)	(1.169)	(0.177)	(0.100)	(0.253)
Financial Performance	-0.0311	-0.0629**	-0.0551	0.0934**	0.0556	0.0031	-0.0600	-0.1824**	-0.0529	-0.1731**	-0.1699**
	(0.027)	(0.025)	(0.044)	(0.038)	(0.043)	(0.046)	(0.039)	(0.081)	(0.074)	(0.087)	(0.068)
Single	0.0177	-0.1058	-0.0687	0.0807	0.0761		-0.0291	0.1762	-0.0872	0.1486	-0.1191
	(0.024)	(0.101)	(0.093)	(0.106)	(0.152)		(0.247)	(0.148)	(0.236)	(0.113)	(0.123)
Foreign	-0.0337	-0.4052**	0.0591	0.0687	0.3111	1.0922***	-0.0684	-0.3144**			
	(0.193)	(0.161)	(0.254)	(0.221)	(0.194)	(0.228)	(0.167)	(0.148)			
Constant	0.1793**	0.3391***	0.3817***	-0.0563	0.1562	0.3948***	0.3969***	0.8617***	0.5430**	0.8735***	0.9918***
	(0.077)	(0.085)	(0.130)	(0.122)	(0.121)	(0.145)	(0.114)	(0.325)	(0.210)	(0.255)	(0.225)
Observations	812	812	812	812	812	256	341	249	359	267	352
R-squared	0.047	0.035	0.025	0.111	0.036	0.135	0.130	0.329	0.046	0.224	0.290

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. LSDV models with establishment and time fixed effects. Sampling weights were used. Variable *groupN* takes value 1 of the establishment was classified into Group N, 0 otherwise. variable *groupNM* takes value 1 if the establishment was classified into Group N, and 0 if it was classified into Group M.

Table A16. Classification of 2004-2011 Panel at the sector level of the Standard Industrial Classification (SIC) System, 2003

	Observations	Percent
D: Manufacturing	246	12.44
E: Electricity, gas and water	35	1.77
F: Construction	84	4.25
G: Wholesale and retail	201	10.17
H: Hotels and restaurants	94	4.75
I: Transport and communication	131	6.63
J: Financial services	55	2.78
K: Other business services	205	10.37
L: Public administration	174	8.8
M: Education	236	11.94
N: Health	384	19.42
O: Other community services	132	6.68
Total	1,977	100

Figure A4. Means of HRM variables for each cluster generated by k-means method, k=3, of establishments in sector D: Manufacturing of the SIC in 2003. (1677observations, 2004-2011 Panel Sample)

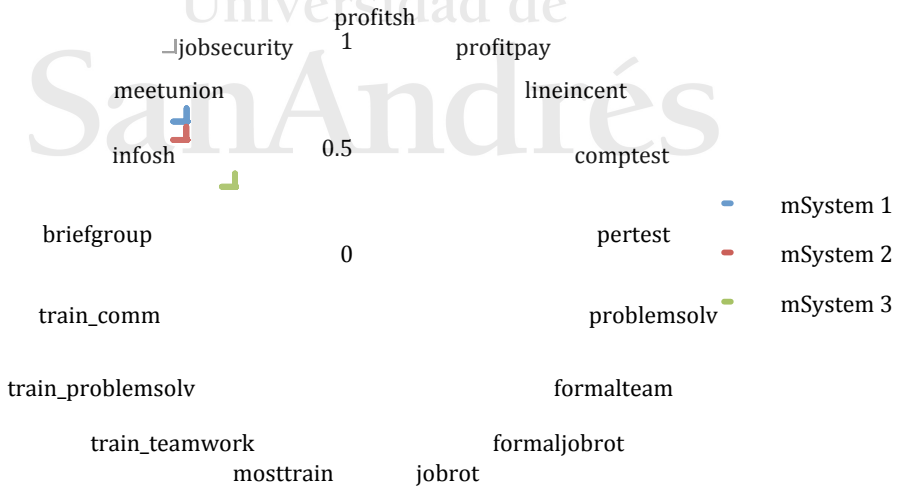


Table A17. Means of HRM variables for each cluster generated by k-means method, k=3, of establishments in sector D: Manufacturing of the SIC in 2003. (1677observations, 2004-2011 Panel Sample)

	System 1	System 2	System 3
profitsh	0.47	0.25	0.31
profitpay	0.72	0.46	0.40
lineincent	0.64	0.53	0.44
comptest	0.84	0.84	0.26
pertest	0.83	0.78	0.07
problemsolv	0.84	0.73	0.12
formalteam	0.86	0.89	0.59
formaljobrot	1.00	0.97	0.85
jobrot	0.91	0.94	0.82
mosttrain	0.66	0.47	0.25
train_teamwork	0.76	0.32	0.09
train_problemsolv	0.93	0.10	0.07
train_comm	0.86	0.08	0.16
briefgroup	0.95	0.95	0.72
infosh	0.91	0.92	0.57
meetunion	0.78	0.80	0.15
jobsecurity	0.09	0.13	0.03
Observations	58	79	68
	28.3%	38.5%	33.2%

Figure A5. Means of HRM variables for each cluster generated by k-means method (1677observations, 2004-2011 Panel Sample)

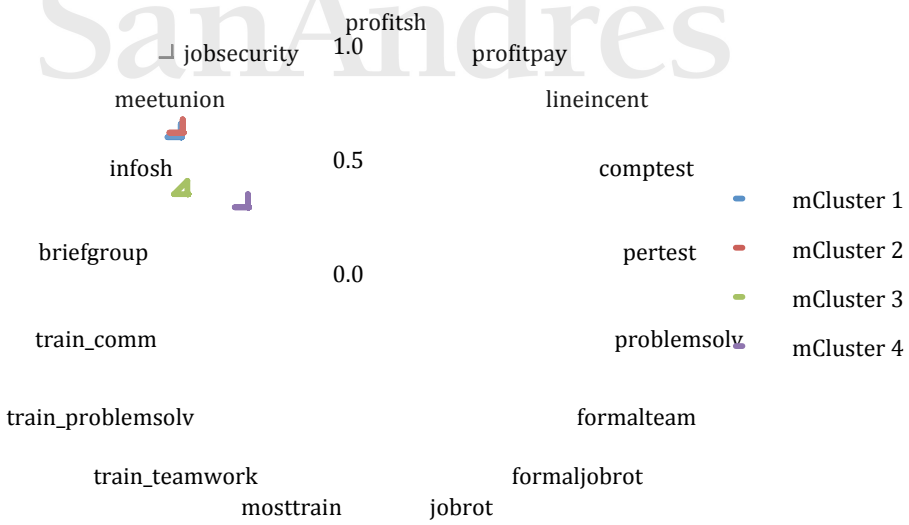


Table A18. Means of HRM variables for each cluster generated by k-means method, k=4, of establishments in sector D: Manufacturing of the SIC in 2003. (1677observations, 2004-2011 Panel Sample)

	Cluster 1	Cluster 2	Cluster 3	Cluster 4
profitsh	0.42	0.37	0.20	0.28
profitpay	0.70	0.55	0.37	0.37
lineincent	0.62	0.66	0.30	0.42
comptest	0.83	0.89	0.57	0.25
pertest	0.85	0.89	0.23	0.09
problemsolv	0.83	0.71	0.77	0.04
formalteam	0.87	0.88	0.87	0.54
formaljobrot	1.00	0.97	1.00	0.82
jobrot	0.91	0.95	0.93	0.79
mosttrain	0.66	0.38	0.73	0.18
train_teamwork	0.85	0.32	0.20	0.05
train_problemsolv	0.91	0.17	0.20	0.04
train_comm	0.94	0.06	0.07	0.19
briefgroup	0.96	0.95	0.93	0.67
infosh	0.92	0.92	0.90	0.51
meetunion	0.77	0.91	0.30	0.16
jobsecurity	0.09	0.11	0.13	0.02
Observations	53	65	30	57
	28.9%	31.7%	14.6%	27.8%

Table A19. The effect of the experiment on individual HRM practices for establishments in sector D: Manufacturing of the SIC in 2003: OLS with Fixed Effects and Clustering Errors by Workplace. Taken together, this table and table A20 collect the effects on the full set of 17 practices.

	profitsh	profitpay	lineincent	comptest	pertest	problemsolv	formalteam	formaljobrot	jobrot
exposed*Post08	0.5341***	0.4962**	-0.0651	-0.2397*	-0.3981	0.1997	0.0812	-0.4216**	-0.0197
	(0.190)	(0.245)	(0.267)	(0.130)	(0.273)	(0.193)	(0.134)	(0.174)	(0.257)
Size	0.0012	0.0015	-0.0004	0.0001	-0.0008	-0.0004	-0.0001	-0.0001	-0.0000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
Size-squared	-0.0000	-0.0000	0.0000	-0.0000	0.0000	0.0000	-0.0000	0.0000	-0.0000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Public Company	0.0301	0.0669	0.0381	0.2561	0.0688	0.1569	0.4121	0.2058	-0.1845
	(0.361)	(0.338)	(0.282)	(0.216)	(0.273)	(0.225)	(0.311)	(0.148)	(0.156)
Financial Performance	-0.1949*	-0.0053	-0.1957*	0.1942**	-0.0238	-0.0864	-0.0146	0.1970***	0.1502
	(0.105)	(0.087)	(0.113)	(0.087)	(0.060)	(0.151)	(0.038)	(0.065)	(0.101)
Single	0.0578	0.1065	0.2101	0.0984	0.1605	0.0056	0.1397	0.0290	0.4011
	(0.213)	(0.189)	(0.268)	(0.131)	(0.166)	(0.113)	(0.107)	(0.165)	(0.241)
Constant	0.5084**	0.0948	0.6841***	-0.2131	0.2172	0.3813	0.6163***	0.0672	0.0701
	(0.246)	(0.252)	(0.256)	(0.283)	(0.157)	(0.402)	(0.099)	(0.178)	(0.406)
Observations	104	104	104	103	104	104	104	104	103
R-squared	0.558	0.395	0.174	0.352	0.333	0.088	0.178	0.489	0.186

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. LSDV models with establishment and time fixed effects. Coefficients on these are not reported. Sampling weights were used. Reduced set of controls because of collinearity.

Table A20. The effect of the experiment on individual HRM practices for establishments in sector D: Manufacturing of the SIC in 2003: OLS with Fixed Effects and Clustering Errors by Workplace. Taken together, this table and table A19 collect the effects on the full set of 17 practices.

	mosttrain	train_teamwork	train_problemsolv	train_comm	briefgroup	infosh	meetunion	jobsecurity
exposed*Post08	0.3548*	-0.2320	0.2671	-0.6220*	-0.0157	0.0341	0.1755	-0.0393
	(0.211)	(0.210)	(0.299)	(0.332)	(0.420)	(0.201)	(0.143)	(0.046)
Size	0.0003	0.0008	0.0005	0.0010	-0.0003	-0.0004	-0.0003	-0.0002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)
Size-squared	-0.0000	-0.0000	-0.0000	-0.0000	0.0000	0.0000	0.0000	0.0000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Public Company	-0.5187	-0.4518	0.2223	-0.2740	-0.3707	-0.4936**	0.4849	-0.0039
	(0.449)	(0.301)	(0.339)	(0.575)	(0.250)	(0.238)	(0.306)	(0.020)
Financial Performance	-0.0894	0.2375	-0.1008	0.0987	-0.0305	-0.0167	-0.0777	-0.0283
	(0.101)	(0.180)	(0.103)	(0.138)	(0.167)	(0.086)	(0.083)	(0.030)
Single	0.1247	1.1226***	-0.0393	0.7521***	-0.3698	0.1918	-0.0268	0.0276
	(0.173)	(0.169)	(0.052)	(0.154)	(0.554)	(0.303)	(0.084)	(0.038)
Constant	0.2562	-1.0287*	0.2220	-0.4841	0.8023***	0.3550	0.3002	0.1036
	(0.340)	(0.536)	(0.200)	(0.353)	(0.275)	(0.249)	(0.255)	(0.073)
Observations	103	85	85	85	102	104	104	104
R-squared	0.182	0.569	0.150	0.539	0.198	0.264	0.310	0.087

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. LSDV models with establishment and time fixed effects. Coefficients on these are not reported. Sampling weights were used. Reduced set of controls because of collinearity.

Table A21. Estimating Linear Trends for establishments of the 2004-2011 Panel in sector D: Manufacturing of the SIC in 2003.

	profitsh	comptest	formaljobrot	mosttrain	train_comm
year*overseas	-0.0123	0.0197	-0.0288	-0.0188	0.0228
	(0.027)	(0.031)	(0.031)	(0.021)	(0.030)
year	-0.0039	-0.0413	0.0040	0.0467**	-0.0119
	(0.021)	(0.026)	(0.024)	(0.018)	(0.024)
overseas	24.5970	-39.3217	57.7336	37.4936	-45.5847
	(54.459)	(61.652)	(62.130)	(42.563)	(60.872)
Size	-0.0000	0.0001**	0.0000	0.0001	0.0001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age	0.0005	0.0001	0.0020**	0.0000	0.0006
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Public Company	-0.0225	-0.0652	-0.1118	0.0399	0.0658
	(0.108)	(0.110)	(0.108)	(0.058)	(0.086)
Government	-0.2462*	-0.3224*	0.1061	-0.0177	0.6163***
	(0.140)	(0.170)	(0.165)	(0.098)	(0.115)
Financial Performance	-0.1013**	-0.0684	-0.0011	-0.0338	-0.0054
	(0.044)	(0.051)	(0.047)	(0.035)	(0.046)
Single	-0.1989**	0.1785*	-0.1031	-0.1129*	0.0561
	(0.098)	(0.104)	(0.095)	(0.059)	(0.102)
Foreign	0.1078	0.1105	0.0625	0.1538	-0.1439
	(0.183)	(0.184)	(0.135)	(0.178)	(0.094)
Constant	8.4021	83.1445	-7.3016	-93.1484**	23.9662
	(41.217)	(51.080)	(48.999)	(36.369)	(48.339)
Observations	476	476	471	474	405
R-squared	0.104	0.092	0.070	0.126	0.029

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Sampling weights for each year were used.