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THE PROVISION OF INCENTIVES AND ORGANIZATION DESIGN

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Doctor of Philosophy

THE PROVISION OF INCENTIVES AND ORGANIZATION DESIGN

by Marco Antonio Barrenechea Méndez

Introduction

The harsh business conditions characterizing our epoch require the design of increasingly efficient business organizations. A better understanding on how to improve the performance of such organizations, through an adequate design, will have important effects on their well-being and consequently on the society as a whole. This dissertation is a modest step toward this goal.

This dissertation comprises three essays on the economic analysis of business organizations. The first essay attempts to provide further evidence on the role of uncertainty and job complexity in blue-collar workers' pay-for-performance and autonomy decisions. It proposes an econometric approach that encompasses previous procedures taken in the related literature in order to explain the differences in the resulting outcomes that may be due to differing methodological approaches. Although our evidence comes from a distinct institutional context, a dataset of Spanish plants, they are nevertheless fairly consistent with previous analyses. The main stylized fact is that workers' autonomy and pay-for-performance are interrelated decisions. Additionally, autonomy is positively related to job complexity and uncertainty, which suggests that the relationship between these latter variables and pay-for-performance could be through autonomy. When we control for autonomy, the positive and significant relationship between pay-for-performance and job complexity disappears, while that between pay-for-performance and uncertainty becomes more negative.

These results provide strong support for Prendergast (2002)'s argument, which suggests that the link of job complexity to pay-for-performance operates through autonomy, and does not account for alternative theories that suggest no role for delegation of decision-making in job complexity and pay-for-performance relations. The results are also consistent with the arguments of Nagar (2002) and Core and Quian (2002). Nagar suggests that the provision of autonomy responds positively to the degree of uncertainty because it reduces the firm's

expenses in operational-decisions information. Core and Quian (2002) suggest the optimal relationship between incentives strength and uncertainty is positive when the project-selection decision task (autonomy) is more important than the production task, and vice versa. In addition, the theoretical debate initiated by Prendergast (2002) around the tenuous relationship between pay-for-performance and uncertainty has its origins in the failure of the empirical literature to find support for one of the central results of the agency model, namely, the negative relation between pay-for-performance and uncertainty ((Holmström 1979, Shavell 1979, Holmström and Milgrom 1987, 1991)). Our results provide some insights for the validity of this prediction. Ultimately, we find that collective agreements and workers' skills are affecting pay-for-performance indirectly, via autonomy.

The second essay argues that the design of job is the result of a set of interrelated decisions: the worker autonomy to decide the tasks to be carried out, the way in which the work will be monitored and the compensation associated with the information generated by the monitoring process. A*utonomy* is referred to the set of decisions that the worker can make about the way that the job is executed. For example, decisions about the order of implementation of the available tasks. *Monitoring* is referred to the information collected about the execution (inputs or/and outputs) of those decisions. Examples of monitoring systems suggested by the accounting literature (Kaplan and Norton, 2001) are the budgeting control, the activity based costs or the balanced scorecard. *Compensation* is referred to the way that the worker is remunerated based on the information provided by the monitoring system. The essay provides empirical evidence on the design of jobs for blue collar workers in Spanish industrial establishments by analyzing the relations among and determinants of autonomy, monitoring and wages. We find that the complexity of the job, the workers´ skills, and the variables related to the power of the workers (collective agreements and unions strength) are important determinants of the workers' autonomy. We also find that monitoring is positively related to workers autonomy and that the level of compensation is negatively associated with both monitoring and autonomy.

We present a theoretical model that is consistent with this empirical evidence. A novel feature of the model is that it considers these three variables, autonomy, monitoring and compensation, as endogenous to the job-design problem of firms. This theoretical framework mainly builds on the previous analyses of Demougin and Fluet (1998, 2001) and Prendergrast (2002). Demougin and Fluet consider as endogenous variables monitoring and compensation, and analyse how the monitoring costs affect both decisions. Prendergast considers as endogenous variables autonomy and compensation. When firms allocate workers into the job, they acquire private information on the best way (i.e., the most productive task) to carry the job out. Autonomy along with pay-for-performance will induce the worker to use this information. This paper argues that both Demougin and Fluet and Prendergast arguments can be linked

because firms have better information quality on the task that the worker currently perform than on innovative or unproven tasks. The model states that autonomy permits workers to introduce innovative tasks that are more difficult to monitor and that the level of monitoring determines the quality of information on workers' effort and ultimately their compensation.

In the third essay we investigate the relationship between mission congruence and the reliance on pay-for-performance and delegation of decision-making. The concept of mission congruence refers to the extent to which the objectives of workers are aligned with the objectives of the organization. The traditional analysis of organizations relies on the assumption that workers preferences are in conflict with those of the organization. For instance, in the agency model (Holmström 1979) there is a tension between firms and workers regarding the level of effort to be exerted while in models of delegation of decision-making (Prendergast 2002) the tension arises around the activity or project to be selected. In both cases, firms prefer that workers select the level of effort and the activities that maximize their benefits, while workers prefer the level of effort and the activities that maximize their own utility. The optimal organization design arising from those assumptions call for the provision of pay-for-performance and centralization of decisions.

In the last few years there have appear several theoretical models suggesting that in some circumstances workers care about what they do (Prendergast 2008). And that this fact could have important consequences for the optimal organization design. One stream of this literature (Akerlof and Kranton 2005, Besley and Ghatak 2005, Prendergast 2008, Van den Steen 2010) considers that mission congruence can operate as a substitute for monetary incentives. Another stream of this literature (Aghion and Tirole 1997, Dessein 2002, Van den Steen 2010) has studied the effects of a change in the assumptions about the workers preferences on the degree of autonomy provided to workers. The underlying idea is that when there is less discrepancy between the objectives of firms and workers, it is more likely that firms see workers as more reliable to pursue the objectives of the organization and hence delegate decision-making.

For testing these hypotheses we rely on dataset of childcare facilities in Minnesota proving information about work organization practices for teachers as well as about the characteristics of the childcare facilities. We find that mission congruence between teachers and childcare facilities is negatively associated with the likelihood of reliance on pay-for-performance and positively associate with teacher autonomy.

Chapter 1

Autonomy and Pay for Performance: Further Evidence and Stylized Facts

1. Introduction

The theoretical debate initiated by Prendergast (2002) around the tenuous relationship between uncertainty and pay-for-performance has sparked further interest in this issue. Prendergast suggests that the pay-for-performance decision is positively related to the autonomy of the worker and that autonomy is related to the employee's risk, due to the complexity of a job where workers have information-related advantages concerning the way their tasks can be organized. Although theoretical analyses suggest that pay-for-performance and autonomy are endogenous variables, most of the empirical literature consider just one of these as dependent, either pay-for-performance[1], or autonomy[2]. Empirical research on the simultaneous determination of both variables in organizational design is, to the best of our knowledge, restricted to Nagar (2002), Foss and Laursen (2005), Ortega (2009), DeVaro and Kurtulus (2010), and Ben-Ner et al. (2011), analyzing countries such as Denmark, the United States or the United Kingdom. This paper contributes to this last stream of empirical literature in several respects.

First, we present an overview of the different results and methods used previously in the literature by proposing an encompassing econometric approach that allows us to distinguish differences with other papers' econometric approaches, and to then restate their results. A simultaneous estimation of pay-for-performance and autonomy decisions allows us to identify those dependent variables that directly affect pay-for-performance or/and autonomy, by controlling for the fact that some of the omitted variables may affect both decisions at the same time. In this sense, other related papers can be understood as partial estimations of our comprehensive approach. For instance, Nagar (2002), Foss and Laursen (2005) and DeVaro and Kurtulus (2010) do not consider job complexity in their analyses, while Ortega (2009) does not consider uncertainty. Furthermore, Ortega (2009) does not take into account the impact of autonomy on pay-for-performance strength. Finally, DeVaro and Kurtulus (2010) do not control

[1] See Gibbons (1998), Murphy (1999), Prendergast (1999), Bushman and Smith (2001), and Gibbs (forthcoming) for a review of this extensive literature.
[2] Osterman (1994), Baiman, Larker and Rajan (1995), Colombo and Delmastro (2004), Gibbs, Levenson and Zoghy (2010).

for the fact that the error terms in the equations for pay-for-performance strength and autonomy may be correlated because omitted variables can affect both decisions at the same time.

Second, the paper presents further empirical evidence based on a new and different context, a dataset of Spanish industrial plants.

Third, the paper summarizes the most consistent results among the different studies, discusses their theoretical explanations and suggests implications for further research. Although the results are mainly consistent with the predictions made by Prendergrast (2002), there is evidence that deserves fuller attention, for example the role of worker's selection procedures and uncertainty in the determination of autonomy.

This paper is structured as follows: Section 2 discusses the theoretical literature related to Prendergast (2002). Section 3 presents data and the econometric approach; Section 4 presents results; Section 5 discusses the implications of the results, and Section 6 sets out conclusions.

2. Theoretical background

Labour relationships frequently imply the delegation of decisions or actions to the workers. The delegation of decision-making is merely a matter of fitting workers' capabilities to their responsibilities when the entrepreneur and workers share the same motivation and information (Sattinger 1975; Rosen, 1982; Garicano 2000). In this situation there is little room for differences between the actions that the employer would carry out and those that workers finally undertake. But there are several streams of literature that casts certain doubts on the above assumptions.

The Agency theory (Holmström 1979, Shavell 1979, Holmström and Milgrom 1987, 1991) emphasizes the fact that motivation cannot be contractually aligned when certain of the actions (usually summarized by effort) are not contractible and workers are more risk-averse than employers. This literature discusses the use of information about other verifiable variables (usually summarized as performance) in the contract offered to the worker so as to provide motivation. Mainly, the correlation between verifiable variables and effort is inversely related to level of uncertainty about true level of effort. These models propose contracts of pay-for-performance. The worker receives a percentage (pay-for-performance intensity) of performance level. The optimal pay for performance intensity derived in those models is inversely related to degree of uncertainty (see Prendergast 1999 for summary and further details on the assumptions).

*Hypothesis 1: Pay-for-performance strength is negatively related to uncertainty***.**

This hypothesis has been extensively tested in various articles. Prendergast (2002) and DeVaro and Kurtulus (2010) provide reviews of this empirical literature. Overall, they find that the evidence is inconclusive. From the articles reviewed, only around 30 percent support the predictions of the standard principal-agent model, while approximately 45 percent show a positive correlation between uncertainty and pay-for-performance, with 25 percent showing a non-significant correlation.

This lack of supportive empirical evidence has encouraged the development of several theoretical models (Zabojnik 1996, Prendergast 2000, 2002, Adams 2002, Baker and Jorgensen 2003, Shi 2005, Raith 2008) that are concerned with explaining such empirical ambiguity. A common underlying idea in these papers is that pay-for-performance could be also a mechanism to exploit workers' information advantage about how to perform a job. According to some authors (Prendergast 2002, Raith 2008, Ben-Ner et all 2011), the existence of this information-based advantage is more likely to be observed in complex work setups. In these environments, i.e., in situations where there are many ways to perform a particular job (Prendergast 2002, Raith 2008), it is more difficult for the firm to identify and assign the most productive way to work. Job complexity can be understood as a measure of the uncertainty that managers face regarding the best way to organize a worker's tasks. This uncertainty has been referred to in the literature in several ways: 'ex-ante uncertainty' (Zábojnik 1996); 'volatility' (Baker & Jorgensen 2003); 'respondable risk' (Shi 2005); 'technological uncertainty' (Raith 2008); 'controllable risk' (Gibbs, Merchant, Van Der Stede, and Vargus 2009) and 'internal uncertainty' (Ben-Ner et al. 2011). So, given that strengthening pay-for-performance increases the worker's interest in selecting the most productive task instead of that with higher private profit, these models predict a positive correlation between workers' pay-for-performance strength and degree of job complexity.

Hypothesis 2: Pay-for-performance strength is positively related to job complexity.

Empirical literature concerned in testing this hypothesis is scant and shows no conclusive results. Ortega (2009) finds a positive effect of job complexity on the implementation of group performance pay, profit sharing and stock ownership; however, he fails to find a significant effect on the implementation of piece rates. Ben-Ner et al. (2011) present empirical evidence that does not support a positive relationship between different measures of pay-for-performance (individual incentives, group bonus and profit sharing) and a compound of three task attributes carried out by the shop-floor workers across several sorts of industries, namely, degree of task variability, task routine and task complexity. Last, Baiman, Larker and Rajan (1995) found that the compensation risk imposed on the business-unit manager increases with the expertise of the parent company relative to that of the business-unit manager, contradicting the above prediction.

Whether an action is contractible or not, it is exogenously given in most of the cited papers. Prendergast (2002) emphasizes that even if certain actions are contractible the firm can prefer to omit them from the contract. This is understood as the firm providing more autonomy to the worker. So, in this model, workers' autonomy is an endogenous variable. When the amount of local private knowledge is low, the firm has a good idea of what the worker should do in order to align private and social benefits. The firm therefore tells the workers what to do, thus centralizing decisions and paying a straight salary. On the contrary, when the amount of local private knowledge or job complexity is high, the firm is likely to have less of an idea about what the agent should do to align the parties' interests. Therefore it delegates decision-making. In order to use the local private knowledge of the worker to its advantage, the firm offers pay-for-performance. Autonomy and pay for firm performance are therefore interrelated decisions.

A first empirical proposition of this argument is that pay-for-performance is more likely to be observed in cases in which employees have a high level of autonomy. The joint nature of the provision of autonomy and incentives is a topic largely studied in the management and economic literature (Stiglitz 1975, Mirrlees 1976, Melumad and Reichelstein 1987, Melumad et al. 1992, Jensen and Meckling 1992, Holmström and Milgrom 1994, Prendergast 2002, Baiman and Rajan 1995, Bushman et al. 2000, Baldenious 2003). In general, this literature predicts a positive relationship between pay-for-performance and autonomy.

Hypothesis 3: Pay-for-performance strength is positively related to autonomy.

Except for Adams (2002), most of the empirical work concerned with testing this prediction provides supportive evidence (MacLeod and Parent 1999, Nagar 2002, Abernethy et al. 2004, Foss and Laursen 2005, Moers 2006, Wulf 2007, Ben-Ner, Kong and Lluis 2011, DeVaro and Kurtulus 2010, Itoh, Kikutani and Hayashida 2008).

The second empirical implication of Prendergast's (2002) argument—the positive relationship between degree of local private knowledge, or job complexity, and the provision of workers' autonomy—is his most original prediction.

Hypothesis 4: Autonomy is positively related to job complexity.

Recent empirical studies provide support for the positive relationship between delegation of decision-making and measures of job complexity (Ortega 2009, Gibbs, Levenson and Zoghy 2010, Ben-Ner, Kong and Lluis 2011) or other measures intended to capture the principal-agents' asymmetric information (Baiman, Larker and Rajan 1995, Colombo and Delmastro 2004).

Furthermore, the literature also provides empirical evidence for a positive relationship between uncertainty and autonomy (Nagar 2002, Foss and Laursen 2005 and DeVaro and Kurtulus 2010). Although, as these authors seem to suggest, these results may follow from the fact that their measures of uncertainty could envelop both the effects of uncertainty itself and local private knowledge, there are arguments that allow for a theoretical rationalization of the positive effect of uncertainty on autonomy. According to Nagar (2002), in highly volatile environments, the cost to firms for acquiring information on operational decisions is high; consequently, they delegate those decisions to the workers who have closer access to this information.

Hypothesis 5: Autonomy is positively related to uncertainty.

Note that in the models developing Hypothesis 2 there is no role for workers' autonomy. The positive relationship between job complexity and incentives strength follows directly from the positive effect of the job complexity on firms' profits, without affecting any other variable of the organizational design. However, in Prendergast (2002), this positive effect is demonstrated exclusively through the provision of workers' autonomy (Hypotheses 3 and 4). Thus, Prendergast predicts that if we were able to control for a measure of delegation in decision-making, the positive effect of job complexity on incentives provision should disappear.

It is worth noting that Hypothesis 3 could be explained by other arguments. Core and Quian (2002) analyze a multitasking situation in which workers have to exert effort both in an evaluation task (for project selection decisions) and in a production task effort. Unlike traditional multitasking models (Holmström 1991) in which agents obtain output for each performed task, in this model both efforts result in a unique output, which is a close characterization of the context of blue-collar work. Given that both efforts are unobservable and therefore non-contractible, the firm needs to provide incentives. When the worker performs the evaluation task, the optimal relationship between pay-for-performance strength and uncertainty is positive. The effort exerted in this evaluation task focuses on research and the use of project information. The positive impact of this information on firms' profits increases with the uncertainty of the environment observed at the time the project-selection decision is taken. It is therefore expected that the intensity of incentives should increase with level of uncertainty. Interpreting autonomy as an indicator of the importance of evaluation relative to the production task, this argument predicts a positive correlation between uncertainty, autonomy, and pay-for-performance strength; in this sense, Core and Quian's (2002) argument also can give rise to Hypothesis 3.

The arguments of both Prendergast (2002) and Core and Quian (2002) are not mutually exclusive. But which of the two variables—job complexity or uncertainty—is more important in

explaining autonomy is an empirical question. Furthermore, from Core and Quian (2002), it can be inferred that after controlling for autonomy (and cancelling out the effects of the information searching task) the coefficient of the variable uncertainty in the pay-for-performance equation will be negative, exactly as stated in Hypothesis 1.

To test the above hypotheses, it is necessary to control for other factors that could determine the use of pay-for performance and/or autonomy. Studying the conditions under which pay-for-performance should be implemented has been the object of considerable scrutiny by economic and management literature. Concepts such as worker's qualifications of capabilities (Adams 2002, Nagar 2002), unions (Estrin, Grout and Wadhwani 1987, Baron and Kreps 1999), the degree of product-market competition (Jensen and Meckling 1976, Hart 1983, Schmidt 1997, Raith 2003) or the existence of turnover costs (Yang 2008) have been highlighted in the literature as determinants of the provision of pay-for-performance. Besides these variables, we also will consider others used in the related empirical literature to control for the specific characteristics of plants or for the environments in which they operate, which could affect the implementation of pay-for-performance and/or autonomy.

3. Methods

3.1. Data description

The data for testing these hypotheses is taken from a survey[3] designed to obtain information on the human-resource practices and work-organization policies of Spanish industrial establishments. The original questionnaire was fine-tuned with a pre-test sample of 15 plant directors. The use of subjective assessments by the interviewee on various scales to obtain information on the theoretical concepts outlined above is a common practice in the related empirical literature (Adams 2002, Foss and Laursen 2005, Wulf 2005, Nagar 2005, Shi 2005, Ortega 2009, Devaro and Kurtulus 2010, Ben-Ner, Kong and Lluis 2011). This approach allows for the possibility of obtaining information on certain concepts even if objective information is not available. Therefore, there is a wider sample of firms.

The target group was manufacturing establishments in peninsular[4] Spain with 50 or more workers, with or without additional plants in Spanish territory or abroad, and whose economic

[3] The survey was jointly designed by a group of researchers from the Universitat Autònoma de Barcelona, Universitat Illes Balears, Universidad Pública de Navarra, and Universidad de Zaragoza. The complete questionnaire can be provided on request.

[4] Due to budget restrictions, the Canary and Balearic Islands, in addition to the two smallest Autonomous Communities (in terms of per capita GDP), Castilla La Mancha and Extremadura, were excluded from the sample.

activity is included in one of the 13 manufacturer sectors of the CNAE classification for 1993.[5] The sample of firms or manufacturing plants was identified in CAMERDATA (the Spanish Chamber of Commerce database) and comprised 3000 plants. A stratified random sample, guaranteeing stratums by size and industrial sector, based on 402 interviews (13.5% of the target group) was finally achieved. The questionnaire were responded to between December 2007 and April 2008, through personal interviews of approximately one hour by a specialized firm, in most cases with the directors or production or human-resource managers at the plants in question.[6] Because some questionnaires were incomplete, we ended up with 358 observations. Table 1 shows the definition, frequency distribution, and the means and standard deviations of the variables used.

Most of these have been constructed on the basis of degree of agreement by the interviewee on a certain assertion. Degree of agreement is measured on a Likert scale from 1 to 5. In the case of the *Pay-for-performance strength*, we use an ordinal variable. However, working with ordinal variables causes problems in empirical applications mostly when these are included as independent variables. Consequently, proper use of the information available for each variable implies the inclusion of four dummies in the regression. In most of the variables, some of the categories have very few observations, which cause collinearity in the estimations. In order to avoid such problems, and for the sake of expositional simplicity, we will use only one dummy for each independent variable. This requires the selection of a category cut-off. Some studies (e.g. Foss and Laursen 2005) use the original middle category (value 3 in our case) for this purpose. This procedure assumes that the distribution of the Likert-scale categories is the same for all variables. The application of this procedure in our data provides highly skewed distributions for certain variables. This fact casts some doubt on the assumption that all variables follow the same distribution. We therefore follow an alternative procedure used in the literature (e.g. DeVaro and Kurtulus 2010), which is some form of standardization: cut-off is the category closest to representing the median for the variable. In all the cases, we proceeded to group the adjacent original categories so as to finally obtain two categories with the most egalitarian distribution possible for the observations. The following binary variables were produced as a result of following this method: *Autonomy* and the control variables *Union influence, Market competition, Job stability, Soft skill requirements*. Based on binary answers to a given question we have the variables *Collective agreement* and *Multi-plant*.

[5] CNAE is the Spanish acronym for the national classification of economic activity used by the Spanish National Institute of Statistics. This classification is based on the guidelines of the Statistical *Classification* of Economic Activities in the European Union (NACE, in its French acronym).

[6] Interviewer status was required by the questionnaire. The results presented are not sensitive to this status. As with other results commented on throughout this paper but not shown in our text, they are available on request.

A challenge is presented when the original middle category (value 3) concentrated more than 50 percent of the observations. In these cases, we consider three categories (two dummy variables) but only if each resulting category reflected at least 10 percent of the observations. This is the case for the variable *Uncertainty* and *Qualification requirements*.

The questionnaire contains 6 statements related to degree of complexity in the production process[7]. In concrete, these statements refer to the number of products produced, to the modifications made to the products, and to product turnover, which presumably increase the number of activities performed by the worker and therefore resemble the concept of complexity considered by Prendergast (2002). We applied the principal component factor analysis to summarize this information. The application of this technique resulted in one factor with a Cronbach alpha of 0.75. This index will be considered in the analysis as our measure of *Job complexity*.

Size of plant is measured through the number of workers. Finally, in order to understand the effects of the firm's technology, we classified the industrial sectors according to their technological intensity in two categories, creating the dichotomous variable *Technological intensity*.

Similar databases have been used previously for analyzing the adoption of pay-for-performance and delegation of decision-making policies. For instance, in the context of production workers, Foss and Laursen (2005) uses a sample of 993 Danish firms taken from the DISKO project at Aalborg University. The information extracted from this survey is complemented by regular register data from Statistics Denmark. Ortega (2009) uses a dataset of 24,000 individuals taken from the last three European Working Conditions Surveys, and DeVaro and Kurtulus (2010) use a sample of 1,245 British establishments taken from the 1998 Workplace Employee Relation Survey (WERS98). For core workers across different occupations, Ben-Ner et al. (2011) uses a dataset comprising 530 firms taken from the Minnesota Human Resources Management Practices Survey as well as from COMPUSTAT. Last, for lower-level bank managers, Nagar (2002) uses a cross sectional sample of 100 banks taken from the Wharton Financial Institutions Center's 1994 survey of retail banks and the Federal Deposit Insurance Corporation.

3.2. Econometric approach

In accordance with the theoretical section and given the construction of the *Pay-for-performance strength* (*p*) and *Autonomy* (*a*) variables (a four-ordered category and a dichotomous variable, respectively), we propose the following general econometric approach:

[7] The 6 statements are reported in appendix 1.

$$p_i^* = {}_1u_i + {}_2c_i + {}_3a_i + \sum_{j=1}^{J} {}_j x_{ji} + {}_{1,i} \quad [1]$$

$$a_i^* = {}_1u_i + {}_2c_i + \sum_{j=1}^{J} {}_j x_{ji} + {}_{2,i} \quad [2]$$

where p^* and a^* are latent variables. For industrial plant *i*, the value of the *Pay-for-performance strength* variable (p_i) will depend on the value of the latent variable p_i^* in the following way: $p_i = 5$ if $p_i^* \geq {}_4$, $p_i = 4$ if ${}_4 > p_i^* \geq {}_3$, $p_i = 3$ if ${}_3 > p_i^* \geq {}_2$, $p_i = 2$ if ${}_2 > p_i^* \geq {}_1$ and $p_i = 1$ if ${}_1 > p_i^*$. The *Autonomy* variable *(a)* will be equal to one ($a_i = 1$) when industrial plant *i* has an associated value of $a_i^* > 0$ and will be equal to zero otherwise. Independent variables will be *Uncertainty* (*u*), *Job complexity* (*c*) and a set of *J* control variables x_j (*j* = 1…*J*). The error terms ${}_1$, ${}_2$ are distributed as bivariate normal with mean zero, unit variance and correlation coefficient . The parameters to be estimated are ${}_1$, ${}_2$, ${}_3$, ${}_4$, ${}_1$, ${}_2$, ${}_3$, ${}_1$, ${}_2$, ${}_j$, ${}_j$ and . Hypotheses 1, 2 and 3 predict that ${}_1 < 0$, ${}_2 > 0$ and ${}_3 > 0$, respectively, while hypotheses 4 and 5 predict that ${}_2 > 0$ and ${}_1 > 0$, respectively.

The general model proposed is logically consistent (for further discussion see Maddala, 1983 section 5.7), its parameters are identified (see Wilde 2000 for further discussion) and can be estimated by the semi-ordered bivariate probit probability model (Greene & Hensher 2009, Buscha & Conte 2009). Nevertheless, some related empirical literature that has estimated both equations at the same time has excluded certain parameters for estimation purposes (Ben-Ner et al. 2012). Furthermore, some of the above variables are not part of the analysis carried out by this literature. Table 2 summarizes the empirical approaches and results of the related literature.

The semi-ordered bivariate probit is an extension of the bivariate probit when the dependent variable is ordinal. The bivariate methodology is the way to carry out empirical analyses when the probit equation contains a binary explanatory variable that is endogenous (Monfardini and Radice 2008, Wooldridge 2010). The bivariate is a full information instrumental variables model (Hausman 1975), in the sense that it takes into account for the possible correlation between disturbances and regressors and the possible correlation between the disturbances of the two equations.

4. Results

Table 3 shows the results of the joint estimation for Equations [1] and [2] by a semi-ordered bivariate probit probability model (Model 1). The first column presents the results of the estimation of *Pay-for-performance strength* equation, relevant for Hypotheses 1, 2 and 3. These results provide some insight into the validity of Hypothesis 1. However, this assertion is true only with the *Middle uncertainty* variable, whose coefficient is negative and significantly different from zero at the 10-percent level, whilst the *High uncertainty* variable, although negative, is not statistically significant, which suggests a convex function. Hypothesis 2 finds no support. The coefficient of the *Job complexity* variable is not statistically different from zero at conventional levels of significance. Hypothesis 3 receives strong support. The coefficient of the *Autonomy* variable is positive and statistically significantly different from zero at the 1-percent level. With regard to the control variables, the results show that workers' *Job stability* decreases *Pay-for-performance strength*. The coefficient of this variable is negative and significantly different from zero at the 9-percent level. Another variable associated with *Pay-for-performance strength* is *Soft skill requirements*. Increases in this variable raise the strength of *Pay-for-performance*. The coefficient of this variable is positive and statistically significantly different from zero at the 2-percent level.

The second column shows the results for estimation of the *Autonomy* equation, which is relevant for Hypothesis 4 and 5. These results provide strong support for the predictions of Hypothesis 4. The *Job complexity* variable is positive and statistically significantly different from zero at the 2-percent level. Finally, there is some evidence supporting Hypothesis 5. The coefficients of the two variables related to uncertainty are positive and statistically significantly different from zero at the 11- and 10-percent levels, respectively. Moreover, the results of this estimation show the importance of several control variables in determining the delegation of decision-making. The sign of the variable *Collective agreements* is negative and significantly different from zero at the 1-percent level. Additionally, the qualification requirements to perform a given job increase the likelihood of granting workers' autonomy. Coefficients of the *Middle qualification requirements* and *High qualification requirements* variables are positive, but the first is statistically significantly different from zero at the 1-percent level, whilst the latter is not statistically significant. In addition, the coefficient of the *Soft skill requirements* variable is positive and statistically significant at the 1-percent level.

Although the semi-ordered bivariate probit probability model (Model 1) is the means for providing consistent estimations for all parameters, we provide different model estimations in Table 4, which imposes some restrictions on parameter values (Model 2 and Model 3). This approach attempts to determine possible explanations for differences in results between our paper and earlier empirical works.

In Model 2, we assume that $= {}_1 = {}_2 = {}_j = 0$, and estimate the remaining parameters (i.e., only those for Equation [1]) through an ordered probit probability model (Column 1 of Table 4). In Model 3, we assume that $= {}_3 = 0$, and estimate Equation [1] through an ordered probit probability model; we estimate Equation [2] through a probit probability model (Columns 2 and 3 in Table 4).

From the estimation of Model 3, we detect no statistically significant relationship between *Autonomy* and *Union influence, Market competition*, *Job stability, Size, Multi-plant* or *Technological intensity*. Furthermore, we observe that the impact of *Unions influence*, *Market competition*, *Size* and *Multi-plant on Pay-for-performance strength* is not statistically significant either in the estimation of Model 2 or in that of Model 3, and that the significant impact of *Collective agreements* and *Qualification requirements* detected in Model 3 (Column 2) is due to the fact that we do not control for *Autonomy*, unlike for Model 3 (see Column 1). Note that from estimations of Models 2 and 3, it is difficult to maintain the assumption that level of *Autonomy* has no impact on *Pay-for-performance strength* decision $({}_3 = 0)$.

With the noted exceptions of *Job complexity*, *Collective agreements* and *Qualification requirements* in the *pay-for-performance* equation, the remaining parameters are fairly stable among the different estimations. In all cases, their coefficients are reduced when passing from Model 3 to Model 1. This reduction responds to two effects, first, to the inclusion of *Autonomy* as a dependent variable in the pay-for-performance equation; second, to the fact that we are controlling for the correlation between the equations' error term.

5. Robustness

The central estimation considers the variable pay-for-performance in its original ordinal form to avoid the loss of information associated with the dichotomization of the dependent variable. For robustness, we also have estimated the model using a dichotomous variable for pay-for-performance. In specific, we gather together the three first categories of the Likert scale (see Table 1) and get a dummy variable whose values zero and one comprises 47 and 53 percent respectively. The results are present in Table 5.

As we can see, most of the central results remain unchanged. We find a positive and significant association between *Pay-for-performance* and *Autonomy*. In firms with autonomy, the probability that the firm grants *Pay-for-performance* is .69% higher than in firms with no autonomy, as reported by the marginal effects. We also find a positive and significant association between *Autonomy* and both *Job complexity* and *Uncertainty*. An increase of 1% in *Job complexity* increases the likelihood of *Autonomy* in .18%. Firms with *Middle uncertainty* or *High uncertainty* have a probability of having *Autonomy* .15% or .16% higher than firms

without *Middle uncertainty* or *High uncertainty*, respectively. In addition, we find no statistically significant correlation between *Pay-for-performance* and *Job complexity*. One change that is noteworthy is that the two dummy variables related to uncertainty are no longer statistically significantly different from zero in the *Pay-for-performance equation*, although they keep their negative signs. With regard to the control variables, we can see that the variable *Job stability* is no longer statistically significantly different from zero in the *Pay-for-performance* equation. Also, the two dummy variables related to qualification requirements are now negative, being the first dummy, *Middle qualification requirements*, statistically significant. Firms with *Middle qualification requirements* are .13% more likely to provide *Pay-for-performance* than firms without *Middle qualification requirements*.

We also check for robustness by dropping from the main analysis the variables related to industry and workers qualifications. The results of the estimation that does not consider the variable associated to the industry, *Technological intensity*, are shown in Table 6. As we can see there are not important differences between this estimation and the original estimation in Table 3. There are two type of variables associated with workers' qualifications. The first one is related to the level of skills of the workers and is represented by two dummy variables, *Middle qualification requirements* and *High qualification requirements*. The results of the estimation in which these variables are dropped out are shown in Table 7. In this case, the central results also remain unchanged. The only differences that are worthy to note are in the coefficient of the variable *Job stability* which passes from a significance level of 9 percent to a significance level of 10.6 percent, in the coefficient of the variable Middle uncertainty which passes from a significance level of 11 percent to a significance level of 5 percent, and in the coefficient of the correlation between the error terms of the two equations which is now significant at the 45 percent level. Table 8 shows the results of the estimations when we drop out the second variable related to workers' qualifications, *Soft skill requirements*. As we can see, no significant differences are found in the central results with respect to the original estimation in Table 3. The only differences are in the degree of significance of the coefficients of the variables *Autonomy* in the *Pay-for-performance* equation, which passes from .08 percent to 3.4 percent, and *Middle uncertainty* in both *Pay-for-performance* and *Autonomy* equations. In the *Pay-for-performance* equation the variable *Middle uncertainty* reduces from 3 to 8 percent while in the *Autonomy* equation it increases from 11 to 6 percent. Another variable that show differences is the correlation between the error terms of the two equations. The degree of significance of this coefficient passes from 39 to 57 percent.

6. Implications

The results obtained and the previous evidence available can be summarized in the following set of stylized facts:

(i) *Autonomy* provision and *Pay-for-performance strength* are interdependent decisions. Evidence of a positive correlation between these concepts $(\ _3 > 0)$ is found in all the related empirical studies that have previously estimated this relationship (Nagar 2002, Foss and Laursen 2005, DeVaro and Kurtulus 2010 and Ben-Ner et al. 2011).

(ii) *Job complexity* positively affects *Autonomy*; this result is also reported by Ortega (2009) and Ben-Ner et al. (2011). Moreover, in the cases in which *Autonomy* is not taken into account (as in our Model 2 or in Ortega 2009), the relationship between *Job complexity* and *Pay-for-performance strength* is positive and statistically significant. However, once *Autonomy* and correlation among the error terms is controlled for, the coefficient of *Job complexity* is not significant at the usual levels of confidence. This evidence shows that the effect of *Job complexity* on *Pay-for-performance strength* could be spurious. An implication of this finding is that part of the positive correlation between job complexity and pay-for-performance strength documented in previous studies could have been over-estimated, since the *job complexity-autonomy* relationship was not considered. This result is in line with Prendergast's prediction (2002).

(iii) There is some evidence[8] for a positive relationship between *Autonomy* and *Uncertainty*. In all the related empirical studies in which the relationship between these concepts has been estimated without controlling for job complexity (Nagar 2002, Foss and Laursen 2005, DeVaro and Kurtulus 2010), the coefficient of the uncertainty variable is positive and statistically significant. However, in cases for which job complexity has been controlled (Ben-Ner et al. 2011), this coefficient turns out to be statistically insignificant.

(iv) Estimation of the effect on *Pay-for-performance strength* of *Uncertainty* is sensitive to the inclusion of *Autonomy* as an explanatory variable as well as to the way in which this variable is included, i.e., taking into account the fact that it is endogenous to *Job complexity*. In the related empirical literature, the effects of uncertainty on pay-for-performance strength are unclear. Nagar (2002) and Ben-Ner et al. (2011) find a non-significant relationship between these variables, whilst Foss and Laursen (2005) find a positive and significant relationship and

[8] The *Middle uncertainty* variable was significantly different from zero at 10.2 percent, whilst the *High uncertainty* variable was significantly different from zero at 9.7 percent.

DeVaro and Kurtulus (2010) discover one that is negative and significant. These papers, except for that of Ben-Ner et al. (2011), do not consider the effects of job complexity in their analyses.

(v) There are other factors important to determining both dependent variables. We found a negative effect for *Job stability* and a positive effect for *Soft skill requirements* on *Pay-for-performance strength* decision. If we associate *Job stability* with tenure, the former result contrasts to that found by Ortega (2009). With regard to *Autonomy*, it is positively related to the *Middle qualification requirements* and *Soft skill requirements* variables and negatively related to the *Collective agreements* variable. In concordance with our results, Nagar (2002) finds the effect of education—comparable to our concept of qualification requirements—to be positive.

(vi) The *Union influence, Market competition, qualification requirements, Size, Multi-plant,* and *Technological intensity* variables were non-significantly related to *Pay-for-performance strength*). Similar results have been found for *Size* (DeVaro and Kurtulus 2010, Nagar 2002), *Multi-plant* (DeVaro and Kurtulus 2010), *Unions* (DeVaro and Kurtulus 2010) and *Technological intensity* (Foss and Laursen 2005), in the related empirical literature. On the other hand, the *Union influence*, *Market competition, Job stability, Size,* and *Technological intensity* variables resulted in being non-significant at explaining the *Autonomy* decision. In this case, similar results have been found for *Size* (Nagar 2002) and *Technological intensity* (Foss and Laursen 2005) in the cited papers.

With regard to the theoretical implications of these facts, they support Prendergast (2002)'s arguments. Degree of autonomy will affect the firm's compensation policy. Empirically, the determinants of autonomy would therefore also affect compensation policies if we do not control for autonomy. One of those determinants is workers' local private knowledge, or job complexity, which in turn also appears as a key explanatory variable in determining pay-for-performance strength when not controlled for autonomy and for the correlation between the equations' error term. As a consequence, after controlling for autonomy and for the correlation between the equations' error term, the positive effect of job complexity on pay-for-performance strength diminishes to non-statistically significant levels. The empirical evidence does not therefore provide support for the direct positive relationship between workers' local private knowledge and pay-for-performance strength. This relationship is suggested by other models (Zabojnik 1996, Adams 2002, Baker and Jorgensen 2003, Shi 2005, Raith 2008) concerned with explaining the failures of the empirical literature to obtain supportive evidence on the negative relationship between uncertainty and pay-for-performance predicted by the traditional agency model.

However, job complexity does not seem to be the sole determinant of autonomy. Uncertainty also appears to play a role. Although further theoretical research is necessary to formalize this finding, the literature provides certain directions for explaining this relationship. Nagar (2002) suggests that the provision of autonomy responds positively to the degree of uncertainty because it reduces the firm's expenses in operational-decisions information. Nevertheless, having autonomy implies that workers perform other tasks, namely, the project-selection decisions. In Core and Quian (2002), the optimal relationship between incentives strength and uncertainty is positive when the project-selection decision task is more important (autonomy) than the production task, and vice versa. The evidence is consistent with those interpretations. However, the resulting trade-off is found only when uncertainty increases from low to middle levels, suggesting a convex function. Although Core and Quian (2002) also discuss this result, further theoretical research is needed.

Moreover, the presence of collective agreements and workers' skills and soft skills are also strongly related to autonomy policies and have a higher statistical significance than that obtained for those measures of risk principally analyzed in the literature. In fact, selection procedures and collective agreements are affecting pay for performance indirectly, via autonomy, with the exception of soft skills, which also has a direct positive effect on performance. These effects deserve more empirical and theoretical attention.

7. Limitations

The data used in this paper comes from a dataset of Spanish manufacturing plants. The sample selection process was designed to be as representative of the Spanish industrial plants as possible; it considered stratums by size, industry and region. However, some country specificity could remain, for example in the labor market conditions or institutional factors such as unions or collective bargaining agreements. In order to (at least partially) deal with this limitation, we controlled for variables related to these concepts. We found that the presence of collective bargaining agreements substantially reduces the provision of workers' autonomy.

Another limitation of the database is the relationship between the theoretical concepts and the measurement of the variables used in the empirical analysis. The variables are constructed using subjective assessments on several scales of the directors or human resource managers of the plants. This procedure however is common in all the related empirical literature.

For our measure of pay-for-performance, the interviewee had to inform about her degree of agreement with the following question: "the results of the evaluation of performance are linked to incentives or used to take decisions about salaries." This measure is about the decision on the provision of pay-for-performance and not about the intensity of pay-for-performance. Hence, it is well suit to test the implications of Prendergast (2002) but it is an indirect measure to test the

implications of the agency model. It would be ideal to have a measure of the percentage or ammount of money associate with the productivity of the worker. Unfortunately the sample does not provide reliable information to construct such variable.

The variable autonomy is based on a question related to the capacity of the agent to decide the implementation (when, how and in which sequence) of the available activities. Our measure for autonomy is close to that used by Ortega (2009), which relies on a set of questions about the discretion of a worker on several attributes of a job. Other empirical studies have used less-detailed questions, such as the intensity of delegation of responsibility (Foss and Laursen 2005) or the degree of influence about the range of tasks (DeVaro and Kurtulus 2010). Or they have asked indirect questions, about, for example, the office status of the division manager and the level of his or her position in the hierarchy (Wulf 2007) or the intensity of workers' participation in an employee involvement program (Ben-Ner et al. 2011).

The election of the measure for uncertainty was done following other empirical papers related to production workers (Adams 2002, DeVaro and Kurtulus 2010). In specific, we use variability in demand as assessed by the director or human resources manager of the plantas a measure of uncertainty. The most used proxies for uncertainty or risk used in the empirical agency literature are variation in sales, stock returns, or profitability (Bushman et al. 1996, Prendergast 2002, Foss and Laursen 2005), but our sample does not provide this more objective information.

The construction of the variable job complexity is based on several statements related to the number of activities that the worker has to perform. This measure differs from those used in the other analyses (Ortega 2009, Ben-Ner et al. 2011), which infer job complexity from a question asking about the degree of complexity of the job in broad terms. Our survey does not provide this information. However, to the extent that these statements refer to the number of products produced, modifications made to the products, and product turnover (see the General Appendix), which presumably increase the number of activities performed by the worker, we believe that it resembles the concept of complexity considered by Prendergast (2002).

8. Conclusions

This article adds new evidence on the role of uncertainty and job complexity in both pay-for-performance intensity and workers' autonomy-provision decisions regarding blue-collar workers. It presents evidence relevant to disentangling the effects of the two different information-based contexts understood by the theoretical literature as determinants of autonomy provision and pay-for-performance strength. These are uncertainty (faced, as in the principal-agent literature, by both parties) and workers' local private information (Zabojnik 1996, Prendergast 2000, 2002, Adams 2002, Baker and Jorgensen 2003, Shi 2005, Raith 2008).

These results provide strong support for Prendergast (2002)'s argument, which suggests that the link of job complexity to pay-for-performance operates through autonomy, and does not account for alternative theories that suggest no role for delegation of decision-making in job complexity and pay-for-performance relationships (Zabojnik 1996, Adams 2002, Baker and Jorgensen 2003, Shi 2005, Raith 2008). Furthermore, autonomy is positively correlated with uncertainty. After controlling for autonomy, the correlation between pay-for-performance strength and uncertainty is negative. Nagar (2002) and Core and Quian (2002) offer certain insights that can further guide research in understanding these latter relationships. The results also show that workers' selection process plays a substantial role that is currently underexplored both theoretically and empirically.

Tables

Table 1
Variable description, frequency distribution and descriptive statistics

Variable	Assertion	Type	Mean	S.d.
Pay-for-performance (p)	Whether the result of the evaluation	Ordinal		
	of workers' performance is linked	No	0.16	
	to incentives.	Low	0.11	
	Likert Scale answer (LS)	Middle	0.19	
		High	0.53	
Uncertainty (u)	Evaluate variability magnitude in	Dummies		
	demand from year to year (LS).	Low	.15	
		Middle	.57	
		High	.28	
Job complexity (c)	Details in the text	Factor	0	1
Autonomy (a)	Measure the level of autonomy (when, how and in what order a task has to be implemented) that the blue-collar worker has in job performance (LS).	Dummy	0.61	
Collective agreements	There is a specific collective agreement that regulates the labor conditions of blue-collar workers	Dummy	0.41	
Unions influence	Assess unions' degree of influence on blue-collar workers (LS)	Dummy	0.33	
Market Competition	Evaluate degree of market competition faced by the plants (LS)	Dummy	0.35	
Job stability	Solid commitment to indefinitely maintain employment relationship with blue collar-workers (LS)	Dummy	0.52	
Qualification requirements	Level of qualification required for	Dummies		
	the plant's blue-collar workers to	Low	0.20	
	perform the job (LS)	Middle	0.62	
		High	0.18	
Soft skill requirements	Plant's selection criterion takes into consideration workers' learning capabilities, interpersonal abilities, cultural adjustment, attitudes, and even the personalities (LS)	Dummy	0.75	
Size	Number of workers	Continuous	206	531
Multi-plant	The firm has plants in addition to that being interviewed, either in Spain or abroad.	Dummy	0.56	
Technological intensity	Author's sector classification	Dummy	0.29	

Note: Number of observations: 358

Table 2
Comparative results

Article	Results					
	1	2	3	1	2	
Nagar (2002)	0	NC	+	+	0	NC
Foss and Laursen (2005)	+	NC	+	+	NC	NC
Ortega (2009)	NC	+	NC	NC	+	NC
DeVaro and Kurtulus (2010)	-	NC	+	+	NC	0
Ben-Ner et al. (2011)	0	0	+	0	+	-

+ positive and statistically significantly different from zero; - negative and statistically significantly different from zero; 0 not statistically significantly different from zero; NC not considered in the analysis.

Table 3
Results of the Semi-Ordered Probit Model Estimations

	Model 1 Dependent variable: pay-for-performance		Dependent variable: autonomy	
Independent Variables	Estimates	*p*-values	Estimates	*p*-values
Autonomy	1.64***	.008		
Middle Uncertainty	-.40**	.03	.35	.11
High Uncertainty	-.08	.71	.40	.10
Job complexity	.08	.35	.19**	.02
Collective agreements	.0004	.99	-.90***	.00
Unions influence	.04	.95	-.23	.15
Market Competition	-.14	.31	-.01	.97
Job stability	-.24*	.09	-.14	.35
Middle qualification requirements	.02	.93	.69***	.00
High qualification requirements	.22	.34	.24	.34
Soft skill requirements	.64**	.02	.59***	.00
Size	.10	.32	-.12	.27
Multi-plant	-.06	.65	.21	.19
Technological intensity	.04	.81	.05	.76
Cut11	.38			
Cut12	.87			
Cut13	1.46			
Cut21	-.21			
Chi2	133.65***	.00		
N	358			
Log likelihood	-555.39			
Rho	-.50	.39		

*Statistically significant at the 10% level, ** at the 5% level, *** at the 1% level

Table 4
Results of the Ordered Probit and Probit Probability Models Estimations

	Model 2 Dependent variable: pay-for-performance		Model 3 Dependent variable: pay-for-performance		Dependent variable: autonomy	
Independent variables	Estimates	*p*-values	Estimates	*p*-values	Estimates	*p*-values
Autonomy	.87***	.00				
Middle Uncertainty	-.32	.08	-.21	.23	.35*	.10
High Uncertainty	.03	.89	.13	.52	.41*	.10
Job complexity	.14**	.04	.18***	.01	.17**	.02
Collective agreements	-.24*	.09	-.47***	.00	-.89***	.00
Union influence	-.01	.932	-.07	.63	-.20	.20
Market Competition	-.13	.35	-.12	.38	.02	.89
Job stability	-.29**	.03	-.31**	.02	-.13	.40
Middle Qualification requirements	.22	.19	.39**	.02	.68***	.00
High Qualification requirements	.31	.15	.35*	.10	.23	.35
Soft skill requirements	.84***	.00	.95***	.00	.58***	.00
Size	.06	.53	-.01	.91	-.14	.16
Multi-plant	-.01	.96	.05	.69	.24	.13
Technological intensity	.05	.73	.07	.65	.08	.64
Cons					.28	.60
Cut 1	-.12		-.61			
Cut 2	.40		-.15			
Cut 3	1.05		.45			
Chi2	128.54***	.00	93.09***	.00	94.07***	.00
Pseudo R2	.15		.11		.20	
N	358		358		358	
Log likelihood	-363.23		-390.96		192.54	

*Statistically significant at the 10% level, ** at the 5% level, *** at the 1% level

Table 5
Results of the bivariate Probit Model Estimations

	Dependent variable: pay-for-performance			Dependent variable: autonomy		
Independent Variables	Estimates	*p*-values	mfx	Estimates	*p*-values	mfx
Autonomy	2.05***	.00	.69**			
Middle Uncertainty	-.26	.18	-.10	.40*	.07	.15*
High Uncertainty	-.01	.95	-.005	.45*	.07	.16*
Job complexity	.003	.96	.001	.18**	.02	.07**
Collective agreements	.21	.13	-.08	-.91***	.00	-.32***
Unions influence	.03	.81	.01	-.28*	.07	-.11*
Market Competition	-.05	.73	-.02	-.06	.71	.02
Job stability	-.13	.34	-.05	-.16	.28	-.06
Middle qualification requirements	-.32*	.06	-.13*	.58***	.002	.22***
High qualification requirements	-.02	.94	-.01	.16	.50	.06
Soft skill requirements	.53***	.001	.21***	.55***	.001	.21***
Size	.05	.61	.02	-.12	.24	-.04
Multi-plant	-.02	.93	-.004	.22	.16	.08
Technological intensity	.02	.89	.01	.01	.95	.004
Constant	-1.49***	.001		.34	.51	
Chi2	374.16***	.00				
N	358					
Log likelihood	-387.78					
Rho	-.99**	.02				

*Statistically significant at the 10% level, ** at the 5% level, *** at the 1% level
mfx are the marginal effects

Table 6
Results of the Semi-Ordered Probit Model Estimations--without technological intensity

	Dependent variable: pay-for-performance		Dependent variable: autonomy	
Independent Variables	Estimates	*p*-values	Estimates	*p*-values
Autonomy	1.68***	.003		
Middle Uncertainty	-.40**	.03	.36*	.10
High Uncertainty	-.09	.70	.41*	.09
Job complexity	.07	.37	.19**	.02
Collective agreements	.02	.94	-.90***	.00
Unions influence	.05	.74	-.23	.15
Market Competition	-.14	.30	-.01	.95
Job stability	-.24*	.09	-.15	.35
Middle qualification requirements	.01	.97	.69***	.00
High qualification requirements	.23	.32	.26	.29
Soft skill requirements	.62	.02	.59***	.001
Size	.10	.29	-.11	.30
Multi-plant	-.07	.64	.21	.19
Technological intensity				
Cut11	.43			
Cut12	.91			
Cut13	1.50			
Cut21	-.18			
Chi2	138.80***	.00		
N	358			
Log likelihood	-555.50			
Rho	-.53	.35		

*Statistically significant at the 10% level, ** at the 5% level, *** at the 1% level

Table 7
Results of the Semi-Ordered Probit Model Estimations—without qualification requirements

	Dependent variable: pay-for-performance		Dependent variable: autonomy	
Independent Variables	Estimates	*p*-values	Estimates	*p*-values
Autonomy	1.55**	.02		
Middle Uncertainty	-.39**	.05	.41**	.05
High Uncertainty	-.06	.79	.41*	.09
Job complexity	.08	.34	.20**	.01
Collective agreements	-.005	.99	-.91***	.00
Unions influence	.03	.82	-.23	.15
Market Competition	-.12	.38	-.01	.97
Job stability	-.24	.11	-.19	.20
Middle qualification requirements				
High qualification requirements				
Soft skill requirements	.69	.02	.71***	.00
Size	.09	.33	-.12	.22
Multi-plant	-.06	.68	.26	.11
Technological intensity	.08	.57	.03	.85
Cut11	.31			
Cut12	.81			
Cut13	1.42			
Cut21	-.59			
Chi2	120.69***	.00		
N	358			
Log likelihood	-564.05			
Rho	-.42	.45		

*Statistically significant at the 10% level, ** at the 5% level, *** at the 1% level

Table 8
Results of the Semi-Ordered Probit Model Estimations—without soft skill requirements

	Model 1 Dependent variable: pay-for-performance		Dependent variable: autonomy	
Independent Variables	Estimates	*p*-values	Estimates	*p*-values
Autonomy	1.59**	.03		
Middle Uncertainty	-.34*	.08	.40**	.06
High Uncertainty	-.02	.69	.48*	.05
Job complexity	.08	.36	.18**	.02
Collective agreements	-.02	.94	-.87***	.00
Unions influence	.05	.74	-.19	.23
Market Competition	-.18	.18	-.02	.90
Job stability	-.14	.30	-.06	.67
Middle qualification requirements	.20	.53	.83***	.00
High qualification requirements	.40	.13	.39	.11
Soft skill requirements				
Size	.08	.43	-.13	.20
Multi-plant	-.10	.50	.17	.28
Technological intensity	.08	.61	.10	.56
Cut11	.05			
Cut12	.52			
Cut13	1.09			
Cut21	-.50			
Chi2	75.53***	.00		
N	358			
Log likelihood	-576.65			
Rho	-.40	.57		

*Statistically significant at the 10% level, ** at the 5% level, *** at the 1% level

Chapter 2

Autonomy, Monitoring, and Wages

1. Introduction

A job position, for example a blue-collar worker of an industrial plant, can be designed by three main variables upon control of the firm: autonomy, monitoring and compensation (Williamson 1975, Ouchi 1979, Brickley, Clifford and Zimmerman 2009, Ben-Ner 2012). A*utonomy* is referred to the set of decisions that the worker can (or not) make about the way that the job is executed. For example, decisions about the order of implementation of the available tasks. Following Demougin and Fluet (1998, 2001) *monitoring* is referred to the information collected about the execution (inputs or/and outputs) of those decisions. Examples of monitoring systems suggested by the accounting literature (Kaplan and Norton, 2001) are the budgeting control, the activity based costs or the balanced scorecard. Following agency literature (Prendergast, 1999) *compensation* is referred to the way that the worker is remunerated based on the information provided by the monitoring system. This paper provides empirical evidence on the determinants and relations among these three variables and develops a theoretical framework for interpreting the results. A novel feature of the theoretical analysis is that it considers these three variables (autonomy, monitoring and compensation) as endogenous to the job-design problem of firms.

The analyses considering only one of those variables, the provision of monetary incentives[9], autonomy[10] or monitoring[11], as the unique variable to be explained (i.e., as the endogenous variable in theoretical works, or dependent variable in empirical works) are longstanding in the economic and management literatures. Scholars have also devoted effort to develop theoretical and empirical models where pairs of those variables are considered as endogenous. For instance

[9] See Gibbons (1998), Murphy (1999), Prendergast (1999), Bushman and Smith (2001), and Gibbs (forthcoming) for a review of the extensive theoretical and empirical literatures.
[10] At the theoretical level, see for instance, Melumad and Reichelstein (1987), Aghion and Tirole (1997), Prendergast (2002), Dessein (2002). At the empirical level, Ortega (2009), Gibbs, Levenson and Zoghy (2010), Ben-Ner, Kong and Lluis (2012), Baiman, Larker and Rajan (1995), and Colombo and Delmastro (2004).
[11] At the theoretical level, see for instance, Baron and Besanko (1988) and Falk and Kosfeld (2005). At the empirical level, Groshen and Krueger (1990).

some articles have explicitly considered monitoring and the provision of monetary incentives[12] or autonomy and incentives[13] as endogenous variables at the same time.

The theoretical framework developed in the paper mainly builds on the previous analyses of Demougin and Fluet (1998, 2001) and Prendergrast (2002). Demougin and Fluet consider as endogenous variables to monitoring and compensation, and analyze how the monitoring costs affect both decisions. These authors characterize a set of contexts in which to motivate workers and set their compensation.In this context, it is optimal for the firm to summarize all the information on the performance of employees (supervisors' evaluations, absenteeism, productivity and so on) in just two signals, a positive and a negative one. The conditional probability that the worker exerted the level of effort required given a positive signal about her performance can be considered a measure of the quality of information. The firms can spend money in order to improve the quality of this information. Therefore, an increase in the monitoring intensity improves the quality of information but have costs, monitoring costs.

On the other hand, Prendergast considers as endogenous variables to autonomy and compensation. When firms allocate workers into the job, they acquire private information (or better knowledge) on the best way (i.e., the most productive task) to carry the job out. Autonomy along with pay-for-performance will induce the worker to use this information. Given that the firms' private profits depend on the task selected by the worker, autonomy might be detrimental to the firm. Then, the provision of autonomy can be seen as the result of a trade-off between the importance of the workers' private information and the importance of firms' private profits. When the centralization of decisions is optimal, there is no reason for providing incentives to the workers for selecting the most profitable task.

The paper argues that both (Demougin and Fluet, and Prendergast) arguments are interrelated because firms have better information quality on the task that the worker currently perform than on innovative or unproven tasks (given a certain monitoring cost). The current task has been carried out so far; then companies have experience on how to monitor this task. This fact gives firms a monitoring comparative advantage with respect to innovative tasks, i.e., tasks that have not been performed before. In other words, when innovations are introduced firms have no experience on monitoring such tasks. So, for obtaining the same level of information quality, firms need higher monitoring intensity in the case in which an innovation has been introduced than in the case in which no innovation has been introduced. The model predicts new and unexplored empirical relations. In concrete, 1) the effects of the monitoring comparative

[12] At the theoeretical level, Lafontaine and Slade (1996), Holmström and Milgrom (1994), Demougin and Fluet (2001). At the empirical level, Leonard (1987), Neal (1993), Gordon (1994), Mahmood Arai (1994), Rebitzer (1995), and Ewing and Wunnava (2004).

[13] At the theoretical level, , see for instance, Stiglitz 1975, Mirrlees 1976, Melumad and Reichelstein 1987, Melumad et al. 1992, Jensen and Meckling 1992, Holmström and Milgrom 1994, Prendergast 2002, Baiman and Rajan 1995, Bushman et al. 2000, Baldenious 2003. At empirical level, Osterman (1994).

advantage of the current task vis-à-vis the innovative task on autonomy, monitoring and compensation levels; 2) the relationship between autonomy and monitoring levels; and 3) how the determinants of the monitoring level also affects autonomy level.

Although there is an array of empirical literature[14] assessing Prendergast (2002) propositions, tests on the Demougin and Fluet (2001) argument are pretty much scarce. Based on a sample of blue collar workers in Spanish industrial establishments we analyze the relationship between the characteristics of the job position (autonomy, monitoring and wages) and proxies of the exogenous variables of our model. Then, we provide further evidence on Prendergast (2002) and Demougin and Fluet (2001) arguments as well as evidence related to the novel relations predicted by the theoretical model.

Overall, the empirical evidence shows a strong relationship between the three endogenous variables analysed in the model. In fact, most of the evidence presented is consistent with the model predictions when there is (an assumed although unobserved) variability in monitoring costs across the firms of the sample.

The paper is organized as follows. In Section 2, we develop the model and state its empirical implications. In Section 3, we present the empirical strategy. In Section 4, we describe the data and the measures used in the estimations. In Section 5, we show the results of the estimations. In Section 6, we discuss the theoretical and empirical implications of the paper. Section 7 concludes.

2. The model

2.1. Model structure and main assumptions

"(Employees)may innovate and find new and unexpected ways to achieve high-level strategic objectives or identify variations in the strategy that open up new growth opportunities."(p.315)"Companies have been attempting to implement change for decades. Why do we advocate that change initiatives now be accompanied by a change in the measurement system to the Balanced Scorecard? Adapting the organization's measurement system to the change agenda is critical for success.(p.343) "The final linkage from high-level strategy to day-to-day actions occurs when companies link individuals' incentive and reward programs to the Balanced Scorecard" (p.253).

R.S. Kaplan andD.P. Norton, 2001, The Strategy-Focused Organization.

Even the assertions above, there are lots of firms that restrict the autonomy to their workers. We offer an explanation of why rational and well informed firms find optimal to restrict such

[14] See for example Nagar (2002), Foss and Laursen (2005), Ortega (2009), DeVaro and Kurtulus (2010), and Ben-Ner et al. (2012).

autonomy. Changes in monitoring implies direct and indirect (via compensation) costs that discourage firms to provide autonomy. The explanation follows much of the implicit and explicit assumptions inherent in the above quoted text.

We try to model some decisions that firms must make when designing the job position of workers who have better information on the effort exerted in and on the possibility of introducing innovations in the work. Theoretical models usually summarize the design of the workplace in the contract that companies offer to workers. In order to elicit workers' effort, agency models suggest to link compensation to measures related to performance (see Prendergast 1999 for a summary). The firm must link the compensation of the worker to the realized values of such measures (e.g. monitoring). On the other hand, Prendergast (2002) suggests that providing autonomy to the workers is a way for firms to take advantage of the worker's informational advantage when the profits associated with innovations in the workplace are private to the firm.

We argue that autonomy is the way companies allow employees to innovate, and that innovative tasks are more difficult to monitor than standard tasks. Firms take this into account when design the job position. The optimal contract has to take into account the interrelations among autonomy, monitoring and compensation. Next, we propose a model for analyzing such interrelations. The model builds on Demougin and Fluet (1998, 2001) who analyse the relationship between monitoring and compensation. In short, we model the relationship among the three variables of the organization design using a principal-agent model with moral hazard, which considers a risk neutral firm and a risk neutral agent protected with limited liability. Below, we define the assumptions of the model with special reference to the contractible and non-contractible variables as well as the preference structure of firms and workers. Figure 1 shows a timeline in which we summarize how states of nature are realized and the different decisions made after the contract has been offered by the principal and accepted by the agent.

Stage 0: *match between firms and workers*. The firm offers a contract to a specific worker to perform a job. Given the observable features of the job and the worker, it is possible for the firm to set the probability (λ) that a (cost-reducing or profitable) innovation in the workplace could be introduced. This probability is positive $\lambda>0$, common knowledge and a given parameter of the model. The contract sets the compensation of the worker contingent on the observable and verifiable variables of the model: the level of autonomy, the type of task performed (standard or innovative), the intensity of monitoring and the information collected by the monitoring activity. The worker can accept or reject the contract. If the worker accepts the contract in this stage, he can leave the firm in any of the next stages.

Stage 1: process innovation. If the worker accepts the contract he is placed into the job and observes whether a process innovation is available. As commented before, a priori (Stage 0) the probability that it occurs (λ) is common knowledge. In Stage 1 this state of nature is realized but this is observed just by the worker. The availability of an innovation itself is worker's private information. When the process innovation is not available (d = 0) is the only possible choice, otherwise the worker decides if he innovates or not. Performing a process innovation (d = 1) or not (d = 0) is observable and contractible.

The private information of the worker is about the feasibility of the innovation. The contract cannot force something like "if the innovation is feasible it must be adopted". But the contract can forbid process innovations, for example, by dismissing the worker if an innovation has been introduced. This situation is interpreted as "the firm does not provide autonomy to the worker". If the firm provides autonomy (a = 1) or not (a = 0) is something that has to be specified in the contract. So this variable is contractible. We assume that the introduction of a process innovation (d = 1) is always beneficial to the firm as it implies a reduction of production costs of B, which is a positive constant. This cost reduction is observable by the worker and the firm but no by third parties. Consequently, it is non-contractible.

Stage 2: production. After the decisions about delegating decision-making and introducing a process innovation, by the firm and the worker, respectively, are taken, the worker performs the job. As in standard agency models (Holmström 1979), there is asymmetric information about the worker's effort e. Firms can invest in monitoring mechanisms (like control systems of absenteeism or measures of productivity) for collecting public and contractible information related to the worker's effort. Then, the contract can link the workers' compensation to the information generated by the monitoring activity. The contract will also set the monitoring mechanism. The monitoring mechanism is characterized by the monitoring intensity (m) and the minimum level of investment or monitoring costs (M) needed to obtain such monitoring intensity. Both variables are considered contractible and are related by the following function: $M = k\kappa(m)$, where $k>0$ is an scalar that has been introduced to simplify the comparative statics. The function $(.)$ satisfies the usual properties, $(0) = 0$, it is twice differentiable and continuously increasing in m, and (1) °.

Intuitively, in the standard way to perform the job (i.e., when there is no innovation, d = 0), the principal can rely more easily on her own experience to infer the actual level of effort exerted. So given the same monitoring intensity (or costs), the quality of the information collected will be better when there is no innovation than when there is innovation. We will denote by θ to the quality (or precision) of the information available about the performance of

the worker, which will depend on the introduction of innovations (*d*) and on the monitoring intensity (*m*) in the following way:

$$\theta \equiv \gamma\,(1-d) + m$$

This variable is public information. The parameter γ is positive and reflects the advantage of eliciting performance' information when there is no innovation vis-à-vis when there is an innovation. This additive functional form of $\theta(d)$ implies that the informational advantage γ is independent of the level of monitoring intensity (and of costs).

Stage 3: execution of the contract. The worker exerts productive effort. The firm obtains an information set *I* (like concrete levels of absenteeism or productivity) related to the worker performance within the job. Also, the compensation contractually established is executed. The compensation established in the contract (in stage 0) is contingent on the following verifiable variables: autonomy (*a*), process innovation (d), monitoring intensity (*m*) and the information finally available (*I*). In the next section we will be more precise with regard to the meaning of information, its quality, and its consequences on the costs of the firm for which the company must incur to achieve the optimal level of effort.

Firms and workers preferences. The firm is risk neutral and offers a contract that minimizes its expected costs. The goal of the firm is to induce a certain level of effort $\hat{e}$ from the worker. The total costs of inducing this level of effort is the sum of expected incentives costs (i.e., expected wages) and monitoring costs:

$$TC(d) \equiv E(w(\hat{e})) + M(m),$$

As we will see, this term will depend on the introduction of an innovation (*d*).

The worker is also risk neutral but protected by limited liability[15]. His compensation is bounded from below by a minimun wage and has a reservation utility $\underline{u}$. The wages in the model refer to the difference between the wages finally paid and the minimum wage. For simplicity we assume that the minimum wage and reservation utility are zero. The worker always can leave the firm[16]. The worker maximizes his expected utility, i.e., he maximizes his

[15] Limited liability is a common justification for the use of efficiency wages or the existence of rents as incentive devices (see, for example the extensive literature presented by Saint-Paul 1996).
[16] This is typical in labor contracts observed in real life, especially when there is local information after signing the contract. The worker may quit given this local information.

expected wages minus the cost of effort, where the function $C(e)$ has the usual regular properties, $C(0) = 0, C'(e) > 0$, $C''(e) > 0 \quad e \quad [0, e], C(\bar{e}) = °$ and $C'(0) = 0$.

2.2. Information quality and the cost of incentives

Suppose that process innovations (*d*) and monitoring (*m*) have been already observed (i.e., the model is in stage 3). Under the assumptions above, Demougin and Fluet (1998) show that in order to elicit an effort $\hat{e}$ at the minimum expected cost, the firm can summarize all the information available about the worker performance (either observing actions or output or both) in a binary statistic $I = \{H, L\}$. The compensation of the worker will be based on this statistic: w_H and w_L, where the former indicates the wage paid when a high performance has been observed and the later the wage paid when a low performance has been observed. Since this information is imperfect, there is a positive probability of getting signal *H* given a certain level of effort *e*, $P(e) = \Pr[H / e] \quad (0,1)$.

Assumption 1: Let $P(e)$ be twice-continuously differentiable, with $P'(e) > 0$, such that *H* can be interpreted as favourable information about effort, and $P(e)'' \; 0$, for all $e \quad E = [0, \bar{e}] \quad [0,1]$.

With this assumption, and following Demougin and Fluet (2001), we can show that the pair of wages (w_H , w_l) that induce the optimal level of effort $\hat{e}$ at a minimum expected wages and that fulfil the incentive and participation constrains are $w_H = c\, C'(\hat{e}) / P'(\hat{e})$, $w_L = 0$.

Proof:

The problem to be solved is:

$$\underset{w_H, w_L}{Min} \; \mathrm{E}(\mathrm{w}(\hat{e})) = P(\hat{e}) w_K + (1 \quad P(\hat{e})) w_L$$

s.t.

$\hat{e} = \arg\max \; P(e) w_H + (1 \quad P(e)) w_L \quad C(e)$ (Incentive constraint)

$P(\hat{e})\, w_H + (1 \quad P(\hat{e}))\, w_L \quad C(\hat{e}) \geq 0$ (Participation constraint)

$w_H \geq 0$ and $w_L \geq 0$ (Limited liability contraint)

The incentive constraint being satisfied implies that $(w_H \quad w_L) = C'(\hat{e})/P'(\hat{e})$, so the lower w_L that satisfies the participation constraint is $w_L = C'(\hat{e})[P(\hat{e})/P'(\hat{e})] \quad cC(\hat{e})$, but it is negative given the convexity and concavity assumptions regarding *C(.)* and *P(.)* imply that $eC'(\hat{e})/C(\hat{e}) < 1$ " $eP'(e)/P(e)$. Then, the lowest pair of wages that also satisfy limited liability constraints will be: $w_H = cC'(\hat{e})/P'(\hat{e})$; $w_L = 0$.

Consequently the expected wage that elicits the optimal level of effort can be expressed as:

$$E(w(\hat{e})) = P(\hat{e})\, w_H = C'(\hat{e})\frac{P(\hat{e})}{P'(\hat{e})} \qquad / \quad ,$$

where $\hat{e}C'(\hat{e})$ and $\hat{e}P'(\hat{e})/P(\hat{e})$. Then, the expected utility of the worker will be:

$$E(u(\hat{e})) = — \; - \; C(\hat{e})$$

Given the assumptions about $P(e)$, it is easy to show that $[0,1]$. In fact, when increases it is always possible to implement the effort $\hat{e}$ and reduce the expected wages $E(w(\hat{e}))$. Then, Demougin and Fluet (2001) interpret the elasticity $= \hat{e}P'(\hat{e})/P(\hat{e})$ as a measure of the quality of the information set *I* about effort $\hat{e}$ provided by the monitoring system. This elasticity has the same interpretation in our model. Take note that $\hat{e}$ and $C(\hat{e})$ are given by assumption, so we are going to consider from now as a parameter and as a variable upon decision of the firm that characterizes the quality of the information provided by the monitoring system.

Following Demougin and Fluet (2001) we have assumed that the firm can choose at previous stages the quality of the monitoring system, , modifying the monitoring intensity. The greater the elasticity , the lower the expected wage needed to pay to the worker to obtain a particular effort level $\hat{e}$. So there is a potential conflict of interest here: workers might prefer a worse information quality while the firm would prefer a better one.

In order to analyze such decision we deviate from the cited authors in the following assumptions. At previous stages, the probability function will depend on the selected as well as $\hat{e}$, $P(\theta, \hat{e})$ where $= \hat{e}P'(\ ,\hat{e})/P(\ ,\hat{e})$. We introduce the next assumption for assuring that the impact of the quality of information on the expected wages $E(w(\hat{e}))$ has the same sign as in w_H, the one observed in empirical applications.

Assumption 2: Given the level of effort $\hat{e}$, the probability of getting signal *H* is greater when there is a greater quality of information , $\frac{\partial P(\ ,\hat{e})}{\partial} > 0$.

Furthermore, we have postulated that for obtaining the same level of information quality the monitoring intensity level (*m)* has to be higher for new tasks (*d*=1), $\theta \equiv \gamma(1- d) + m$. So the information quality finally established would be perfected determined by the monitoring level (*m*) and the introduction or not of an innovation (*d*).

2.3. The cost minimization problem

In this section, we state formally the complete problem of the firm. The worker has discretion to exert a certain level of (unobservable) effort, as standard in agency models, and perform process innovations (verifiable and contractible). The firm has to decide whether to provide autonomy or not. The optimal wages and monitoring will depend on the fact that an innovation has been introduced (d = 1) or not (d = 0) and autonomy has been provided (*a* = 1) or not (*a* = 0), i.e., $w_H(a, d)$, $w_L(a, d)$ and $m(a, d)$.

Let us to simplify the notation. Given our assumptions, when the firm centralizes decisions (*a* = 0) and an innovation is introduced (d = 1), the worker will be dismissed $w_H(0, 1) = w_L(0, 1) = m(0, 1) = 0$. Given that it is never in the interest of the worker to introduce an innovation (d = 1) when autonomy is not provided (*a* = 0), this case does not deserve more attention. Furthermore, note that when there are no innovations (d = 0), the optimal wages and monitoring will not depend of autonomy, $w_H(0, 0) = w_H(1, 0) = w_H(0)$; $w_L(0, 0) = w_L(1, 0) = w_L(0)$; $m(0, 0) = m(1, 0) = m(0)$. So, wages and monitoring will depend only on the decision about the introduction of an innovation $w_H(d), w_L(d)$ and $m(d)$, where $w_H(1), w_L(1)$ and $m(1)$ refers to the case in which $w_H(1,1)$, $w_L(1,1)$ and $m(1,1)$ (see Figure 2).

The firm solves the following cost minimization problem:

$$\underset{a,m(d),w_H(d),w_L(d)}{Min} E[TC(d)] = a(\ (TC(1)\ \ B) + (1\ \ )TC(0)) + (1\ \ a)TC(0)$$

s.t.

$$\hat{e} = \arg\max(P(e)w_H(d) + (1\ \ P(e))w_L(d)\ \ C(e)) \quad d = 0,1 \tag{1}$$

$$A[\ E[w(1)] + (1\ \ )E[w(0)]] + (1\ \ A)E[w(0)]\ \ C(\hat{e}) \geq 0\ \ A = 0,1 \tag{2}$$

$$E[w(d)] \quad C(\hat{e}) \geq 0, \quad d = 0,1 \tag{3}$$

$$w_H(d) \geq 0 \quad d = 0,1 \tag{4}$$

$$w_L(d) \geq 0 \quad d = 0,1 \tag{5}$$

$$P(\hat{e})w_H(1) + (1 \quad P(\hat{e}))w_L(1) \geq P(\hat{e})w_H(0) + (1 \quad P(\hat{e}))w_L(0) \tag{6}$$

Restrictions (1) and (2) are the standard incentive compatibility and participation constraints. Restriction (3) is the interim participation constraint which guarantees that it is in the best interest of the worker to continue in the firm after the private information is revealed but before exerting effort. Restrictions (4) and (5) are the limited liability (or minimum wage) constraints. Restriction (6) is the sorting condition which guarantees that it is in the best interest of the worker to introduce an innovation whenever possible. Remember also that $\theta \equiv \gamma(1- d) + m$.

2.4. The solution

2.4.1. The compensation structure

The objective function of the firm can be rewritten as:

$$E[TC(d)] = a \quad (TC(1) \quad TC(0) \quad B) + TC(0) = a \quad (\quad B) + TC(0)$$

Where is the firm total cost difference between introducing or not an innovation $TC(1) - TC(0)$ when the worker has exerted the optimal level of effort. Note that whenever B- > 0, autonomy will be provided. In any case (d=0 or d=1), the minimization of the objective function implies to minimize the cost functions TC(d) subject to restrictions 1 to 5. Above, we have seen that the set of wages that solves both minimization problems are $w_H(m(d)) = cC'(\hat{e}) / P'(\hat{e})$ and $w_L(m(d)) = 0$, the expected wage will be / at the optimum. So the optimal compensation depends on the innovation decision (d) because of $\theta \equiv \gamma (1- d) + m$.

2.4.2. The optimal monitoring level

The above results, jointly with $\theta \equiv \gamma (1- d) + m$, allow us to rewrite the total cost function TC(d) as:

$$TC(d) = \frac{}{(d)} + M(m(d)) = \frac{}{(1 \quad d) + m(d)} + M(m(d))$$

The optimal level of monitoring *m* will be the one that minimizes the function above. Proof 1 shows that the optimal *m* satisfies the following condition: $0 < m(1) \quad m(0) <$. This result has direct implications for the information quality, expected wages, and monitoring intensity.

Proposition 1: In the case in which an innovation is introduced (vis-à-vis the case in which no innovation is introduced):

a) The quality of the information will be lower $\left(\ (1) < \ (0) \right)$

b) The expected wages and w_H (*w* from now on) will be greater $\left(w(1) > w(0) \right)$

c) The monitoring intensity will be greater $\left(m(1) > m(0) \right)$

Proposition 1a and 1c follow from condition $0 < m(1) \quad m(0) <$. Note that the differences on information quality can be expressed as $(1) - \ (0) = m(1) \qquad m(0)$, which is negative given that $m(1) \quad m(0) <$. Proposition 1b is derived from proposition 1a. Remember that, from section 2.2, the expected wage of the agent is / . Assumption 2 extends the result to w_H. It is noteworthy that proposition 1b implies that Restriction 6 is not binding. When it is possible to introduce an innovation, Proposition 1b implies that it is in the best interest of the worker to introduce it.

2.4.3. The delegation decision

Proposition 1 implies that if innovations are introduced, the firm will pay higher expected wages and also will spend more on monitoring. Then, we should expect an increase in the firm total cost of inducing the optimal level of effort:

$$= TC(1) \quad TC(0) = \quad /(m(1)) + M(m(1)) \qquad /(\quad + m(0)) \quad M(m(0)) > 0$$

So, the net benefit of introducing an innovation, B-□, may not always be positive. In the cases in which it is negative, it will be optimal to forbid innovations by providing no autonomy (*a* = 0). Otherwise autonomy will be provided (*a* = 1), because it is expected that innovations will take place with probability $\lambda > 0$.

When autonomy is provided (a=1), the probability to observe $w(1)$ and $m(1)$ are equal to λ= Prob (d=1/ a = 1) otherwise (a=0) this probability is 0= Prob (d=1/ a = 0).

2.5. Comparative statics

In this section we analyze the effects of a variation of the exogenous variables of the model, B, , $\hat{e}$ and k, on the expected profits of providing autonomy, λ (B-), wages w(d) and monitoring intensity m(d). As the model has been stated, the probability of observing autonomy can be just 0 or 1 and the switch occurs at the point that the expected profits of providing autonomy are greater than zero, λ (B-)>0. In the next section we will relax this assumption as it is usually done in empirical applications. The expected profits of providing autonomy will be positively related with the probability of observing autonomy.

It is straightforward to check that an increase in the private profits of the firm (B) increases the expected profits of providing autonomy. No other variables are affected upon movements in B. The remaining exogenous variables affect the firm total cost difference between introducing or not an innovation , monitoring $m(d)$ and wages $w(d)$. The Propositions below summarize the effects. Appendix 2 provides the proofs.

Proposition 2. Ceteris paribus, an increase in the advantage of generating performance information, , does not affect either $m(1)$, $w(1)$ and TC(1). But when there is no innovation (d = 0), an increase in will decrease $m(0)$, $w(0)$, and TC(0). Consequently, there is an increase in and a reduction on the expected profits of providing autonomy, autonomy is less likely.

The intuition comes from the fact that the parameter measures the difference in the effectiveness of a given monitoring level depending on the fact that an innovation has been introduced or not. The greater this difference the greater the difference in monitoring, wages and total costs.

Proposition 3. Ceteris paribus, an increase in the level of effort required ($\hat{e}$) increase m(d) and w(d) for every d, d =0,1, as well as . So the expected profits of providing autonomy decrease, autonomy is less likely.

Intuitively, when more effort is needed[17] higher wages will be demanded by the worker. Furthermore, this implies an increase in the marginal reduction on the expected wages per additional unit of monitoring level, so that it is optimal for the firm to increase the monitoring intensity. Overall, these effects imply greater differences in the wages paid to workers in the case in which an innovation is introduced vis-à-vis the case in which no innovation is introduced.

Proposition 4. Ceteris paribus, an increase in the costs of providing a certain level of monitoring across firms, *k*, decrease *m*(d) and increases *w*(d) for every *d*, *d* =0,1, as well as . So the expected profits of providing autonomy decrease, autonomy is less likely.

When the cost of monitoring increases, it is optimal to the firm to reduce the level of monitoring. As a consequence, the quality of information decreases and hence the wages needed to obtain a certain level of effort increases. Overall, these effects imply greater differences in the monitoring costs borne by the firm in the case in which an innovation is introduced vis-à-vis the case in which no innovation is introduced.

The proofs are provided in Appendix 2.

3. Empirical approach

3.1. Hypotheses formulation

According to the model, the expected profits of autonomy for firm *i* will be $_i(B_i \quad _i)$. Autonomy can have other benefits in addition to the cost reduction analyzed in the model. We will make explicit some of them in the section 3.3. Let us now to summarize such benefits by the random variable ε. Autonomy will be granted by the firm *i* whenever $_i(B_i \quad _i) + \ _i > 0$. Then, the probability that a firm grants autonomy to their workers is given by Prob(ε > $_i(\ _i \quad B_i)$) = Prob (a_i=1/ X_i), where X is the set of exogenous variables in the model, X= (B, λ, , $\hat{e}$, *k*). When we can control for all the exogenous variables in the model, from Proposition 1, we will expect that the average wages and monitoring levels of those firms with autonomy (*a*=1) will be greater:

E(*m*/*X*,*a*) = (*w*(d=1/ X_{1i}) λ*a* + (1-λ*a*) *w* (d=0/ X_{1i})

E(*w*/ *X*,*a*) = (*w*(d=1/ X_{1i}) λ*a* + (1-λ*a*) *w* (d=0/ X_{1i}),

[17] If we define C = *g*C(e) where *g*>0 is an scalar, it is easy to check that the results of the static comparative about *c* are the same that those summarized in Proposition 3 referred to $\hat{e}$.

where X_1= ($\hat{e}$, k).

As in most of the empirical studies, in the best of the cases there are just proxies for some of those exogenous variables. We argue that this is the case for λ and B, and postulate the next two hypotheses.

Let us to assume that $(B_i \quad _i) > 0$, on average the private profits of introducing an innovation are higher than the differences in the costs borne by a firm between introducing or not an innovation. In that case, the probability of granting autonomy will be positively related to the likelihood of introducing an innovation $_i$. This probability $_i$ will depend on the capabilities of the worker and the characteristics of the job. One characteristic that favors autonomy is the degree of complexity of the job (Prendergast 2002, Raith 2008, Ben-Ner et al. 2012). The idea is that when the task is complex, the worker, who is closer to the production process, is in a better position than the supervisor or firm to determine how a task should be done or which task should be performed, in other words, the worker is in a better position to introduce a cost-reducing innovation.

Hypothesis 1: The likelihood that a company grants autonomy to the worker increases with the complexity of the job and the ability of the worker to introduce an innovation in the workplace.

We postulate that the private profits *B* of the firm are negatively related with the presence of unions. The private profits of the firm are those not negotiated and therefore not shared with the workers. An increase in the presence of unions can be interpreted as a reduction in the private profits of the firm, or in other words, as an increase of the profits to be negotiated or rents extraction by the unions. Unions could have resources (e.g. experience or time) for information collection that can improve the access to information and make more verifiable the private profits of the firm (for example, a careful collection of financial information could be showed as evidence in court). Given the negative relationship between unions and *B* from the model we expect a negative relation between autonomy and the power of workers.

Hypothesis 2: The likelihood that a firm grants autonomy to the workers diminishes with the power of the workers.

It could be argued that unions also can demand a higher minimun wage. As stated the model, the variable wage refers to differences between the wage finnally paid and the minimum wage.

When this minimum wage increase the firm will end up paying higher expected salaries. However, it has no implications for the other variables or relations stated in the paper.

For the remaining exogenous variables X_1= (, $\hat{e}$, k) we do not have proxies. So the relationship between autonomy ($_i$ for being more precise) and the other endogenous variables of the organizational design, namely, monitoring and wages will depend on the unobserved variability of those exogenous variables. If this unobserved variability is low, it will predominate the relationships postulated by Proposition 1. Otherwise can predominate the remaining propositions. When the effect of the unobserved variability is important and comes from , it will predominate Proposition 2, when it comes from $\hat{e}$ Proposition 3 and when it comes from k Proposition 4. Which of these effects prevails is an empirical issue. Just for expositional purposes let us to assume that the difference in the costs of introducing or not an innovation $_i$, comes from differences in the monitoring costs across firms k. Then, according to Proposition 4 we will expect that:

Hypothesis 3: Monitoring is positively related to autonomy.

Hypothesis 4: Wages are negatively related to autonomy.

Hypothesis 5: Wages are negatively related to monitoring.

Hypotheses are sorted by the number of propositions which supported them. For example, Hypothesis 3 also holds even when there is no variability in $_i$ (Proposition 1). This hypothesis also comes when the variation of $_i$ is just caused by the variation of the advantage of generating performance information when no innovation occurs vis-à-vis when an innovation occurs, (Proposition 2). Only Proposition 3 establishes an inverse relation to the one stated in Hypothesis 3. Hypothesis 4 also holds when the variability in $_i$ just comes from a variation in the level of effort required, $\hat{e}$ (Proposition 3). Proposition 1 and 2 state an inverse relation to the one stated by Hypothesis 4. Hypothesis 5 comes exclusively from Proposition 4. The rest of propositions state an inverse relation to the one stated in Hypothesis 5.

3.2. Econometric approach

The endogenous variables of the model are autonomy (a), monitoring (m) and wages (w). As proxies of the exogenous variables of the model we suggested to use measures of worker

capabilities (*c*), job complexity (*jc*) and unions power (*u)*. As usual in empirical literature we are going to control for a set of *J* variables x_j ($j = 1 \ldots J$) not included in the theoretical model, but considered in other theoretical and empirical papers as determinants of the endogenous variables of the model. The theoretical model proposed establishes the level of autonomy in the contract. The contract also establishes the monitoring and wages levels according with the future realization of the state variables, i.e. the possibility of introducing an innovation. Then, what we will observe is that first it is established autonomy, then levels of monitoring depending on autonomy and finally wages depending on levels of autonomy and monitoring intensity. To take account of those facts we propose to estimate the following simultaneous linear equation system, as a benchmark model:

$$a_i = {}_1 jc_i + {}_2 wc_i + {}_3 u_i + \sum_{j=1}^{J} {}_j x_{ji} + {}_{a,i} \qquad [7]$$

$$m_i = {}_1 a_i + {}_2 jc_i + {}_3 wc_i + {}_4 u_i + \sum_{j=1}^{J} {}_j x_{ji} + {}_{m,i} \qquad [8]$$

$$w_i = {}_1 a_i + {}_2 m_i + {}_3 jc_i + {}_4 wc_i + {}_5 u_i + \sum_{j=1}^{J} {}_j x_{ji} + {}_{w,i}, \qquad [9]$$

where ${}_h$ is the error term of the equation in which the dependent variable is *h, h* $\{a, m, w\}$. The error term are distributed as Trivariate normal with mean zero, unit variance and correlation coefficient ${}_{hl}$ between ${}_h$ and ${}_l$, where *l* $\{a, m, w\}$ and ${}_{hl} = 1$ when *h* = *l*. So these variables could be affected by the same unobservable variables. In summary we develop a full information instrumental variables model that it takes into account for the possible correlation between disturbances and regressors and the possible correlation between the disturbances of the three equations (Hausman 1975). The parameters to be estimated are ${}_1, {}_2, {}_1, {}_2, {}_3, {}_1, {}_2, {}_3, {}_4, {}_1, {}_1, {}_1$ and ${}_{hl}$. Hypothesis 1 predicts ${}_1 > 0$ and ${}_2 > 0$. Hypotheses 2, 3, 4 and 5 predict ${}_3 < 0$, ${}_1 > 0$, ${}_1 < 0$ and ${}_2 < 0$, respectively.

3.3. Control variables

For testing the hypotheses above we will control for some specific characteristic of the firm or of the environment in which the firm operate that could influence the decisions on the level of autonomy, monitoring and/or wages. In concrete, we control for environmental uncertainty,

competition in the product market, job stability, the size of the establishment, the number of plants belonging to the same headquarters, and the industry to which the establishment belongs.

The literature offers arguments supporting a positive association between autonomy and the degree of environmental uncertainty. In highly volatile environments, the cost for firms to acquire information for operational decisions is high; consequently, the firms delegate those decisions to the workers who have closer access to this information (Nagar 2002)[18].

On the other hand, the literature on wage determination suggests a negative association between the level of wages and competition in the product market. The idea underlying this assertion is that product market rents (obtained in non-competitive setups) tend to be shared with the workers. The empirical literature provides evidence supporting this prediction (Nickell, Vainomiaki and Wadhwani 1993). The role of product market competition on the provision of incentives is also a topic that has occupied the attention of scholars. Most of the literature asserts that in highly competitive environments, firms provide stronger incentives in order to enhance productive efficiency (Harth 1983, Raith 2003). However, there are also arguments supporting the idea that competition in the product market has no significant (Jensen and Meckling 1976) or even negative (Schmidt 1997) effects on incentives. Jensen and Meckling argue that slack exists as much in monopolies as it does in competitive firms; there is thus no reason to offer different incentive schemes in each of these market structures. Schmidt suggests that the reduction in profits caused by high competition could lead to a decrease in the profitability of cost reduction and therefore on the value of effort.

Job stability could enhance the accumulation of experience and knowledge by the part of the worker and consequently we would expect that this variable has a positive effect on autonomy (Adams 2002). Empirical literature provides support for this prediction (Neal 1993, Osterman 1994). The turnover version of the efficiency wage theory suggests a negative correlation between the costs of turnover (job stability) and the level of wages (Leonard 1987, Yang 2008). In the empirical literature so far analyzed, the impact of job stability on wages is not significant (Altonji and Shakotko 1985, Mahmood Arai 1994, 2003). With regard to the relationship between job stability and monitoring, we are not aware about theoretical rationalizations about that association. Empirical research has typically found a negative correlation between the degree to which firms monitor workers and job stability (Gordon 1994, Osterman 1994).

The inclusion of variables related to the size of the firm or the business unit is standard in the literature for their effects on all organization design choices (Nagar 2002). Smaller establishments could have fewer resources to invest in human resource innovations, such as

[18] There is a large theoretical and empirical literature that has study the relationship between incentives and uncertainty. Incentives in those studies are in the form of pay-for-performance. Given that in our model the worker is protected by limited liability uncertainty does not affect the type of incentives studied in this paper.

delegation of decision-making; however, they also could be more agile and more likely to adopt new production techniques than large establishments (Osterman 1994). The empirical literature provides instances of a non-significant association between size and autonomy (Adams 2002, Nagar 2002 and Devaro and Kurtulos 2010) as well as of a positive association (Foss and Laursen (2005). The use of size in empirical studies concerned about monitoring and wages is a common practice. There is evidence of a negative correlation between size and monitoring (Osterman 1994). On the other hand, most empirical studies provide evidence of a positive association between the size of the firm and the level of wages (Rebitzer 1995, Mahmood Arai 1994, 2003, Ewing and Wunnava 2004).

We also control for the existence of additional plants belonging to the same headquarters as well as by industry. Regarding the former, the decisions related to organization design could be made by the headquarters instead of by the establishment (Foss and Laursen 2005). Controlling by industry is also a common practice in the related literature (Devaro and Kurtulus 2010, Ben-Ner, Kong and Lluis 2012). The industry type has particular characteristics, in terms of technology or capital intensity (Foss and Laursen 2005), with possible effects on the variables of the organization design.

4. Data

The data for testing the hypotheses is taken from a survey[19] designed to obtain information on human resources and work organization practices of Spanish industrial establishments. The original questionnaire was fine-tuned with a pre-test sample of 15 plant directors. The use of subjective assessments by the interviewee on various scales is a common practice in the empirical literature concerned in the analysis of human resources and work organization practices. This approach allows for the possibility of getting information on some concepts even if objective information is not available.

The target group was manufacturing establishments in continental[20] Spain with 50 or more workers and whose economic activity is included in one of the 13 manufacturer sectors of the NACE classification for 1993.[21] The unit of observation is the establishment, not the firm as a whole. The firms or manufacturing plants sample was identified in CAMERDATA (the database of the chamber of commerce of Spain) and comprised of 3000 plants. A stratified

[19] The survey was jointly designed by a group of researchers from the Universitat Autònoma de Barcelona, Universitat Illes Balears, Universidad Pública de Navarra, and Universidad de Zaragoza. The questions that demonstrate the variables can be found in Appendix 4. The complete questionnaire can be provided under request.

[20] Due to budget restrictions the Canarian and Balears islands as well as the two smallest (in terms of per capita GDP) Autonomous Communities, Castilla La Mancha and Extremadura, were excluded from the sample.

[21] The European Community statistical classification of economic activities.

random sample, guaranteeing stratums by size and industrial sector, based on 402 (13.5% of the target group) interviews was finally achieved. The questionnaire forms were filled out between December 2007 and April 2008, using personal interviews approximately 60 minutes long by a specialized firm, in most cases, with the directors or with the production or human resources managers of the plants.[22] Because some questionnaires were incomplete, we ended up with 358 observations.

Table 1 shows the frequency distribution, means and standard deviations of the variables used in the estimations. Most of them have been constructed on the basis of the interviewed degree of agreement on a certain assertion. The degree of agreement is measured in a Likert scale from 1 to 5.

The dependent variables defined in the theoretical section have been measured in the following way:

Autonomy. The survey provides a question that measures the level of autonomy (when, how and in which order a task has to be implemented) that the blue collar worker has when performing his job. The answers were ranked in a Likert scale from 1 to 5, where 1 meant that the worker's autonomy was null or very low and 5 meant that it is very high. The distribution of plants for the five categories is 15.08, 24.02, 53.63, 6.70 and 0.56 percent, respectively. In this case, we create the 5-categories ordinal variable *Autonomy*.

Monitoring. The question that explores our measure of monitoring asks the interviewee to evaluate the extent to which workers are supervised while performing their jobs. The answers are ranked in a Likert scale from 1 to 5, where 1 means that the interviewee totally disagrees, and 5 means that she totally agrees with the statement. The distribution of plants for the five categories is 2.79, 17.60, 32.40, 41.62 and 5.59 percent, respectively. Based on this information we create the 5-categories ordinal variable *Monitoring*.

Wages. The survey provides a question that asks the interviewee to assess the level of wages of their blue collar workers relative to the level of wages of the blue collar workers of the competing firms in five categories (1. very inferior, 2. inferior, 3. the same, 4. superior, 5. very superior). The distribution of plants for the five categories is 0, 3.05, 62.34, 32.32 and 2.29 percent, respectively. In order to resemble the theoretical concept of efficiency wages we gather together categories 1, 2 and 3 and categories 4 and 5 for creating the dummy variable *Wages*,

[22] The status of the interviewer was required by the questionnaire. The results presented are not sensitive to this status. As the rest of results commented along the paper but not showed, they are available upon request.

whose value of zero (former categories 1, 2 and 3) is interpreted as the pay of no efficiency wages and 1 (former categories 4 and 5) as the pay of efficiency wages (rents).

As the dependent variables are categorical variables, Equations [7], [8], [9] can be estimated as ordered probit models, where the dependent variables are latent variables. The proper use of autonomy and monitoring as explanatory variables in equations [8] and [9] implies including four dummies in both of these estimations. A problem with this procedure is that some of the categories have very few observations, causing collinearity in the estimations.

In order to avoid such problems, and for the sake of expositional simplicity, we will use only one dummy variable for each independent variable. This implies the selection of a category cutoff. Some studies (e.g. Foss and Laursen 2005) have used the original middle category (value 3 in our case) as the category cutoff. This procedure assumes that the distribution of the categories of the Likert scales is the same for all the variables. However, the application of this procedure to our data provides highly skewed distributions of some variables. This fact casts some doubts on the assumption that all the variables follow the same distribution. Then, we follow an alternative procedure used in the literature (e.g. Devaro and Kurtulus 2010), which is some kind of standardization. We choose as the cutoff the category closest to the median of the variable distribution. So we proceeded to group the adjacent original categories to finally obtain two categories with the most egalitarian distribution possible of observations. Applying this method, the dummy associated with autonomy takes the value 1 if the plant is in one of the three last categories while the dummy associated with monitoring takes the value 1 when the plant is in one of the two last categories. This procedure allows us also to estimate equations [7] and [8] as probit probability models.

The independent variables have been measured in the following way:

Job complexity. With regard to job complexity, the questionnaire contains 6 statements related to the degree of complexity of the production process. In concrete, they refer to the number of products produced, to the modifications made to the products, and to the product turnover, which presumably increase the number of activities performed by the worker, and therefore resemble the concept of complexity considered by Prendergast (2002).[23] For

[23] Besides the 6 statements reported in appendix 1 -from which we construct the variable Job Complexity- the original survey contains 6 additional statements that could be related to complexity of the job. When we applied the principal component factor analysis to the full group (of 12 statements) it resulted in three indexes, one related to the number of products produced, and to the introduction of new products and changes in existing products (statements 1, 2, 3, 5, 6 and 9 –that are the ones reported in appendix 1). Another was related to the intensity of products' changes (statements 7, 10 and 11) and a third one related to the production process sensitivity upon products' changes (statements 4, 8 and 12). The Cronbach alphas for these factors are 0.75, 0.59 and 0.60, respectively. Because the reliability of the later two

summarizing this information we applied the principal component factor analysis. The application of this technique resulted in one factor with a Cronbach alpha of 0.75. This index will be considered in the analysis as our measure of *Job complexity*.

Worker capabilities. A variable typically considered in empirical studies is the level of skills of the workers. A question of the questionnaire asks the interviewee about the level of qualification required for the plant's blue collar workers to perform the job. The answers fall on a Likert scale from 1 to 5, where 1 means that it is very low and 5 means that it is very high. The distribution of plants for the five categories is 2.23, 17.60, 62.29, 17.32 and 0.56 percent, respectively. The original middle category (value 3) concentrated more than 50 percent of the observations. In these cases, we consider three categories (two dummy variables) but only if each resulting category had at least the 10 percent of the observations. In this instance, we have gathered together categories 1 and 2, and 4 and 5 and created three dummy variables: *Low*, *Middle* and *High qualification requirements*.

There is also a question that asks the interviewee if the selection criterion of the plant takes into consideration the learning capabilities, interpersonal abilities, cultural adjustment, attitudes, and even the personalities of the workers. The answers are ranked in a Likert scale from 1 to 5, where 1 means that the interviewee totally disagrees and 5 that she totally agrees. The distribution of plants for the five categories is 1.68, 6.42, 17.32, 68.72 and 5.87 percent, respectively. We dichotomized this distribution to create the dummy variable *Soft skill requirements,* which takes the value of zero to represent a low level, when the original variable is 1, 2 or 3, and the value of 1 represents a high level otherwise.

Ceteris paribus, one would expect a positive relationship between the level of skills required and the probability of introducing an innovation in the workplace.

Unions. To capture the concept of workers power, the survey provides two questions. One of them asks if there is a specific collective agreement that regulates the labor conditions of the blue collar workers. Based on this question, we create the dichotomous variable *Collective agreement*. The other question asks the interviewee to assess the degree of influence of unions on blue collar workers. This variable has been dichotomized following the criterion above. We call this variable *Union influence.*

Control variables. Following the grouping method described above, we create most of the control variables. For instance, the variables*, Market competition, Job stability* are dummies. The level of Uncertainty is captured by two dummies, three categories, low, middle and high.

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factors measured by the Cronbach alpha does not pass the standard 0.70 threshold, we will consider in the analysis only the first index as our measure of job complexity.

The variable *Multi-plant* comes in a binary form from the survey. The *Size* of the plant is measured as the number of workers. Lastly, in order to understand the effects of the firm's technology, we classified the industrial sectors according to their technological intensity in two categories creating the dichotomous variable *Technological intensity*.

5. Results

5.1. Main results

For providing the estimations we initially assume $_{kl} = 0$ and estimate equations [7], [8] and [9] as Probit probability models. The results are shown in Table 2. In all cases, the likelihood ratio rejects at the 1 percent level the null hypothesis that all the explanatory variables are zero.

The first column of Table 2 presents the results of the estimation of the *Autonomy* equation. The results provide support for Hypothesis 1. The coefficients of the variables *Soft skill requirements, Middle qualification requirements* and *Job complexity* are positive and statistically significantly different from zero, the last one at the 3 percent level. Firms with *Soft skill requirements* or *Middle qualification requirements* are more likely to provide autonomy in .23% and .26% than firms without *Soft skill requirements* or *Middle qualification requirements*, respectively. An increase of 1% in *Job complexity* increases the likelihood of providing *Autonomy* in 06%. The coefficient of *High Qualification requirements* although positive it is statistically insignificant. The estimation also provides support for Hypothesis 2. The coefficient of the variable *Collective agreement* is negative and statistically significant at the 1 percent level. Firms with collective agreements are less likely to provide autonomy in .32%. The second variable associated with the workers power, *Union influence,* although negative is only statistically significant at the 17 percent. The variables related to uncertainty are positive and statistically significant at the 10% level. Firms with *Middle uncertainty* or *High uncertainty* are more likely to provide autonomy in .14% or .15%, respectively, than firms without *Middle uncertainty* or *High uncertainty*. The remaining variables are statistically insignificant.

The second column of Table 2 presents the results of the estimation of the *Monitoring* equation. Hypothesis 3 receives strong support. The coefficient of the variable *Autonomy* is positive and statistically different from zero at the 1 percent level. Firms that provide *Autonomy* are morel likely to supervise in .20% than firms with no autonomy. In this estimation, there are three additional variables that play a role in determining the extent of workers supervision, *Collective agreement*, *Job stability* and *Soft skill requirements*. The coefficient of the variable *Collective agreement* is statistically significantly different from zero at the 4 percent level, the coefficient of the variable *Job stability* is statistically significant at the 7 percent level and the

coefficient of the variable *Soft skills requirements* is significant at the 3 percent level. Firms with *Collective agreements* and *Job stability* are less likely to supervise in .12% and 2.6%, respectively, than firms without collective agreements. Firms with *Soft skills requirements* are more likely to supervise in .15% than firms without soft skill requirements.

The third column of Table 2 presents the results of the estimation of the *Wages* equation. Hypothesis 4 receives support. The coefficient of the variable *Autonomy* is negative and statistically significantly different from zero at the 9 percent level. Firms with autonomy are less likely to pay efficiency wages in .10% than firms with no autonomy. Hypothesis 5 also receives strong support. The coefficient of the variable *Monitoring* is negative and statistically different from zero at the 3 percent level. Firms that supervise are less like to pay efficiency wages in .12% than firms that do not supervise. The results of the estimation also show the importance of two independent variables. The coefficients of the variables *Collective agreement* and *Unions influence* are both positive and statistically significantly different from zero at the 3 percent level. Firms with *Collective agreements* and *Unions influence* are more likely to pay *Efficiency wages* in .12% than firms without collective agreements.

5.2. Robustness

For robustness, we do not impose any restriction on the parameter values (i.e., $_{kl} = 0$ does not hold any longer) and estimate equations [7], [8] and [9] jointly, as a Trivariate probit probability model. The results are shown in Table 3. The most striking differences are in the coefficients of the variable *Autonomy* in the Monitoring and Wages equations. In the Monitoring equation, though still positive, the variable *Autonomy* is no longer statistically significant at conventional levels of significance. In the Wage equation, though it keeps its negative sign, the variable *Autonomy* is statistically significant only at the 20 percent level. In all the other cases, the results are fairly consistent. The estimation of the trivariate probit probability model also shows that the correlation coefficients $_{kl}$ are statistically insignificant (it was significant only at 58 percent level). Precisely, $_{kl} = 0$ is the assumption made in the estimations presented in Table 2. So we cannot reject that those are the more appropriate econometric models.

6. Discussion and Conclusions

We argue that the job design of the firms include decisions about autonomy, monitoring and wages and those decisions are interrelated. In fact, the evidence presented shows statistically significant relationships among these variables. We develop a theoretical comprehensive model

for understanding such relationships and their main determinant variables. As Autonomy we understand that firms let workers to introduce changes or innovations in the workplace. Such innovations can generate some profits to the firm but have costs. In particular, such innovations increase the monitoring investments of the firm and the wages in order to induce effort. We show that when the real feasibility of introducing an innovation is private information of the worker while some of the innovation profits are private of the firm, it is optimal for the firm to provide autonomy when the expected private profits overcome costs. Otherwise the firm will centralize decisions.

The expected private profits will increase with the "a priori" probability that the innovation will be finally introduced. Such probability is conditional to the job and worker features. Among those that we have measured are the job complexity and worker's capabilities. The empirical evidence shows its positive relationship with autonomy (Hypothesis 1). In fact, after controlling for autonomy, they do not have any impact on wages and monitoring.

The private profits of an innovation will be more difficult to measure. We have argued that their volume could be inversely related with the union presence or power. The evidence supports this negative relationship between autonomy and union presence or weight (Hypothesis 2). But in this case we also find that unions will affect the other variables of the job position design in favour of the workers, increasing wages and reducing monitoring. So although in the model the market power of the workers is null, more realistic extensions can take into account for the possible negotiations between workers and firms and their impact on organizational decisions.

Furthermore, the model explores the increases on monitoring and incentive costs that an introduction of an innovation causes. Such increases depend on variables difficult to measure, as the workers' preferences for working, the monitoring comparative advantage of the current task, or the economic cost of increasing monitoring. So we cannot control for the variability of such features among the firms in the sample, but we can make predictions among the relationship between autonomy, monitoring and wages if they occur. Take note, that even when the variability is null we also expect some relationships between the cited variables (Proposition 1). Overall the empirical evidence shows a positive relationship between autonomy and monitoring (Hypothesis 3) and negative relationships between autonomy and wages (Hypothesis 4) and wages and monitoring (Hypothesis 5). This evidence is consistent with the fact that among the unobserved variables the one with more variability across the firms of the sample is the cost of increasing monitoring. In fact, the hypotheses are order by the number of unobserved variables which variability supports them. The evidence show that the statistical significance of the relationships proposed also follows this order.

7. Limitations

Further work is needed for covering some of the paper limitations. First, empirical work is needed for analyzing which of the relationships detected in this paper are reproduced in other institutional contexts. Second, alternative theoretical justifications should be provided to the results found. Third, tests of such alternative justifications will improve measures of the model variables, mostly of the variables of our model unobserved in our data sample are required for strengthening the evidence around the model.

Appendix 1: Figures

Figure 1: Model Time-line

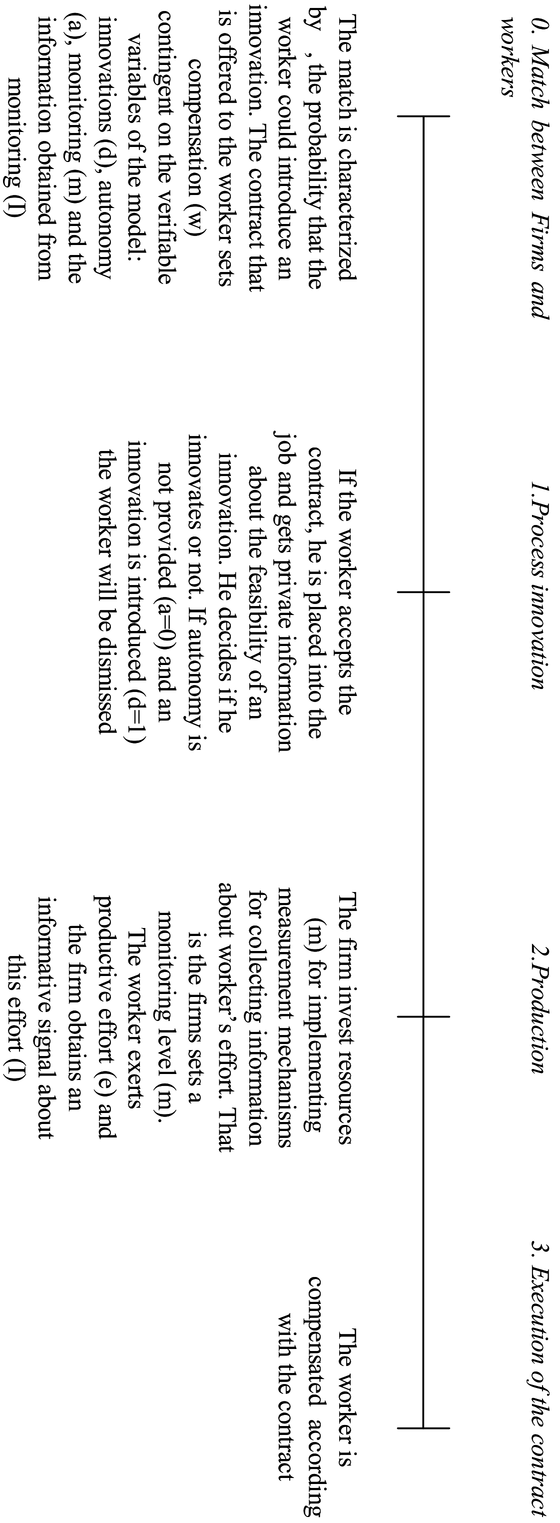
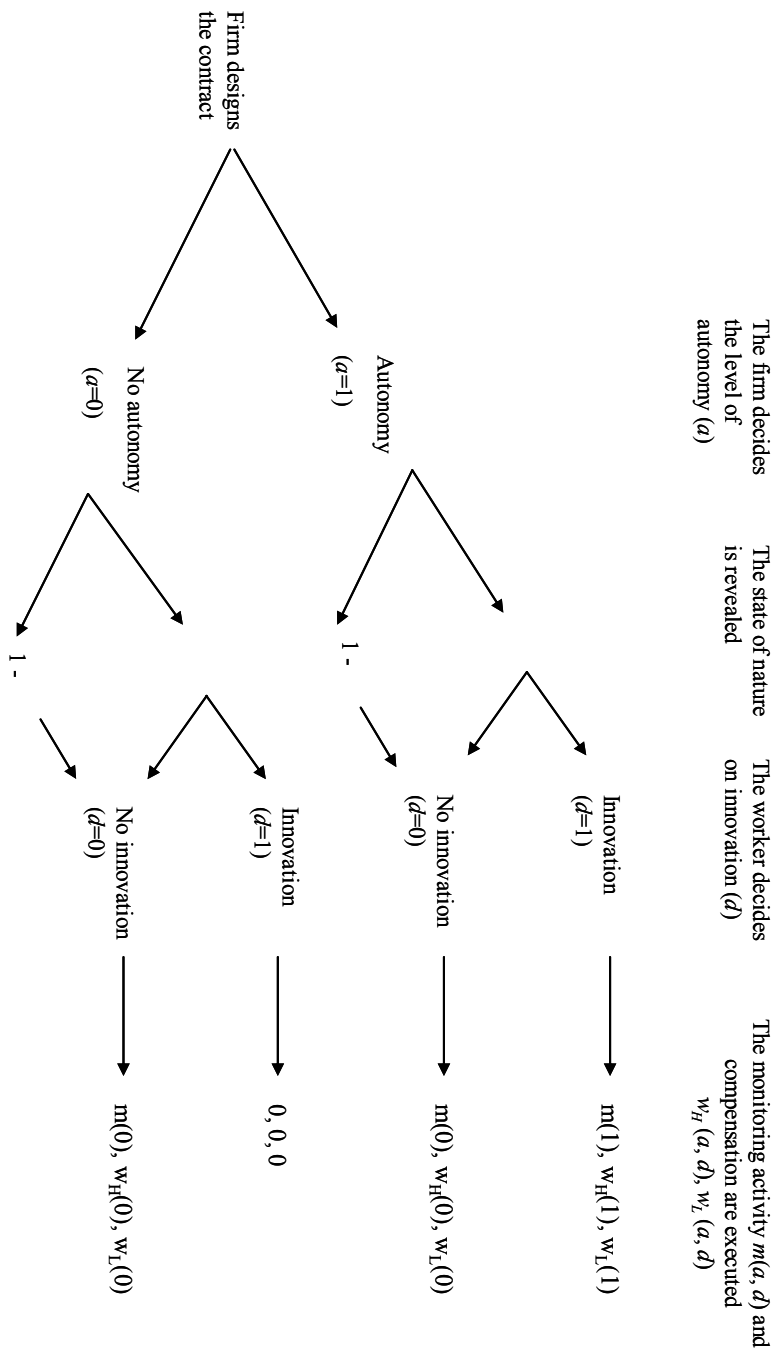


Figure 2: Details of stages 0 and 1



Appendix 2: Proofs

Proof 1: Optimal level of monitoring

The optimal monitoring intensity is obtained by solving:

$$\underset{m}{Min}\ TC(d) = \frac{}{(1 \quad d) + m} + k \quad (m)$$

The first order condition for *m* is:

$$\frac{}{(\ (1 \quad d) + m)^2} + k \quad '(m) = 0$$

Given the assumptions about the monitoring cost function, the second order conditions for a minimum are satisfied. The first order condition equation could have different solutions for the optimal *m* depending on *d*. Let us to define n = $m(d=1) \quad m(d=0)$ as the difference in the solution when an innovation has been introduced and when this is not the case. The first order condition imply that: $'(m(d=0))(\ + m(d=0))^2 = \ / k = \ '(m(d=1))(m(d=1))^2$. Consequently:

$$\frac{(\ + m(d=1) \quad n)^2}{(m(d=1))^2} = \frac{'(m(d=1))}{'(m(d=1) \quad n)}$$

Given that $''() > 0$, when n= γ,

$$\frac{(\ + m(d=1) \quad n)^2}{(m(d=1))^2} = 1 < \frac{'(m(d=1))}{'(m(d=1) \quad n)}$$

whereas when n= 0, $\frac{(\ + m(d=1) \quad n)^2}{(m(d=1))^2} > 1 = \frac{'(m(d=1))}{'(m(d=1) \quad n)}$.

Consequently, 0< n< γ. Q.E.D.

Proof 2: Comparative statics

Note that the first order condition for the monitoring intensity m is: $= M'(m)(\ (1\ \ d) + m)^2$, while the first order condition for expected wages (E(w($\hat{e}$)) = w) is $w(\ (1\ \ d) + m) =\ \ $. Then, Δ can be written as:

$$\Delta = TC(1) - TC(0) = \ \ (\frac{1}{m(0) + n}\ \ \frac{1}{m(0) + }) + M(m(0) + n)\ - M(\ m(0)),$$

where $m(1)$-$m(0) = n < \delta$.

Proposition 2: Changes in

When $d = 1$, the first order conditions for the monitoring intensity and expected wages do not suffer changes. But, when d=0, we have that:

$$0 = \partial\ \ /\partial\ \ = M''(m)(\ \ + m)^2\ \partial m/\partial\ \ + M'(m)2(\ \ + m)(1 + \partial m/\partial\ \ ) \text{ and}$$
$$0 = \partial\ \ /\partial\ \ = (\ \ + m)\ \partial w/\partial\ \ + w(1 + \partial m/\partial\ \ )$$

So:

$$-1 < \partial m/\partial\ \ = \frac{1}{1 + \frac{M''(m)(\ \ + m)}{2M'(m)}} < 0 \text{ and}$$

$$\partial w/\partial\ \ = \ \ \frac{w}{(\ \ + m)}(1 + \partial m/\partial\ \ ) < 0$$

$$\partial TC(0)/\partial\ \ = \ \ \frac{1}{(\ \ + m(0))^2} < 0$$

Increases in reduces $w(0)$, $m(0)$ and TC(0). Then, it follows that: $\frac{\partial}{\partial} > 0$ Q.E.D.

Proposition 3: Changes in $\hat{e}$ (or α)

The analysis is done for α. Given that $\partial \quad /\partial \hat{e} = C(\hat{e}) + \hat{e}C'(\hat{e}) > 0$, the signs are independent of the variable used.

For $\partial m/\partial \quad$ and $\partial w/\partial \quad$, and for a given *d*, it must be satisfied:

$1 = M''(m)(\ (1 \quad d) + m)^2\ \partial m/\partial \quad + M'(m)2(\ (1 \quad d) + m)\ \partial m/\partial \quad$ and

$1 = (\ (1 \quad d) + m)\ \partial w/\partial \quad + w(\partial m/\partial \quad)$, respectively

So:

and $\partial m/\partial \quad = \dfrac{1}{(M''(m)(\ (1 \quad d) + m)^2 + M'(m)2(\ (1 \quad d) + m)} = \dfrac{1}{M''(m)(\ (1 \quad d) + m)^2 + 2w} > 0$

$\partial w/\partial \quad = \dfrac{1 \quad w(\partial m/\partial \quad)}{(\ (1 \quad d) + m)} > 0$, given that: $1 > w(\partial m/\partial \quad) = \dfrac{1}{M''(m)(\ (1 \quad d) + m)^2 + 2}$

For $\partial \quad /\partial \quad$, given that $(\dfrac{1}{m(0) + n} \quad \dfrac{1}{m(0) +}) > 0$, the effect is positive.

Note that the indirect effect on *w* and *m* cancels out given the first order conditions (by the envelope theorem).

Proposition 4: Changes in *k*.

For $\partial m / \partial k$ and $\partial w / \partial k$, and for a given *d*, it must be satisfied that:

and $0 = \partial \quad /\partial k = \ '(m)(\ (1 \quad d) + m)^2 + k(\ ''(m)(\ (1 \quad d) + m)^2 + \ '(m)2(\ (1 \quad d) + m))(\partial m/\partial k)$

$0 = \partial \quad /\partial k = (\ (1 \quad d) + m)\ \partial w/\partial k + w\partial m/\partial k$

So:

$\partial m/\partial k = \quad \dfrac{'(m)(\ (1 \quad d) + m)}{k(\ ''(m)(\ (1 \quad d) + m) + 2\ '(m))} < 0$ and

$\partial w/\partial k = \quad w\dfrac{\partial m/\partial k}{(1 \quad d) + m} = \dfrac{w\ '(m)}{k(\ ''(m)(\ (1 \quad d) + m) + 2\ '(m))} > 0$

$$\partial \ / \partial k = \partial((M(m(0)+n) - M(m(0)))/\partial k = \kappa(m(0)+n) - \kappa(m(0) > 0$$

Note that, by the envelope theorem, the indirect effects cancels out by the same reason that in the former proposition.

Tables

Table 1
Frequency distribution and descriptive statistics

Variable	Categories	Percentage	Mean	S.d.
Wages	Likert Scale		3.34	.56
	Low Wages	65.08		
	High Wages	34.92		
Monitoring	Likert Scale		3.30	.92
	Low Monitoring	52.79		
	High Monitoring	47.21		
Autonomy	Likert Scale		2.54	.85
	Low Autonomy	39.1		
	High Autonomy	60.89		
Job complexity	Factor	100	0	1
Collective agreement	Yes	41.34		
	Not	58.66		
Unions influence	Likert Scale		3.11	.98
	Low Unions influence	67.32		
	High Unions influence	32.68		
Uncertainty	Likert Scale		3.16	.77
	Low Uncertainty	14.53		
	Middle Uncertainty	57.26		
	High Uncertainty	28.21		
Market Competition	Likert Scale		4.11	.83
	Low Market Competition	64.80		
	High Market Competition	35.20		
Job stability	Likert Scale		3.53	.76
	Low Job stability	48.53		
	High Job stability	51.67		
Qualification requirements	Likert Scale		2.96	.68
	Low Qualification requirements	19.83		
	Middle Qualification requirements	62.29		
	High Qualification requirements	17.88		
Soft skill requirements	Likert Scale		3.71	.75
	Low Soft skill requirements	25.42		
	High Soft skill requirements	74.59		
Size	Continuous	100	206	531
Multi-plant	Yes	55.87		
	Not	44.13		
Technological intensity	Low Technological intensity	71.23		
	High Technological intensity	28.77		

Note: Number of observations: 358

Table 2
Results of the Probit Probability Models Estimations

	Model 1 Dependent variable: Autonomy			Dependent variable: Monitoring			Dependent variable: Wages		
Independent Variables	Estimates	*p*-values	mfx	Estimates	*p*-values	mfx	Estimates	*p*-values	mfx
Monitoring							-.33**	.03	-.12**
Autonomy				.51***	.00	.20***	-.28*	.09	-.10*
Job complexity	.17**	.03	.06**	.03	.64	.01	-.10	.18	-.04
Collective agreement	-.90***	.00	-.32***	-.31**	.04	-.12**	.34**	.03	.12**
Unions influence	-.22	.17	-.08	-.09	.57	-.03	.32**	.03	.12**
Middle Uncertainty	.37*	.09	.14*	-.21	.31	-.08	.09	.68	.03
High Uncertainty	.42*	.08	.15*	.02	.95	.01	.13	.57	.05
Market Competition	.03	.87	.01	.02	.88	.01	.10	.52	.04
Job stability	-.15	.32	-.06	-.26*	.07	-.10*	.19	.20	.07
Middle Qualification requirements	.68***	.00	.26***	.22	.24	.10	.04	.86	.01
High Qualification requirements	.24	.33	.10	-.09	.72	-.04	.08	.75	.03
Soft skill requirements	.60***	.00	.23***	.39**	.03	.15**	.01	.96	.003
Size	-.0002	.20	-.0001	-.0003	.16	-.0003	.00002	.85	.00001
Multi-plant	.21	.18	.08	.04	.81	.01	.20	.18	.07
Technological intensity	.08	.70	.03	.03	.85	.03	-.08	.61	-.03
Constant	-.33	.26		-.33	.25		-.75**	.01	
Chi2	94.08	.00		52.05***	.00		36.01***	.00	
Pseudo R2	.20			.11			.10		
N	358			358			358		
Log likelihood	-192.54			-221.57			-213.59		

*Statistically significant at the 10% level, ** at the 5% level, *** at the 1% level
mfx are the marginal effects

Table 3
Results of the Trivariate Probit Probability Models Estimations

	Model 2 Dependent variable: Autonomy		Dependent variable: Monitoring		Dependent variable: Wages	
Independent Variables	Estimates	*p*-values	Estimates	*p*-values	Estimates	*p*-values
Monitoring					-1.14**	.02
Autonomy			.36	.56	-.69	.20
Job complexity	.17**	.02	.05	.55	-.05	.56
Collective agreement	-.90***	.00	-.34	.14	.03	.88
Unions influence	-.21	.17	-.11	.50	.22	.17
Middle Uncertainty	.38*	.0*	-.24	.30	.10	.64
High Uncertainty	.38	.12	.04	.87	.22	.35
Market Competition	.02	.92	.03	.83	.11	.43
Job stability	-.15	.33	-.27*	.06	.05	.75
Middle Qualification requirements	.73***	.00	.23	.28	.24	.29
High Qualification requirements	.28	.28	-.09	.70	.09	.70
Soft skill requirements	.57***	.002	.44**	.02	.25	.23
Size	-.0003	.19	-.0004*	.09	-.0001	.63
Multi-plant	.22	.15	.03	.84	.22	.12
Technological intensity	.08	.66	.03	.86	-.06	.69
Constant	-.34	.25	-.23	.56	-.13	.78
Chi2	214.10	.00				
N	358					
Log likelihood	-626.71					
Rho	1.99	.58				

*Statistically significant at the 10% level, ** at the 5% level, *** at the 1% level

Chapter 3

Mission Congruence, Incentives and Autonomy: An Empirical Analysis of Child-Care Facilities in Minnesota

1. Introduction

The concept of mission congruence refers to the extent to which the objectives of workers are aligned with the objectives of the organization. A growing theoretical literature in economics (Aghion and Tirole 1997, Dessein 2002, Akerlof and Kranton 2005, Besley and Ghatak 2005, Prendergast 2008, Van den Steen 2010) has explored mission congruence in organization design. However, despite this growing interest, empirical evidence on this relationship is scant. The present paper investigates the relationship between mission congruence and the reliance on pay-for-performance and delegation of authority using a dataset of childcare facilities in Minnesota.

The traditional economic analysis of organizations relies on the assumption that workers preferences are in conflict with those of the organization. While firms prefer that workers work hard and select the activities that maximize their profits, workers prefer to work little and to select the activities that maximize their own utility. Under this assumption, firms must offer incentives to workers to make them exert productive effort and centralize decisions to preclude workers from selecting unproductive activities. Nonetheless, this is not always the case. As largely suggested in several streams of the literature concerned with the analysis of organizations (Ouchi 1984, Merchant 1985, Simons 2000, Van der Stede 2007), there are many circumstances in which worker's preferences are aligned with those of the organization because they agree with the objectives of the organization. As an instance, a social worker may work hard or select the best way to work just because she believes in the mission of the organization. Acknowledgement of this fact will have important consequences on the organizational design (Akerlof and Kranton 2005, Ben-Ner 2008).

Recent theoretical literature in economics includes modeling the effects of mission congruence on incentives and delegation of decision-making. In this literature, less dissonance between organizations' and employees' objectives reduces the cost of exerting productive effort and permits organizations to economize on monetary incentives (Akerlof and Kranton 2005, Besley and Ghatak 2005, Prendergast 2008, Van den Steen 2010). Mission congruence also allows principals to trust agents' decisions regarding the selection of activities to be carried out

by granting of autonomy to workers (Aghion and Tirole 1997, Dessein 2002, Van den Steen 2010).

Tests on the first hypothesis, a negative association between pay-for-performance and mission congruence, are scant. An example of this literature is Heckman et all. (1996), who find that preferences for helping the disadvantaged overrode pecuniary incentives. Empirical evidence on the second hypothesis, a positive association between delegation of decision-making and mission congruence, is also scant. This hypothesis seems to have been tested only by Ting Ren (2010), who finds a positive effect of mission congruence on workers participation in employee involvement programs but no effect on the degree of control over how employees' work is done.

Using a dataset of 206 child care facilities in Minnesota, we provide empirical evidence on both of these hypotheses. We find that the provision of pay-for-performance is negatively associated to mission congruence. This result suggests that childcare facilities economize on the provision of monetary incentives on teachers who believe in the mission of the organization. We also find that the provision of autonomy is positively associated to mission congruence. Teachers who do believe in the mission of the organization are more trusted by supervisors and receive more discretion to take decisions than teachers who do not share the mission of the organization. In addition, and in concordance with previous empirical literature, this paper provides empirical evidence supporting a positive association between pay-for-performance and autonomy. The interrelated nature of these decisions seems to be a stylized fact (MacLeod and Parent 1999, Nagar 2002, Abernethy et al. 2004, Foss and Laursen 2005, Moers 2006, Wulf 2007, Ben-Ner, Kong and Lluis 2011, Devaro and Kurtulos 2010, Itoh, Kikutani and Hayashida 2008).

The rest of the paper is organized as follows. In section two we review the relevant literature and state the hypotheses to be tested. Section three presents a description of the sample data and the measures to be used in the estimations as well as the econometric approach. Section four shows the results. Section five deals with the implications of the results and section six concludes.

2. Theoretical background

2.1. Mission congruence

Mission congruence refers to the extent to which the objective of a worker is aligned with that of the organization. This construct captures the idea that individuals have different objectives and that some of them could share, at different intensities, the objectives of the organizations for which they work.

It could be the case that the existence of multi principals has effects on the provision of incentives. The effects of multi-principals on the provision of incentives have been studied by several scholars (Bernheim and Whinston 1986, Dixit 1996, 1997, Martimort 1996). We follow Martimort to explain the basic nature of the multi principal problem. He analyses a situation in which two principals (two regulators) must offer to an agent (a firm) monetary incentives to produce a socially valuable project. The model finds that when principals behave non-cooperatively (i.e., free ride) principals reduce the provision of monetary incentives vis-à-vis the case in which they cooperate. As a consequence, fewer projects than socially acceptable will be provided.

It is straightforward to adapt Martimort's model to our context. In our setup, we can distinguish at least two types of principals, top management and parents, and one agent, a childcare facility teacher. In the case that both top management and parents have the right to pay incentives, as well as different objectives, we would expect a reduction in the likelihood of providing incentives to teachers. However, it is difficult to figure out a situation like that in this context. On the one hand, it is only the top management who has the right the offer monetary incentives to teachers. On the other hand, the objectives of top management must be the same as the objectives of parents. Under normal circumstances, both should expect that teachers care for children and teach them the contents of their respective program. There is no insight that the existence of multi-principals will be driving the decision about provision of incentives.

The concept of mission congruence has been addressed in the literature from several points of views. In one of them, it is stressed that individuals exhibit, beside self-interests, values such as altruism, honesty, reciprocity, trusting, trustworthiness, truth-telling and fairness (Ben-Ner and Putterman 1997). Then, the congruence of objectives follows from the dispositional dimension of human behavior to act according to those values. Another point of view assumes that employers and employees are either profit or mission-oriented (Besley and Ghatak)—for instance, toward the provision of collective goods or social work. The congruence of objectives is achieved when a mission-oriented agent is matched with a mission-oriented principal. The concept of mission congruence has been also been defined as differences in beliefs instead of as differences in objectives (Van den Steen 2010). The idea is that both firms and workers care about the success of the firm but may openly disagree about the best course of action. Lastly, in most of the literature, the congruence of objectives is straightforwardly defined as the coincidence of the agents' and principals' objectives, without specifying the type of preferences of the workers or organizations (Akerlof and Kranton 2005, Prendergast 2008, Bénabou and Tirole 2003, Aghion and Tirole 1997, Dessein 2002).

Our setup is also consistent with the literature on matching. Overall, this literature can be split into two streams, learning and asymmetric information models (Lazear and Oyer 2008). On the one hand, in learning models (Jovanovic 1979), the expected productivity of a worker

depends on where she works. One empirical implication of these models is that wages will increase in job tenure. On the other hand, asymmetric information models consider how employees match to firms when one party is better informed (Akerlof 1970). The solution to this problem is provided by the signalling model of Spence (1973).

Our context is consistent with learning models of matching in the sense that the productivity of the worker will depend on where she works. But while these models have only concentrated in the ability of the worker, our setup allows room for ability and preferences (Besley and Ghatak 2005). A key prediction of these models is that wages will increase in job tenure. Unfortunately, our survey does not allow us to control for job tenure in order to remove the positive effect of job tenure on compensation. Our context could also be consistent with the second stream of the matching literature. It would be possible to think in a situation in which applicants get some credentials (e.g. a degree in social work or childhood education) in order to signal their preferences to employers. As it is well known, the associate increased in human capital could have effects on the compensation of the teacher. Fortunately, the survey provides us with a measure for the degree of workers' skills. This variable is not significant in any of the specifications.

Another important issue to discuss is reverse causality. This literature assumes that organizations adapt to the type of workers they hire. In other words, the degree of mission congruence of the worker determines the decisions about incentives and delegation of decision-making. However, it could be possible that the causality would go in the reverse direction. For instance, we could think in a situation in which for any exogenous reason the firm takes the level of incentives or autonomy as granted. It could be possible that for historical reasons firms are reluctant to change their organizational design. It is also possible that firms are in a process of learning by doing and therefore select different human resource practices in order to learn about their consequences. In the tradition of Benabou and Tirole (2003), a high level of incentives or a low level of autonomy could adversely impact the agents' own abilities. For instance, if the firm offers incentives, workers could feel disrespected and as a consequence they will reduce their level of productivity. The supervisor in turn could interpret this behaviour as a lack of mission congruence.

Ultimately, we discuss the issue of self-selection bias, a situation in which individuals select themselves into a group, causing bias in the coefficients. In specific, applicants could have certain characteristics that cause them to self-select into childcare facilities. Unfortunately, the survey does not provide information to control for various characteristics of the workers usually used to control for self-selection, like place of residence, income level of the parents, education level, and so on.

2.2. Main hypotheses

The traditional analysis of the organization design relies on the assumption that workers' preferences are in conflict with those of the organization. This is exemplified in the agency model (Holmström 1979), where there exists a tension between principals and agents regarding the optimal level of effort to be exerted. Firms would like that workers work hard, while workers would like to exert a low level of effort. The same is true in models of delegation of decision-making. In this case, firms prefer that workers select the activities that maximize their benefits, while workers prefer to select the activities or projects that maximize their own utility (Prendergast 2002). Under this assumption, firms must offer incentives to make workers exert productive effort or centralize decisions on the selection of the activities to be carried out.

However, although standing as an important departing point for the understanding of the organization design, this approach ignores that sometimes workers care about what they do (Prendergast 2008). Some workers may derive utility from the success of the organization's mission. This is likely, for instance, in social work (Prendergast 2008), army (Akerlof and Kranton 2005), and in the non-profit sector (Besley and Ghatak 2005) contexts. In those cases, workers could adjust their effort levels and activity selection to the preferences of the organization.

Different assumptions about the extent to which workers share the mission of the organization (mission congruence), or, in other words, about the degree of disparity between the preferences of the organization and workers regarding effort exertion and activities selection, will have important effects on the structure of the organization (Akerlof and Kranton 2005, Ben-Ner 2008). For instance, we expect that workers who share the mission of the organization will receive lesser monetary incentives and more discretion—without the need of monetary incentives—than workers who do not.

2.2.1. Incentives and mission congruence

For most of the literature (Akerlof and Kranton 2005, Besley and Ghatak 2005, Prendergast 2008, Van den Steen 2010 Ben-Ner, Paulson and Ting Ren 2011) mission congruence can operate as a substitute for monetary incentives. Workers who share the objectives of the firm require less incentive pay to motivate effort. The underlying idea of these models is that mission congruence provides intrinsic motivation. The desire of the workers to perform an activity because of inherent enjoyment of the activity (Baron and Kreps 1999) reduces the cost of exerting effort and therefore economizes on the need to provide explicit monetary incentives. Recent economic literature provides efforts to model this assertion.

Akerlof and Kranton (2005) suggest that some employees may have identities that lead them to behave in concert with the goals of the organization. Those workers identify with the firm—they are insiders. The norm of an insider is to act in the interest of the firm and therefore exert the high effort. Workers with such identities lose utility by deviating from norms of high effort. Thus, for those workers, firms can reduce the wage differential needed to induce the worker to take the high effort action. Given that identity reduces the employees cost of effort, firms may find optimal to elicit yet more effort.

Besley and Gathak (2005) classify organizations as either mission or profit-oriented. They define mission as the attributes of a project that make some principals and agents value the success of the project over and above any monetary income they get in the process. The attributes of the project may refer to the organizations´ business approach, e.g., if it is commercial or charitable, and are exogenously associated with a particular principal. Some organizations attach more importance to the mission motive than to the profit motive. Payoffs of the projects' success for those principals include a non-pecuniary component. Moreover, some agents also care about the mission of the organization for which they work. The idea of the model is that they get a non-pecuniary benefit from project success when they are matched with similar-minded principals. In the optimum, those agents receive lower incentive pay.

Prendergast (2008) studies the change in the firm's hiring preferences upon changes in contractibility of performance measures. He predicts that in absence of perfectly contractible performance measures, organizations will hire agents disproportionately motivated to carry out a subset of activities the firm cares about. In other words, the firm will hire workers with preferences over some actions of particular interest for the firm. A firm can economize on the provision of monetary incentives by hiring such workers.

Van den Steen (2010) studies the role of differences in beliefs in the provision of monetary incentives. He suggests that when the members of an organization openly disagree on the right course of action, then at least some members will feel that the organization goes down the wrong path. This lowers their expected utility from being part of the organization and will lower their motivation because they will feel that their effort is spent on the wrong project. Implementation effort increases as beliefs of manager and employee are more similar. This result is straightforwardly translated to the case of mission congruence. Implementation effort will be higher in organizations with more homogeneous preferences or values.

Hypothesis 1: monetary incentives are negatively related to mission congruence.

As far as we know there is not empirical work on the relationship between monetary incentives and mission congruence. The literature, however, has devoted a lot of effort to provide empirical evidence on the "crowding out" effect (Frey 1997). That is, if the subjects´

intrinsic motivation is destroyed when explicit monetary incentives are provided (Etzioni 1971, Kruglanski 1978, Deci and Ryan 1985, Baron and Kreps 1999; see Bénobou and Tirole 2003 for an effort to formalize this effect). This negative effect of monetary incentives on intrinsic motivation has been largely documented in the experimental literature in the students' context (Kruglanski, Friedman and Zeevi 1971, Lepper, Greene and Nisbett 1973, Deci 1975, Wilson, Hull and Johnson 1981, Deci, Koestner and Ryan 1999). However, this evidence is anything but conclusive (see Gneezy and Rustichini (2000) for a discussion). The effect that we are discussing may be termed "reverse crowding out," as mission congruence "crowds out" monetary incentives. There is also a literature that has investigated the provision of incentives in the public sector. Given the nature of the public sector, managers and workers may care about the amount produced, and therefore be less inclined to shirk (Burgess and Ratto 2003). In this context, it has been found that preferences for helping the disadvantaged overrode pecuniary incentives (Heckman et al. 1996).

2.2.2. Delegation of decision-making and mission congruence

Another variable of organization design that has captured the attention of this literature is the delegation of decision-making. Overall, this literature (Aghion and Tirole 1997, Dessein 2002, Van den Steen 2010) predicts that the congruence between the principals' and the agents' objectives has a positive impact on the delegation of decision-making.

Delegation of decision-making arises when the relevant information to take decisions regarding how to carry out a job (i.e., which are the projects or activities that should be implemented) is disperse along the organization (Melumad and Reichelstein 1987, Aghion and Tirole 1997, Prendergast 2002, Dessein 2002). However, the management could hesitate to delegate decision-making to workers if their objectives are not aligned to that of the organization. On the contrary, when there is less discrepancy of interests, employers are more likely to see employees as more reliable and trustworthy to pursue the interests of the organization (Ben-Ner 2008, Ting Ren 2010) by selecting the most appropriate projects and are more likely to delegate decision-making.

Aghion and Tirole (1997) shows that managers delegate more when the objectives of the workers are more aligned to those of the firms. The idea of this model is that workers have private benefits over course of actions or projects. Then, the firms will delegate more whenever their profits are positively linked to the private benefits of the agent. That is, whenever the principal can trust the agent. This is likely in those cases in which firms´ and workers´ objectives are more similar.

Dessein (2002) shows that an uninformed principal may delegate decision-making to a better informed agent to avoid the noisy communication, and hence the loss of relevant

information, which stems from the objectives dissonance between them. In this model, more mission congruence enhances both delegation of decision-making and better communication. However, delegation dominates communication. Delegation of decision-making is a better instrument to use the local knowledge of the agent than communication.

Van den Steen (2010) shows that managers will delegate more if the employees´ beliefs are sufficiently similar to her own. The intuition for this result is that as the manager and employee have more different beliefs, the employee is more likely to make the wrong choice from the manager's perspective. Belief differences thus give the manager more reason to keep control by not delegating. More granting of autonomy will be observed in organizations with more homogeneous preferences or values.

Hypothesis 2: delegation of decision-making is positively related to mission congruence.

To the best of our knowledge, empirical evidence on the positive association between mission congruence and delegation of decision-making is restricted to Ting Ren (2010). With a sample of 91 nursing homes in Minnesota, the U.S., he finds a positive effect of firms-workers mission congruence on the "employees' participation in any employee involvement program." However, he fails to find a positive association when a more direct measure for delegation of decision-making is used, namely, the degree of control over how their work is done. Campbell (2010) analyses a related hypothesis using data from a credit-union in the U.S. He finds that employees aligned to the organization via selection are more likely to use their decision-making authority in the granting and structuring of consumer loans than those who are not aligned. The emphasis of this work is on workers´ reaction. The effect on firms' decentralization decisions of changes in hiring practices is not analyzed.

2.3. Other considerations

2.3.1. Incentives and delegation of decision-making

The theoretical economics and management literature has devoted a lot of effort for understanding the relation between the provision of incentives and delegation of decision-making (Melumad and Reichelstein 1987, Melumad et al. 1992, Jensen and Meckling 1992, Holmström and Milgrom 1994, Prendergast 2002, Baiman and Rajan 1995, Bushman et al. 2000, Baldenious 2003). Overall, this literature predicts that both variables of the organizational design should be positively correlated.

The idea is that when organizations delegate decision-making they create a room for workers to choose the activity or project they like the most instead of the activity or project with

the highest productivity. Then, the constraining of misbehaviour by the part of the workers created by the delegation of decision-making implies that firms offer incentives (Prendergast 2002). Moreover, when organizations decide to delegate decision-making, effort exertion within a task is more difficult to monitor (Ben-Ner et al. 2010). That is, delegation of decision-making also fosters the asymmetric information problem analysed in the standard agency model (Holmström 1979, Shavell 1979, Holmström and Milgrom 1987, 1991).

The prominent role of incentives is to prevent both the selection of a suboptimal project as well as a suboptimal level of effort. The idea that the possible misbehaviours created by delegation of decision-making needs to be constrained via the provision of incentives seems to be a stylised fact (MacLeod and Parent 1999, Nagar 2002, Abernethy et al. 2004, Widener et al. 2004, Foss and Laursen 2005, Moers 2006, Wulf 2007, Itoh et al. 2008, Gibbs et al. 2009, Devaro and Kurtulos 2010, Ben-Ner, Kong and Lluis 2011).

2.3.2. Control variables

For testing the hypotheses above, it is necessary to control for specific characteristics of the business units or the environment where they operate that could determine the use of the variables of the organization design analyzed in this article, incentives and delegation of decision making. In concrete, we control by the size of the business unit, the number of business units belonging to the same parent organization, the age of the organization, the degree of task complexity, the degree of skill demanded by the tasks, and the legal status of the organization.

The inclusion of a variable related to the size of the business unit is standard in the empirical literature for its effects on all organization design choices (Nagar 2002). In fact, this variable has been considered in every empirical analysis where the relationship between delegation of decision-making and incentives has been analyzed (Adams 2002, Nagar 2002, Shi 2005, Foss and Laursen 2005, Devaro and Kurtulos 2010, Ben-Ner et al. 2011). Overall, we would expect that larger units, in which supervision is more difficult, have larger asymmetry information problems than smaller firms. Then, we would observe less delegation of decision making and more incentives. However, we do not provide empirical prediction for this variable because some other arguments provided by the literature leads to ambiguous conclusions. For instance, smaller establishments could be more agile (e.g. flatter hierarchies) and more likely to adopt human resources innovations than large establishments (Osterman 1994).

We also control for the number of business units belonging to the same parent organization (Foss and Laursen 2005) because the decisions related to organizational design could be made by the headquarter instead of by the child-care facility. So, despite establishments that are part of larger organizations may receive greater resources, information and technical assistance for

implementation of innovative organizational practices (Osterman 1994), we consider the expected sign of this variable as an empirical question.

In addition, we control by the years of the organization in business since establishment (Shi 2005, Ortega 2009, Ben-Ner 2011), because the number of years could be an indicator of the difficulty to develop particular organizational practices (Lafontaine 1992). Also, the epoch when the organization was founded is important in that cultural attitudes about appropriate policies get set into place. This is exemplified by the tendency of recently formed firms to provide autonomy (Osterman 1994).

Delegation of decision-making arises when relevant information to take decisions regarding how to perform optimally a task by choosing the right activity or project is in hands of the workers (Melumad and Reichelstein 1987, Aghion and Tirole 1997, Prendergast 2002, Dessein 2002)[24]. For empirical implementation, some authors (Prendergast 2002, Raith 2008, Ben-Ner et al. 2011) suggest that the amount of the agent's local private information is closely related to the degree of complexity of the tasks that workers have to perform. When the production process is simple, there is not much room for differences between the workers and supervisors to identify the best course of action for a given task. But when the task is complex, the worker, who is closer to the production process, is in a better position than the supervisor to determine how a task should be done. So, job complexity can be interpreted as a measure of the agents' informative advantage (Ortega 2009, Ben-Ner et al. 2010) and a positive relationship of this measure with delegation of decision-making is expected. Recent empirical studies provide support for the positive relationship between the delegation of decision-making and measures of job complexity (Ortega 2009, Gibbs, Levenson and Zoghy 2010, Ben-Ner, Kong and Lluis 2010) or other measures intended to capture the principal-agents' asymmetric information (Baiman, Larker and Rajan 1995, Colombo and Delmastro 2004)..

Other authors argue that the agents´ informative advantage (Zabojnik 1996, Prendergast 2000, 2002, Adams 2002, Baker and Jorgensen 2003, Shi 2005, Raith 2008) could have positive effects on the provision of incentives. The idea is that firms can take advantage of the workers´ local private information by increasing the strength of incentives. The empirical literature provides some efforts (Baiman, Larker and Rajan 1995, Ortega 2009, Ben-Nert et all. 2011) to test this prediction.

The degree of skill demanded by the tasks could also have important effects on delegation of decision making. We expect that tasks that are more difficult to perform will be more delegated. Also, we expect that a highly skilled task could have negative effects on the

[24] The literature suggests alternative explanations to delegating the decision to the workers. For instance, delegation of decision-making could encourage incentives to collects information (Aghion and Tirole 1997), incentives to implement or execute the project (Van den Steen 2006) or because it takes time and effort (Van den Steen 2010).

provision of incentives because it affects negatively the marginal productivity of effort and could add risk to the relationship (Holmström and Milgrom 1991).

Last, the legal status of the organization, namely, if it is a for-profit, non-profit, or local government organization, could have effects on the severity of the agency problems of the organization (Clarkson 1972, Brody 1996, Steinberg 2008). In for-profit organizations principals are equity owners who maximize returns on their investment, in non-profit organizations principals are members of boards of directors who have fiduciary duties towards the organization but are not required to pursue specific goals, and in government organizations principals are the constituents who exercise their rights through elected officials, i.e., citizens with no enforceable property rights. For-profit organizations are more likely to take advantage of the residual asymmetric information to their clients and to be more efficient in the use of resources than other forms of corporate government (Ben-Ner, Karaka-Mandic and Ting Ren 2012). Thus, we expect this type of organizations will be more motivated to direct their agents to act in profit-maximizing ways. We should observe a larger use of incentive mechanisms such as performance pay. This assertion is supported by the empirical literature (Weisbrod and Ballou 2003, Bertrand, Hallock and Arnould 2005).

This conclusion is consistent with the results of Francois (2007) who suggests that when the worker exhibits pure or output-oriented altruism (the individual cares about the overall value of the good or service to which he contributes) he is motivated to contribute effort because of its effects on the social good only when working for a not-for-profit organization. Then, workers in not-for-profits receive less compensation than in for-profit organizations. The reason is that if the principal were a for-profit organization she could take advantage of the worker by reducing her own level of effort, then, the worker will chose not to exert extra effort. With regard to the impure or action oriented altruism (the individual receives a "warm glow" from the actual act of contributing to the production of a good or service he cares about), the pro-social motivation literature is mute about the type of ownership status needed to elicit effort of motivated agents (Francois and Vlassopoulos 2008).

3. Methods

3.1. Data description

The data for testing the hypotheses is drawn from the structure and performance in the human services industry in Minnesota survey applied to childcare institutions. We believe this is a suitable setup to carry out the analysis. Small organizations (with an average of 13.77 workers) are expected to be flexible enough to adapt to the characteristics of the workers. Also, children-liking must be an important motivational element of teachers in childcare facilities.

The use of subjective assessments by the interviewee on various scales to get information on the theoretical concepts above examined is a common practice in the related empirical literature (Adams 2002, Foss and Laursen 2005, Wulf 2005, Nagar 2005, Shi 2005, Ortega 2009, Devaro and Kurtulos 2010, Ting Ren 2010, Ben-Ner, Kong and Lluis 2011). This approach allows the possibility of getting information on some concepts even if more objective information is not available.

The survey was administered in summer 2006 to all child-care facilities existing at that time. So, we expect no sampling selection bias problems. The survey was addressed to child-care facilities' directors and requested detailed information on human resources and work organization practices for teachers as well as information on general characteristics of the facilities and/or parent organizations. We got 504 responses. Because some questionnaires were incomplete, we ended up with 206 observations.

A similar database has been used previously for the study of the impact of mission alignment on delegation of decision-making and supervision by Ting Ren (2010). This study uses a sample of 91 nursing home administrators in Minnesota, also drawn from the structure and performance in the human services industry in Minnesota survey.

Childcare facilities care for different kind of children, infant (between 6 weeks and 16 months), toddler (between 16 months and 33 months), pre-schooler (between 33 months and kindergarten) and school age (kindergarten +, usually to age thirteen). Each of these groups uses different formal curriculums. Infants are given hugs whenever needed; prompt attention when walking; fun toys, music and playmates; books read, songs sung and dance to dance, and so on. Toddlers have available music, arts and crafts, books and stories, sensory and fine motor, cognitive and language development, and so on. Pre-schoolers programs promote decision-making and problem-solving skills, character development, vocabulary, social-emotional activities, literacy skills, and so on. School-age care programs are available before and after school, on school holidays and during the summer. These programs are designed to meet the full range of each child's developmental, social and emotional needs. With regard to the staff, the center must have a director and the appropriate number of staff qualified as teachers, assistant teachers, and aides based on staff ratio and distribution requirements. A teacher must be at least 18 and have a high school diploma with 4,160 hours experience as an assistant teacher and 24 quarter credits in a child care-related field. An assistant teacher must work under the supervision of a teacher, must be at least 18, and have a high school diploma with 2,080 hours experience as an aide or intern and 12 quarter credits. An aide carries out the child care program activities under the supervision of a teacher or assistant teacher. Must be at least 16; if under 18 must be directly supervised by a teacher or assistant teacher.

3.2. Measures

Dependent variables

Pay-for-performance (*p*)

The question related to the provision of incentives asks the interviewer if the teachers receive any form of incentive pay or bonus. The answer is presented in a dichotomized way. Based on this question we create the variable *Pay-for-performance*, which take the value of zero if incentives are not provided and 1, otherwise. The distribution of child-care facilities for teachers for the two categories is 74.76 and 25.24 percent, respectively. Table 1 shows the frequency distributions and the means and standard distributions of the variables defined in this section.

Autonomy (*a*)

The question that explores our measure of delegation of decision-making asks the interviewee to evaluate the degree of control that teachers have over how their work is done. The answer ranks in a five-point scale, where 1 means "not at all," 2 means "small," 3 means "moderate," 4 means "large" and 5 means "extreme." The distribution of the child-care facilities for teachers for the five categories is 0, .49, 10.68, 51.46, and 37.38 percent, respectively. Based on this information we create the 4-categories ordinal variable *Autonomy*.

Independent variables

Mission congruence (*m*)

The concept of mission congruence is measured through a question that asks the interviewer if teachers believe in the mission of the organization. The answer ranks in a Likert scale from 1 to 5, where 1 means that the interviewee strongly disagree with the statement, 2 that she disagrees, 3 that she neither agrees nor disagrees, 4 that she agrees and 5 that she strongly agrees. The distribution of plants for the five categories for teachers is 2.91, 0, 2.43, 26.21 and 68.45 percent, respectively. As we can see, the variation of this distribution is very low, in specific, biased toward the higher categories of the Likert scale. A possible explanation for this fact is that it is very difficult for managers to accept (even if it is in an anonymous survey) that their personnel do not believe in the mission of the organization. We deal with this

issue in Subsection 4.2, where we attempt to confirm the mangers believes about the degree of mission congruence.

Like mission congruence and some of the independent variables of the previous sections, many of the independent variables used in the empirical part of this section have been measured by Likert scales from 1 to 5. Thus, in order to avoid the problems associated with this kind of information, we apply the grouping criterion used in the former sections of this dissertation. Applying this general procedure to this distribution, we gather together categories 1 to 4 and create the dummy variable *Mission congruence*, whose value of zero (former categories 1 to 4) is interpreted as the existence of weak mission congruence and one (former category 5) as the existence of strong mission congruence.

Tables 2 and 3 show descriptive statistics for firms with high mission congruence and low mission congruence, respectively. As we can see, overall, the results of both groups are very similar. The only striking differences are in the number of facilities and in the child-care facility status. The average number of facilities is 7.17 for the group with high mission congruence and 86 for the group with low mission congruence. Also, the percentage of childcare facilities belonging to the government is larger in the group with low mission congruence (7.69) than in the group with high mission congruence (0.7).

Other variables (x)

Following the theoretical discussion above, as well as the related empirical literature, we control for the size of the business unit, the number of business units belonging to the same parent organization, the age of the organization, the degree of task complexity, the degree of skill demanded by the tasks, and the legal status of the organization.

The size of the child-care facility, *Size*, is measured as the number of full time employees. With regard to the number of child-care facilities belonging to the same parent organization, the survey provides a question that ask the interviewee approximately how many child-care facilities does your organization have. Based on this question, we created the variable *Number of facilities*. The variable *Age* is taken from a question that asks the interviewee in which year the organization that owns a particular facility was established.

The question that brings the measure for task complexity asks the interviewee to evaluate if the tasks performed by the teachers are complex. The answer is presented on a 5-point Likert scale, where 1 means “not at all,” 2 means “small,” 3 means “moderate,” 4 means “large” and 5 means “extreme.” The distribution of the plants for teachers for the five categories is 2.91, 3.88, 35.44, 40.78, and 16.99 percent, respectively. In this case, we gather together categories 1, 2 and 3, and 4 and 5, and create the dichotomous variable *Task Complexity*. The value of zero (former

categories 1 to 3) is interpreted as the existence of no task complexity and the value of one (former categories 4 and 5) as the existence of task complexity.

As we have mention above, children are typically cared for in groups divided by age and follow different formal curriculums. To the extent childcare facilities—presumably—have different mix of children, we expect that the childcare facilities exhibit different levels of complexity. In particular, male infants (and to a lesser extent female infants) seems to be the type of children whose care is more complex, i.e., there is a high correlation between this kind of children and the degree of complexity reported by the human resources manager or plan director of the childcare facility.

For the degree of skilled of the task we rely on a question that asks the interviewee if the task performed by the teachers is highly skilled. The answer is presented on a 5-point Likert scale. As in the former case, 1 means "not at all," 2 means "small," 3 means "moderate," 4 means "large" and 5 means "extreme." The distribution of the plants for teachers for the five categories is 1.94, 4.85, 19.90, 45.63, and 27.67 percent, respectively. In this case, we gather together categories 1, 2 and 3, and 4 and 5, and create the dichotomous variable *Task skill*. The value of zero (former categories 1 to 3) is interpreted as the existence of a low task complexity and the value of one (former categories 4 and 5) as the existence of a high task complexity.

Ultimately, the questionnaire requires the interviewee to respond if the child-care facility belongs to a "for-profit," "non-profit" or "government" form of corporate governance. The distribution of the childcare facilities for the three categories is 51.94, 45.15 and 2.91 percent, respectively. Based on this information we created the dummy variables *For-profit*, *Non-profit* and *Government*. The omitted variables will be *Non-profit* and *Government.*

3.3. Econometric approach

According to the theoretical section and given the construction of the Pay-for-performance (p) and Autonomy (a) variables (a dichotomous and a four-ordered categories variable, respectively), we propose the next general econometric approach:

$$p_i^* = {}_1 m_i + {}_2 a_i + \sum_{j=1}^{J} {}_j x_{ji} + {}_{1,i} \qquad [1]$$

$$a_i^* = {}_1 m_i + \sum_{j=1}^{J} {}_j x_{ji} + {}_{2,i} \qquad [2]$$

where p_i^* and a_i^* are latent variables. For the childcare facility *i,* the value of the variable *Pay-for-performance* (p) will be equal to one $(p_i = 1)$ when the childcare facility *i* has an associated positive value $(p_i^* > 0)$ and will be equal to zero $(p_i = 0)$, otherwise. Also, for the childcare facility *i,* the value of the variable *Autonomy* (a_i) will depend on the value of the latent variable a_i^* in the following way: $a_i = 4$ if $a_i^* \geq \ _3$, $a_i = 3$ if $\ _3 > a_i^* \geq \ _2$, $a_i = 2$ if $\ _2 > a_i^* \geq \ _1$ and $a_i = 1$ if $\ _1 > a_i^*$. The independent variables are *Mission congruence* (*m*) and a set of *J* control variables (x_j), where *j* = 1…*J*. The error terms $\ _1$, $\ _2$ are distributed as bivariate normal with mean zero, unit variance and correlation coefficient . The parameters to be estimated are $\ _1$, $\ _2$, $\ _3$, $\ _1$, $\ _2$, $\ _1$, $\ _j$, $\ _j$ and . Hypotheses 1 and 2 predict $\ _1 > 0$ and $\ _1 > 0$, respectively. From the theoretical section we also expect $\ _2 > 0$. With regard to the control variables we expect a positive relationship of *Pay-for-performance* with *Task skill* and *for-profit*. Also, we expect that *Autonomy* will be positively correlated to *Task complexity* and *Task skill*. For the rest of the control variables, we provide no prediction.

The general model proposed is logically consistent (for further discussion see Maddala, 1983 section 5.7), the parameters are identified (Wilde 2000) and can be estimated by the bivariate probit probability model. As it was mention in chapter 1, the bivariate methodology is the way to carry out empirical analyses when the probit equation contains a binary explanatory variable that is endogenous (Monfardini and Radice 2007, Wooldridge 2010). The bivariate is a full information instrumental variables model (Hausman 1975), in the sense that it takes into account for the possible correlation between disturbances and regressors and the possible correlation between the disturbances of the two equations.

4. Results

4.1. Parameters' estimation and hypotheses tests

The results are shown in Table 4. The likelihood ratio test rejects at the 1 percent level the null hypothesis that all the explanatory variables are zero. The first column of Table 4 presents the results of the estimation of the incentives equation. These results provide support for Hypothesis 1. The coefficient of the variable *Mission congruence* is negative and statistically significantly different from zero at the 4 percent level ($\ _1 < 0$). With regard to the other variables, the level of autonomy of the teacher and the size of the childcare facility are also important to explain the decision on incentive provision. The three dummy variables associate

to the variable *Autonomy* are positive and statistically significant at conventional levels of significance while *Size* is positive and statistically different from zero at the 1 percent level.

The second column of Table 4 presents the results of the estimation of the Autonomy equation, which is relevant for Hypothesis 2. The results also provide support for this Hypothesis. The coefficient of variable Mission congruence is positive and statistically significant at the 7 percent level ($_1 > 0$). None of the other independent variables in this specification resulted statistically significant to explain the decision on the provision of autonomy. Note however that the fact that the coefficient of the variable Task complexity is very close to being significant $(= .108)$ provides some insight of its importance.

4.2. Are managers beliefs right?

The variable about the degree of mission congruence comes from subjective answers of the childcare facilities directors. In order to confirm if manager believes are right we incorporate in the analysis a measure of performance. In specific, we estimate a model for analyzing the correlation between the performance of the childcare facility and the degree of mission congruence. The questionnaire contains 7 statements related to the performance of the childcare facility. These statements can be found in the General Appendix of the dissertation (Questionnaire 2: definition of variables from the questionnaire for childcare facilities in Minnesota). We applied the principal component factor analysis to summarize this information. The application of this technique resulted in one factor with a Cronbach alpha of .80. This index will be considered in the analysis as our measure of *Performance*. The results are present in Table 5. As we can see, the coefficient of the variable *Mission Congruence* is positive and statistically significantly different from zero at the 1 percent level. This result provides an insight into the beliefs of managers could be correct.

4.3. Robustness

For robustness, we have also estimated the model using dichotomous variable for autonomy. The results of the estimations change dramatically depending on the way we construct the dummy variable. If we use the grouping criteria--stated the first chapter of this dissertation--the results are very different to the ones found in the main estimations. Any variable is able to explain the decision about pay-for-performance provision. The results can be found in Table 6. Following the grouping criteria we have gathered together categories two to four and create a dummy variable with the following distribution: 62.62 percent for low levels of autonomy (category zero) and 37.38 percent for high levels of autonomy (category one).

This results change a lot if instead we gather together categories one and two and categories three and fourth and create the dummy variable *Autonomy1* whose value of zero and one comprises 11.17 and 88.83 percent of observations, respectively. The results of the latter estimation are present in Table 7. As we can see, most of the central results remain unchanged. Column 1 shows the results of the *Pay-for-performance* equation. The coefficient of the variable *Mission congruence* is negative and statistically significantly different from zero, although the degree of significance drops to six percent. Firms with *Mission congruence* are less likely in .12% to provide *Pay-for-performance* than firms with no *Mission congruence*. Also, the coefficient of the variable *Autonomy1* is positive and significantly different from zero at the one percent level. Firms with *Autonomy* are more likely in .30% to provide *Pay-for-performance* than firms with no *Autonomy*. Column 2 shows the results of the *Autonomy* equation. As in the original equation, *Mission congruence* is positive and statistically significant (at the 3 percent level). Firms with *Mission congruence* are more likely in .11% to grant *Autonomy* than firms with no *Mission congruence.* A difference worthy to note is that the coefficient of the variable *Tax complexity* is now statistically significant (at the 7 percent level). Firms with *Task complexity* are more likely in .09% to provide *Autonomy* than firms with no *Task complexity*.

The results are not robust to different codifications of the ordinal variable *Autonomy*. The original estimation of Table 4 respects the way in which the information is provided and unlike the former two cases do not loose any information.

5. Discussion: Incentives and delegation of decision-making

According to the literature (Melumad and Reichelstein 1987, Melumad et al. 1992, Jensen and Meckling 1992, Holmström and Milgrom 1994, Prendergast 2002, Baiman and Rajan 1995, Bushman et al. 2000, Baldenious 2003) the positive relation between pay-for-performance and autonomy is consequence of the conflict of interests between firms and workers. The idea is that firms offer incentives to constraint misbehavior by the part of the workers created by the delegation of decision making. This rationale will imply that after controlling for a measure of decision-making we should observe no longer a positive association between pay-for-performance and autonomy. However, our results show that after controlling for mission congruence the positive association between pay-for-performance and autonomy is still positive. In fact, there are not important differences when we dropped out the variable mission congruence. We have not been able to find a satisfying explanation for this result. We believe that further research is necessary to find the variables other than congruence of objectives that could be driven the positive association between pay-for-performance and autonomy.

6. Conclusions

This article provides evidence on the role of mission congruence for reliance on pay-for-performance and autonomy. Despite the interest of the theoretical literature, empirical evidence on those relationships is scant. Using a dataset of childcare facilities in Minnesota, we attempted to fill this gap.

We find that mission congruence is negatively related to pay-for-performance and positively related to autonomy. Those results are consistent with most of the arguments developed by the theoretical literature in economics that have explored the role of mission congruence on organization design. Mission congruence between workers and organizations allows firms to decentralize decisions and economize on the provision of costly extrinsic motivation. Moreover, in concordance with previous empirical literature, we find that pay-for-performance and autonomy tend to be given together. This result seems to confirm the interrelated nature of those decisions.

Tables

Table 1
Frequency distribution and descriptive statistics

Variable	Categories	Percentage	Mean	S.d.
Pay-for-performance	Low pay-for-performance	74.76		
	High pay-for-performance	25.24		
Autonomy	Likert scale		4.26	.66
		.49		
		10.68		
		51.46		
		37.38		
Mission congruence	Likert scale		4.57	.80
	Low Mission congruence	31.55		
	High Mission congruence	68.45		
Task complexity	Likert scale		3.65	.91
	Low Task complexity	42.23		
	High Task complexity	57.77		
Size	Continuous		13.77	15.45
Number of facilities	Continuous		32.05	209.14
Age	Continuous		40.49	34.71
Task skill	Likert scale		3.92	.92
	Low Task skill	26.70		
	High Task skill	73.30		
For-profit		51.94		
Non-profit		45.15		
Government		2.91		

Number of observations: 206

Table 2
Frequency distribution and descriptive statistics for firms with high mission congruence

Variable	Categories	Percentage	Mean	S.d.
Pay-for-performance	Low pay-for-performance	74.66		
	High pay-for-performance	23.40		
Autonomy	Likert scale		4.31	.64
		.71		
		7.09		
		51.77		
		40.43		
Task complexity	Likert scale		3.74	.85
	Low Task complexity	40.43		
	High Task complexity	59.57		
Size	Continuous		12.85	13.59
Number of facilities	Continuous		7.17	24.95
Age	Continuous		42.79	37.93
Task skill	Likert scale		4.04	.89
	Low Task skill	23.40		
	High Task skill	76.60		
For-profit		53.90		
Non-profit		45.39		
Government		0.71		

Number of observations: 141

Table 3
Frequency distribution and descriptive statistics for firms with low mission congruence

Variable	Categories	Percentage	Mean	S.d.
Pay-for-performance	Low pay-for-performance	74.77		
	High pay-for-performance	29.23		
Autonomy	Likert scale		4.12	.70
		0		
		18.46		
		50.77		
		30.77		
Task complexity	Likert scale		3.44	1.00
	Low Task complexity	46.15		
	High Task complexity	53.85		
Size	Continuous		15.78	18.82
Number of facilities	Continuous		86.01	366.63
Age	Continuous		35.09	25.86
Task skill	Likert scale		3.66	.92
	Low Task skill	33.85		
	High Task skill	66.15		
For-profit		47.69		
Non-profit		44.62		
Government		7.69		

Number of observations: 65

Table 4
Bivariate Probit Probability Model Estimations

	Dependent variable: pay-for-performance		Dependent variable: autonomy	
Independent Variables	Estimates	p-values	Estimates	p-values
Autonomy1				
Autonomy2	.69**	.04		
Autonomy3	1.21***	.00		
Autonomy4	2.58***	.00		
Mission congruence	-.35**	.04	.31*	.07
Task complexity	-.23	.16	.27	.11
Task skill	.02	.90	.003	.98
Size	.01*	.05	-.004	.44
Number of facilities	-.0002	.52	.00007	.85
Age	-.001	.66	-.001	.63
For-Profit	.12	.45	-.10	.56
Cut11	1.75			
Cut21	-2.36			
Cut22	-1.04			
Cut23	.55			
Wald Chi2	234.88	.00		
N	206			
Log likelihood	-304.49			
Rho	-1	.16		

*Statistically significant at the 10% level, ** at the 5% level, *** at the 1% level

Table 5
Results of the OLS Model Estimation

	Dependent variable: *performance*	
Independent Variables	Estimates	*p*-values
Mission congruence	.51***	.00
Pay-for-performance	.26*	.10
Autonomy	.14	.54
Task complexity	.09	.54
Task skill	.11	.52
Size	-.003	.60
Number of facilities	.0003	.31
Age	.005**	.03
For profit	.02	.91
Cons	-.85***	.003
R2	.10	
N	189	

*Statistically significant at the 10% level, ** at the 5% level, *** at the 1% level

Table 6
Bivariate Probit Probability Model Estimations—variable *Autonomy* dichotomized (first version)

	Dependent variable: pay-for-performance			Dependent variable: autonomy		
Independent Variables	Estimates	p-values	mfx	Estimates	p-values	mfx
Autonomy1	-.18	.91	-.06			
Mission congruence	-.14	.60	-.04	.23	.27	.08
Task complexity	.08	.75	.02	.23	.24	.09
Task skill	.09	.70	.03	.07	.76	.03
Size	.01	.27	.003	-.01	.23	-.003
Number of facilities	-.0001	.53	-.0001	.00003	.95	.00001
Age	-.004	.23	-.001	-.001	.85	-.0002
For-Profit	.06	.79	.02	-.11	.55	-.04
Constant	-.61	.34		-.49*	.07	
Wald Chi2	6.14	.63				
N	206					
Log likelihood	-246.43					
Rho	.19	.85				

*Statistically significant at the 10% level, ** at the 5% level, *** at the 1% level
mfx are the marginal effects

Table 7
Bivariate Probit Probability Model Estimations—variable *Autonomy* dichotomized (second version)

	Dependent variable: pay-for-performance			Dependent variable: autonomy		
Independent Variables	Estimates	p-values	mfx	Estimates	p-values	mfx
Autonomy2	1.52***	.00	.30***			
Mission congruence	-.36*	.06	-.12*	.56**	.03	.11**
Task complexity	-.17	.38	-.06	.48*	.07	.09*
Task skill	.10	.62	.03	-.08	.78	-.01
Size	.01*	.10	.003*	-.003	.70	-.0006
Number of facilities	-.0004	.42	-.0001	.0001	.91	.00002
Age	-.002	.48	-.001	-.003	.42	-.001
For-Profit	.90	.63	.03	-.01	.96	-.002
Constant	-1.78***	.00		.88***	.01	
Wald Chi2	7.38	.00				
N	206					
Log likelihood	-179.83					
Rho	-.99	.11				

*Statistically significant at the 10% level, ** at the 5% level, *** at the 1% level
mfx are the marginal effects

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General Appendix: Questionnaires

Questionnaire 1: Definition of variables from the questionnaire for Spanish industrial establishments

Autonomy

Please indicate the degree of suitability of the following Human Resource management practices among your workers (1: Nil or very low, 5: Very high)

	Nil or very low	Low	Average	High	Very high
The autonomy of the worker to decide the implementation (when, how and in which order) of the available tasks is…	1	2	3	4	5

Monitoring

Please indicates your degree of agreement with the following assertions (From 1: Total disagreement to 5: Total agreement)

	Total disagreement	Disagreement	Neither agreement nor disagreement	Agreement	Total agreement	NR
At performing their job, workers are very supervised	1	2	3	4	5	9

Wages

How do you consider are the salaries of your blue collar workers relative to the salaries of the blue collar workers of your direct competitors?

1. Very inferior; 2. Inferior; 3. The same; 4. Superior; 5. Very superior

Job Complexity (Local private knowledge)

Please, indicates your degree of agreement with the followings assertions in relation with the products made in this plant (From 1: Total agreement to 5: Total agreement)

	Total disagreement	Disagreement	Neither agreement nor disagreement	Agreement	Total agreement
A large number of products are made in your plant	1	2	3	4	5
The products made in the plant are very different among them	1	2	3	4	5
The mix of products made in the plant can be easily changed	1	2	3	4	5
Many new products are introduced every year	1	2	3	4	5
The new products are usually very different of the existing ones	1	2	3	4	5
The products we produce suffer continuous modifications	1	2	3	4	5

Collective agreements

There exists a plant- or firm-specific collective agreement that regulates the working conditions of your production workers?

1. Yes, 2. Not, 9. NR

Unions

How do you asses the influence of the unions on the blue collar workers?

1. Very high, 2. High, 3. Average, 4. Low, 5. Very low, 9. NR.

Uncertainty (Demand Variability)

How do you qualify the amount of orders received by your plant in relation with the following aspects?

	Very low	Low	Average	High	Very high	NR
Its variability from year to year	1	2	3	4	5	9

Product market competition

Please answer the following question about the competition

	Very intense	Intense	Average	Low	Very low
The competition in the market where the plant brings along its activities is…	1	2	3	4	5

Job stability

Please, indicate us the degree of application of the following practices of human resources among your workers (1: Nil or very low, 5: Very high)

	Nil or very low	Low	Normal	High	Very high
The commitment to keep indefinitely the employment relationship with our workers is…	1	2	3	4	5

Qualification requirements

How do you consider the required qualification level of the production workers of the plant to perform the job?

1. Very low, 2. Low, 3. Average, 4. High, 5. Very high, 6. NR.

Soft skill requirements

Please indicate your degree of agreement or disagreement with each one of the following statements about the Human Resource management practices applied to the workers of your plant (from 1: Total disagreement to 5: Total agreement)

	Total disagreement	Disagreement	Neither agreement nor disagreement	Agreement	Total agreement
The selection criterion takes into consideration the learning capabilities, interpersonal abilities, cultural adjustment and attitudes or even personality of the workers…	1	2	3	4	5

Size

How many workers approximately did you have in 2005?

Multi-plant

Has the parent company any other production plant in Spain besides this one?

1. Yes, 2. Not, 9. NR

Has the parent company any other production plant in foreign countries (out Spain)?

1. Yes, 2. Not, 9. NR.

Technological Intensity

Category	Industrial sector
Low technological intensity	Food, drink and tobacco
	Textile industry, dressmaking, leather and footwear
	Wood, cork, paper and graphic arts
	Furniture and various manufacturing industries
	Rubber, plastic materials and non-metallic mineral products
	Machinery and metal equipment
High technology intensity	Chemical industry
	Mechanical equipment and machinery
	Electric equipment
	Motor vehicle and transport supply
	Electronic, medical, optimal and computer equipment
	Pharmaceutical industry
	Aeronautical industry

Questionnaire 2: definition of variables from the questionnaire for childcare facilities in Minnesota

Pay-for-Performance

Please check the forms of compensation and fringe benefits received by most employees in each group

	Teachers
Any form of incentive or pay bonus Please specify type:	

Autonomy

To what extend do these employees

1. Not at all, 2. Small, 3. Moderate, 4. Large, 5. Extreme

	Teachers
Have control over how their work is done?	1 2 3 4 5

Mission Congruence

Please evaluate the following statements

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Most of our Teachers believe in the mission of our organization	1	2	3	4	5

Task Complexity

To what extend

1. Not at all, 2. Small, 3. Moderate, 4. Large, 5. Extreme

	Teachers
Are the tasks performed by these employees complex?	1 2 3 4 5

Task Skills

To what extend

1. Not at all, 2. Small, 3. Moderate, 4. Large, 5. Extreme

	Teachers
Are the tasks performed by these employees highly skilled?	1 2 3 4 5

Size

	Teachers	Assistant Teachers	Aides	Supervisors
Number of full-time and part time employees				

Age

In what year was the organization that owns your particular facility established?

_____

Number of child facilities

Approximately how many child care facilities does your organization have?

_____

Legal Status

_____

Performance

How would you compare your facility´s performance over the past three years to that of others child care centers in Minnesota?

	Much better	Somewhat better	About the same	Somewhat worse	Much worse
Quality of services	1	2	3	4	5
Development of new services	1	2	3	4	5
Ability to attract essential employees	1	2	3	4	5
Ability to retain essential employees	1	2	3	4	5
Satisfaction of parents	1	2	3	4	5
Relations between management and other employees	1	2	3	4	5
Relations among employees in general	1	2	3	4	5