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**Is Seniority-Based Pay used as a Motivation Device?
Evidence from Plant Level Data**

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Is Seniority-Based Pay used as a Motivation Device? Evidence from Plant Level Data*

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Abstract

In this paper we use data from industrial plants to investigate if seniority-based pay is used as a motivational device for production workers. Alternatively, seniority-based pay could simply be a wage setting rule not necessarily related to the provision of incentives. Unlike previous papers, we use a direct measure of seniority-based pay as well as measures of monitoring devices and piece-rates. We find that firms that offer seniority-based pay are less likely to offer explicit incentives. They are also less likely to invest in monitoring devices. We also find that firms that offer seniority-based pay are more likely to engage in other human resource management policies that result in long employment relationships. Overall these results suggest that seniority-based pay is indeed used as a motivation device.

JEL codes: M52, M12, J30.

Keywords: Human resource management practices, incentives, monitoring.

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1 Introduction

The use of incentive schemes are an important instrument in the hands of firms to motivate workers. However, not all firms and not all types of production processes require the same type of incentives to enhance motivation and, therefore, labor productivity.

There are two basic types of incentives that can be provided by firms in order to motivate workers: explicit and implicit incentives (the latter also referred to as deferred compensation or delayed payment schemes). Explicit incentives are appropriate when the individual output is easy to observe and quantify. In that case, the easiest way to provide motivation is to pay workers a straight piece rate. Implicit incentives are more appropriate when the output is difficult to observe (or define) at the individual level.

In this paper, we concentrate on implicit incentives. More specifically, we concentrate on one type of implicit incentives: the seniority-based pay. In general, any deferred compensation scheme implies a contract in which, at some point in the worker's life-cycle, there is a discrepancy between the spot wage and the spot value of the worker's marginal product. The reason being that workers are paid below their productivity during the first few years of their contract, while their wage is above their productivity in the final stage of their career with the firm. If workers do not shirk, they will be allowed to stay with the firm and will be able to recuperate their initial losses. If they shirk, however, they run the risk of being caught and dismissed, and therefore of losing the chance to recover the wages owed to them in the last years of their contract. According to Lazear (1979), workers and firms enter into these long-term implicit contracts to discourage shirking and malfeasance by shifting compensation to the end of the contract.

Incentive theories have been difficult to test empirically due to the lack of available data (see Lazear, 1999). This problem is perhaps even more acute with regard to implicit rather than explicit incentives.¹

In the past, there have been several attempts to test the theory presented in Lazear (1979) with the available data sets (see, for example, Lazear and Moore, 1984; Hutchens, 1987; or Barth, 1997, among others).² Most of these studies tested the predictions of the theory in terms of worker's earnings and productivity, the incidence of mandatory retirement or

¹A recent test of explicit incentives is provided in Lazear (2000).

²A review of the literature is provided in the next section.

pensions, or dismissals and tenure. A common characteristic of the existing labor literature is that it uses survey data at the worker level inferring the existence of a relationship between wages and seniority. However, to our knowledge, there is not yet a study that has used a direct measure of the existence of a seniority-based pay policy at the firm level. In this paper, we test empirically the theory of implicit incentives using a new data set which allows us to directly observe whether firms decide to set workers' wages according to seniority or not.³

We use a unique plant level data set that contains information on several firm's personnel practices for 734 Spanish industrial establishments. All surveyed establishments are involved in production processes within the manufacturing sector. Regarding personnel practices, the survey refers to the blue-collar workers in each plant (that is, workers involved directly in production). Overall, we obtain very homogenous data for every surveyed plant. At the same time, a wide scope of different firms within the manufacturing sector are included in the survey.

The main feature of the data set is that it refers to firms rather than individuals and that it contains a considerable number of firms in the survey. This allows us to measure the presence of seniority-based pay from a different perspective than the one traditionally used in the empirical literature of tenure and wages which concentrates on worker level data. Similarly, our data allows us to obtain direct measures of monitoring devices, as well as other measures of explicit incentives practices. Moreover, the use of plant level data allows us to get a better understanding of the role that firm and job characteristics play in the diffusion of deferred payment schemes. This is a question that has been scarcely dealt with in the literature using data at the plant level.

Spain is an interesting case for analyzing seniority-based pay because in this country there is mandatory retirement for all workers at the age of 65. Therefore, all establishments in our sample are subject to this mandate. According to Lazear (1979), jobs with delayed payment contracts should be characterized by mandatory retirement. This institution establishes a termination date after which the worker is not entitled to continue receiving a wage that is

³Bayo-Moriones and Huerta-Arribas (2002a and 2002b), using the same data set as the one we use here, have studied explicit incentives. In Bayo-Moriones and Huerta-Arribas (2002a), the authors investigate the factors that influence the adoption of incentive schemes that link the pay of blue-collar workers to the results achieved by the establishment that employ them, i.e. the so called organizational incentive plans. And in Bayo-Moriones and Huerta-Arribas (2002b), they identify the factors that determine the use of production incentives for manual workers in the Spanish manufacturing industry.

greater than her productivity. In this context, seniority-based pay can become an optimal contract.

Using direct data on firm's personnel practices, we provide empirical support for the theories that are behind the deferred wage schemes as motivation devices. We find that firms that offer seniority-based pay are less likely to offer explicit incentives. They are also less likely to invest in monitoring devices. We also find that firms that offer seniority-based pay rather than explicit incentives are more likely to engage in other personnel practices that imply long employment relationships. Finally, since seniority-based pay could be related to other personnel practices, specially training, we also study if this is the case in our data set.

The paper is organized as follows. In the next section we review the related literature. Section three is devoted to the description of the survey from which we obtained the data used to perform our exercise. In section four we undertake our empirical analysis. We define all the variables used in our exercise and proceed to the descriptive analysis of such variables. The results appear in section five, which is followed by the conclusion.

2 Related Literature

In this section we first review the different theories that try to explain the positive correlation between wages and seniority. We then review the empirical literature that has tested the theory of seniority-based pay as a motivation device.⁴

2.1 Explanatory Theories of Seniority-Based Pay

Although there is an agreement regarding the existence of a positive relationship between seniority and wages, the same cannot be said when the discussion moves to determine the factors that explain it (see, for example, Hutchens, 1989; or Topel, 1991). Some empirical papers show that this positive relationship does not necessarily imply that seniority has an effect on wages (see, for example, Abraham and Farber, 1987; or Altonji and Shakotko, 1987), since tenure is likely to be related to unobserved individual, job and match characteristics that affect wages. However other studies, like Topel (1991), find that this heterogeneity is not so important and that there is a remarkable impact of tenure on wages.

⁴Two interesting surveys about these issues are Hutchens (1989) and Carmichael (1989).

Several explanations have been given for the positive effect of seniority on wages. The most widely recognized and popular is the specific human capital theory (see Becker, 1964; Mincer, 1974; and Felli and Harris, 1996). Specific human capital generates quasi-rents to be shared between worker and employer. The sharing takes place through the increase of wages with tenure, with the main objective of avoiding turnover (see Levine, 1993). Even though the relationship between wages and seniority is positive, it will not be equal to the productivity-seniority profile. In order for the human capital investment to take place, the former will not be as steep as the latter, since the company must reap part of the benefit from its investment in the worker.

The existing empirical evidence is not unambiguously consistent with the specific human capital theory. While a part of the literature has found that wage increases due to seniority have their origin in productivity increases (see, for example, Brown, 1989; and Hellerstein and Neumark, 1995), other part of the literature provides empirical evidence that cast doubt on the validity of the predictions of the specific human capital theory (see Medoff and Abraham, 1980; Kotlikoff and Gohkale, 1992; Levine, 1993; Flabbi and Ichino, 2001; among others) and suggest the need for alternative explanations.

One of these alternative explanations of upward sloping wage profiles is provided by the models of self-selection (see Salop and Salop, 1976). According to these models, these profiles will attract only workers who intend to stay with the company throughout their professional careers. This has a positive impact on the firm due to the reduction in turnover costs. Deferred payment has also been said to appear because firms may insure risk-averse workers who are uncertain about their productivity (see Harris and Holmstrom, 1982) or because workers prefer rising earnings-seniority profiles rather than decreasing or flat profiles (see Loewenstein and Sicherman, 1991; or Frank and Hutchens, 1993).

An alternative view, and the one that we adopt in this paper, is offered by Lazear (1979 and 1981), who approaches the problem from the point of view of worker motivation. Deferred wages schemes can be used to align the interests of the worker with those of the company. The way in which the wage is distributed over time may have an effect on the gains generated in the working relationship. By allowing initial wages to be paid at the end of the employee's career, the firm discourages the worker from engaging in inappropriate behavior, and therefore, increases both the value that the employee can be expected to contribute to the firm and the total amount of wages that this worker receives throughout her career in

the firm. This would imply a steeper association between wages and seniority than between productivity and seniority. This is contrary to the claims of the human capital theory which states that wage growth will always be on a par with or below productivity growth.⁵

There are several implications to Lazear's theory. The first implication is that seniority-based pay becomes unnecessary as a motivational device when workers' compensation depends directly and positively on the degree of effort they are willing to exert in the job and on the results they achieve. In other words, firms are more likely to use implicit incentives when output is more difficult to observe. The second implication is that jobs characterized by seniority-based pay should have higher wage growth rates than productivity growth rates. Similarly, pensions (which discourage shirking until the end of job) are more likely in situations in which implicit incentives are in place. An additional implication of the theory is that firms with jobs in which implicit incentives are in place should implement mandatory retirement in order to fix a termination date, after which wages cannot grow beyond the worker's productivity. The last implication is that long-tenured workers are more likely to have jobs that offer mandatory retirement and pensions. In the next section, we review the empirical literature that has tried to test the theory of implicit incentives.

2.2 Empirical Literature on Implicit Incentives

If linking the wage to seniority is used as a means of motivating workers, it will be applied in circumstances where there is an agency problem. A situation in which there is no problem of this sort is when workers are self-employed, that is, when they are the owners of the firm in which they work. If deferred payment acts as a motivator to workers, the wage-seniority slopes found in self-owned companies ought to be less pronounced than in other types of firms. Lazear and Moore (1984) find empirical evidence to support this argument, since the present value of the lifetime income earned by an employee increases less with the slope of the age-earnings profile in the case of self-employed workers.

Most existing literature has tested the theory on implicit incentives presented in Lazear (1979) by focusing on different implications of the theory. Some authors have concentrated

⁵Carmichael (1983), however, reconciles human capital theory with the fact that wage-seniority profile slopes should be more pronounced than those of the productivity-seniority profile. This author claims that when a job requires specific training, it may prove to be efficient for a firm to pay its more long-standing workers a wage that is above their marginal productivity.

their efforts on the prediction of worker's wage growth, i.e. wages rise more rapidly than marginal product. See, for example, Medoff and Abraham (1980), Lazear and Moore (1984), Spitz (1990) and Lazear (2000). This approach falls directly into the heart of the debate about causality between tenure and wages mentioned in the previous subsection.

Other authors have studied the implications of the theory on mandatory retirement and earnings. Examples of which are the original paper by Lazear (1979) and the paper by Clark and Ogawa (1992) which tests the theory for Japan. Alternative approaches have studied the implications of the theory for dismissals and tenure (see, for example, Idson and Valetta, 1996).

Finally, some papers have used proxies for seniority-based pay to test the implications of the theory. An interesting example that relates to our work is Hutchens (1987). In Hutchens (1987) seniority-based pay is proxied by the degree of monitoring, which in turn is proxied by how repetitive tasks are in a job. The author then analyzes jobs according to the predicted characteristics of Lazear's theory (long tenure, pensions, mandatory retirement, etc.) taking into account the degree of monitoring.

Another paper that relates to our work is Barth (1997). Working with a sample of Norwegian workers, the author reports that workers being paid on a piece work basis have nothing to gain in terms of wage from staying with the same company over a long period of time. The author arrives to this conclusion by estimating a wage regression (controlling for worker seniority) and includes a variable that captures the presence of piece rates along with an interaction term between piece rate and seniority.

A common characteristic of all these papers is that they use survey data at the worker level inferring the existence of a relationship between wages and seniority from worker's wage and tenure data. Our paper, on the other hand, has a direct measure for the existence of a seniority-based pay policy at the firm level. In addition we also have direct measures of both monitoring devices and explicit incentives. Finally, we also have information on other personnel practices that have important implications for the worker's tenure and thus should be related to seniority-based payments.

3 Survey's Description and Data

In this paper, we use a unique data set that contains plant level information on several firm's policies. All surveyed establishments are involved in production processes within the manufacturing sector. Overall, we obtain very homogenous data for every surveyed plant. At the same time, a wide scope of different firms within the manufacturing sector are included in the survey. In what follows we describe the characteristics of the survey and concentrate on the variables that we are going to use in our analysis.

The data was carefully collected in 1998 in the context of a wider research project on human resource management and operations management in the Spanish manufacturing industry. All answers in the questionnaire refer to 1997. The concept of manufacturing industry is clearly defined in the National Classification of Economic Activity (*Clasificación Nacional de Actividades Económicas*, CNAE)⁶ which includes all the manufacturing industries with the exception of the oil refining industry and the treatment of nuclear fuel.

The manufacturing industry was chosen as the focus of research for several reasons. First, it is a sector in which heterogeneity is limited when compared, for example, to other sectors like services. Second, manufacturing is an industry with a very important weight in the economy of Spain. This allows one to draw more general conclusions applicable to a wider range of firms. Moreover, within manufacturing companies it is easier to measure variables such as technology, a key element in the development of the research. Finally, by choosing a wide scope of activities within the manufacturing sector it allows us to obtain fairly general conclusions, while avoiding the problems of data sets that are too general and heterogeneous (see Ichniowski and Shaw, 2003).

In the survey design, it was decided that information should be collected at the plant level. In the manufacturing sector the plant consists of the business unit, which is of strategic importance for the implementation of the practices under study. These practices are adopted in the plant, and therefore, it is at this level that problems arise and where results must be analyzed. Moreover, the answers to the different questions raised are expected to be more reliable when taken at the plant level, since knowledge of these issues is greater at this level, even if it is only due to greater proximity.⁷

⁶This is equivalent to ISIC rev.3 activity classification.

⁷As Osterman (1994) states: "The great advantage of surveying establishments, as opposed to firms, is that the respondent in an establishment is likely to know the facts" (page 174).

Another aspect of the research scope to be decided was the size of the establishments to be analyzed. The industrial plants included in our sample employ fifty or more workers. This limit has been used in other similar studies (see, for instance, Osterman, 1994) and it serves to cover a wide spectrum of the population employed in Spanish industry. Moreover, it simplifies the fieldwork, since for this group of firms there are more reliable directories of the population of firms.

In order to carry out the investigation, a questionnaire was made up jointly by the firm in charge of the fieldwork and the members of the research group. The preliminary survey was piloted in nine plants. After the pilot, the survey was modified in several ways to come up with the final version of the questionnaire. In order to design the questionnaire, the international literature in relation to the content of the project was examined. The questionnaire was divided into the following parts: general characteristics of the establishment, technology and quality management, human resource management, work organization, relations with customers and suppliers, and information on the firm.

Regarding personnel practices, the survey refers to the blue-collar workers in each plant (that is, workers involved directly in the production process). The fact that we refer to a specific group of workers could create problems, as far as the generalization of the results to other professions is concerned. However, limiting the occupation under study makes comparisons easier, since within the company there are possibly several internal labour markets with substantial differences between them.

The information was gathered by interviewing the manager of the plant. In most cases the interview was conducted with either the plant manager or the manager of operations or human resources in the plant. A personal interview was chosen as the method of collecting information because it allows a higher response rate.

The reference universe, that is, manufacturing plants with at least 50 workers, was formed by 6,013 units. The aim was to obtain a sample of one thousand units, stratified according to sector and size. The larger-size stratum was represented at 50 per cent in the sample design. For the two remaining size strata, a fixed number of 30 interviews was allocated to each sector; the rest of the interviews being allocated proportionally across sectors. The sample allocated to each of the strata within a sector was also distributed proportionally. A random selection of plants was taken from each stratum for interview. After making 3,246 telephone calls to make the necessary appointments, 965 valid interviews were conducted.

For the purpose of this paper we analyze a final sample of 734 plants, such that none of the variables have missing values. For this type of data, this is a considerably large sample size.

4 Empirical Analysis

In order to understand if seniority-based pay is used as a motivation device rather than as a simple rule for setting wages, we will proceed as follows. We will first analyze the relationship between seniority-based pay, monitoring devices and explicit incentives. In the presence of an agency problem, the firm can adopt different solutions to increase its output. In the event that monitoring worker's effort is difficult and costly, the firm is more likely to implement implicit incentive devices (such as seniority-based pay). According to this, we expect to find seniority-based pay and monitoring devices to be substitutes. If, however, monitoring worker's effort is easy, the firm can induce output using monitoring devices as well as allowing explicit incentives, such as piece rates. Therefore we also expect to find seniority-based pay and explicit incentives to be substitutes.

Once it is established that seniority-based pay is used as a motivation device, in a second step we analyze other practices that are potentially important for the firm when deciding to choose seniority-based pay to motivate its workers. We consider other personnel practices that favour long term employment relationships. These practices make the firm's commitment to pay high future wages credible and therefore are complementary measures to implicit incentives. They provide further evidence that seniority-based pay is used as an incentive device.

As mentioned earlier, wages can be correlated with worker's tenure for reasons other than those related to incentives. The most obvious alternative that we consider is the existence of training. In a third step we will analyze the relationship between seniority-based pay and training policies.

Different personnel practices are usually chosen simultaneously by a firm, generating "systems" or "bundles" of practices. There are theoretical foundations that explain the complementarities of different policies (see for example, Holmstrom and Milgrom, 1994). We are aware of the possible endogeneity problems of including different personnel practices as independent regressors when estimating the probability that firms use seniority-based pay schemes. However, in the present context, and precisely due to this multidimensional nature

of the firm’s practices, it is very difficult to find instruments. Therefore, we will carefully interpret our results as bivariate relationships between different personnel practices.

In the next two subsections we describe the variables used in our exercise and perform a descriptive analysis of those variables.

4.1 Variables

In this section, we define the variables used in our empirical analysis. Table 1 defines each variable and provides their basic summary statistics.

[TABLE 1 HERE]

The survey contains information on the two most important factors that are accounted for when setting the fixed-part of wages for blue-collar workers. The survey makes a clear distinction between the part of the worker’s remuneration that is fixed and the part of the worker’s remuneration that is variable. There are five possible factors that can determine the fixed-part of wages. These include seniority, worker characteristics (skills, effectivity, evaluation from a supervisor) and job characteristics. Using the information gathered from the survey, we construct two variables *SENIORITYPAY1* and *SENIORITYPAY2*. These will be the main dependent variables in our exercises. *SENIORITYPAY1* takes value one if wages are set according to seniority (i.e. if seniority is recorded as the most important or the second most important factor in determining wages) and zero otherwise. We have also constructed *SENIORITYPAY2* that takes value two when seniority is said to be the most important factor for setting wages, value one when it was mentioned as the second most important factor, and value zero in the remaining cases. These variables directly capture the idea of deferred wages. We find that a substantial fraction of firms follow this policy: around 30 per cent of firms pay according to seniority. Among these, 30 per cent say that seniority is the most important criteria used when setting wages, while for the remaining 70 per cent it is the second most important criteria. This figures are empirically relevant to conduct our exercise.⁸

In the survey firms are asked if they offer incentives to their blue-collar workers. These include incentives that are based on productivity, quality, plant-level or firm’s results. The

⁸We have not been able to find any other paper that studies this variable with a cross section of firms, so we can not establish any comparison.

incentives correspond to the explicit incentives referred to earlier. Using this information, we construct the variable *EXPINCENTIVES* that takes value one if firms answer affirmatively to this question and zero otherwise. As table 1 shows, around 62 percent of firms offer some explicit incentives to their workers.

The survey also contains information on the degree of supervision and control under which manual workers perform their duties at the plant. The answers are in a scale of one to five, where one is equivalent to “no supervision” at all, and five is equivalent to “very supervised”. Using this information we construct the variable *MONITORING* which takes value one if the degree of control is sufficiently high (i.e. values four and five as the answers to this question) and zero otherwise. In our sample, around 40 per cent of firms spend resources in supervising their workers according to this variable.

We now turn to looking at factors other than incentives that can be behind the determination of seniority-based pay schemes. In our empirical analysis, it is important that we control for these factors.

- Sector

In our data set we have information on the sector to which the plant’s activity belongs (at a three digit level). The sector indicators capture the nature of the production technology. This is crucial in determining the ease to monitor effort (see Hutchens, 1987). According to the information available, we can distinguish among 91 different sectors. Since it is very important that we analyze the provision of incentives among plants that have similar difficulties in observing effort, we will include sectorial dummies in all of our regressions.

- Region

The province in which the plants are located also appears in our data set. There are 50 different provinces within Spain which correspond to 17 different Autonomous Communities. Although the labor legislation is exactly the same in all regions, part of the collective negotiation between unions and employers’ representatives is done at the provincial level. Therefore, it may still be important to control for possible province effects, given the existence of potential differences in the negotiation of some labor conditions between unions and employers.

- Age of the establishment

In the data set we also have information regarding the year in which the establishment was founded. We construct the variable *OLD* that takes value one if the establishment was

founded before 1980 and zero otherwise. The year 1980 is particularly relevant in Spain since it is the year in which the Worker's Statute, the main law that regulates the different aspects of labor relations in the Spanish democratic era, was signed.

- Ownership

Different sources of information regarding the ownership structure of the firms are available in the data set. From this information, we construct the following variables. We define the variable *STATESHARE* that takes value one if the state owns a share of the firm and zero otherwise. Around three percent of firms in our sample have some of their shares owned by the state. Among these, on average, 65 per cent of their capital is state owned. Moreover, since the establishments respond if they belong (totally or partially) to a multinational group, we can define the variable *MULTINATIONAL* that takes value one if the firm belongs to a multinational group and zero otherwise.

- Size

The size of the establishment is also available since the data set provides information regarding the number of workers employed at each establishment. We construct the variable *LARGE* that takes value one if the firm has more than 500 workers and zero otherwise.

- Union

The presence and influence of unions in the firm can also be obtained from the available information. In Spain, most large firms negotiate an agreement beyond the regional one that applies solely to that firm. All workers, unionized or not, are subject to this agreement. A unionized worker has the right to enter in this negotiation process, since unionized workers have the right to vote among them their representatives in the negotiation with the firm. The number of unionized workers at the firm can play an important role in determining the type of agreement reached since this number also gives an idea of the strength of unions in the firm (see, for instance, Diaz-Moreno and Galdon-Sanchez, 2004). We construct the variable *UNION* that takes value one if the level of workers' unionization is higher than 60 per cent and zero otherwise.

- Wage Level

Firms are asked to compare the wages paid to their workers with the wages of similar workers in similar firms and in the same region. We construct the variable *WABOVE* that takes value one if firms say that the wages of their workers are above the wages of comparable workers and zero otherwise.

- Foreign Product Markets

The dataset has information regarding the distribution of firms' sales in Spain, Europe and the rest of the world. From this information, we construct the variable *INTSALES* that takes value one if more than 50 per cent of the firm's sales are international and zero otherwise.

Once we establish that seniority-based pay is used as a motivation device, and in order to provide further evidence, we analyze different factors and personnel policies that could be more relevant to the use of seniority-based pay than to the use of explicit incentives. These are described below.

- Temporary (or Fixed-Term) Contracts⁹

The proportion of workers under fixed-term and permanent contracts is also available in the data set. This ranges from zero to 96 per cent. We construct the variable *TC1* that takes value one if there is a positive amount of workers under temporary contracts in the establishment, and value zero if there are only workers under permanent contracts. We also define the variable *TC2* which takes value 1 if at least 20 per cent of the workers at the plant are under a fixed-term contract and zero otherwise.

- Firing policies

There is information regarding firing policies from those firms that have recently fired workers or that were in the process of adjusting their work force at the time. The number of observations for these variables is reduced substantially since many firms in the sample were not in a process of workforce adjustment. In particular, firms were asked about the adoption of alternative policies to avoid firing workers under permanent contracts. We use the information provided for the firms that were involved in this process to define three variables. The first is *NOFIRE* which takes value one if the firm found ways other than firing to adjust its work force and zero otherwise. If firms try to avoid firing workers, the alternative ways of adjustment include reducing the outsourcing production in other firms, relocating workers into other tasks, reducing additional hours of all workers, or reducing the normal hours of work of the affected workers. The second is *EARLYRET* that takes value

⁹In 1984 there was a reform of the Spanish Labor Law that allowed the use of fixed-term contracts for jobs whose nature was not necessarily temporary. These contracts imply much lower termination costs than permanent contracts (see, for instance, Güell, 2000; and Alonso-Borrego et al., 2004, for an analysis of their effect in the Spanish economy).

one if the firm offered early retirement to the older workers in the establishment and zero otherwise. The third is *FIRETC* that takes value one if the firm fires temporary workers first in order to avoid firing permanent workers.

- Training

As we have previously mentioned, wages can be correlated with worker's tenure for reasons other than incentives. A prominent alternative to this explanation is the existence of training. We have information on whether blue-collar workers were offered training courses. From this information we construct the variable *TRAINING*. This variable takes value one if training was offered by the establishment to blue-collar workers and zero otherwise.

4.2 Descriptive Analysis

The descriptive analysis of the variables used in our exercise can be found in table 2. This analysis is based on the variable *SENIORITYPAY2*. The left hand panel of this table displays the summary statistics for the main variables used by firms that set their wages according to seniority, while the central panel displays the summary statistics for the main variables used by firms where seniority is never used as a criteria to set wages. The right hand panel displays the p-values associated with the one-sided tests regarding the difference in variable means for firms that pay according to seniority and those that do not.

[TABLE 2 HERE]

The first important feature to note is that the firms that provide seniority-based pay are less likely to provide explicit incentives than those that do not provide such wage scheme. They also tend to undertake less monitoring in terms of our measure (*MONITORING*), although the difference is not significant. These factors provide some preliminary evidence that seniority-based pay and other incentive mechanisms can be considered substitutive devices. It is also worth noting that these firms tend to be older, partly or totally owned by the state, and larger. Firms that offer wages according to seniority tend to be more unionized, although the difference is not significant. Since the firm's characteristics could affect the way in which the firm sets its wages, it is important to control for these factors in our regression analysis. For example, stated owned and/or large firms may have a preference for rules rather than discretion with regard to their pay schemes. Therefore it is important

to see if the negative relationship between seniority-based pay and explicit incentives, that appears in the data, holds once these variables are included as controls in our analysis.

With regard to other personnel policies, firms that provide seniority-based wages have also a lower proportion of workers under fixed-term contracts. More often they offer the option of early retirement to their workers and, in general, they try to look for alternative ways to adjust their work force rather than firing workers. Regarding training and seniority-based pay, table 2 shows that there is no difference in terms of training between firms that offer seniority-based pay and those that do not.

5 Results

In this section we undertake the empirical analysis and explain the results obtained. We want to investigate if the propensity of a firm to offer delayed payments is related to long-term incentives. That is, to see if the negative correlation between seniority-based pay and other incentive devices (explicit incentives or monitoring devices) remains after controlling for different firm characteristics as well as regional and sectorial controls. In particular, we estimate probit models in which *SENIORITYPAY2* is the dependent variable and then ordered probit models in which *SENIORITYPAY1* is the dependent variable.¹⁰ The results are displayed in tables 3a and 3b, respectively.

[TABLES 3a and 3b HERE]

We start with the most simple specification which includes *EXPINCENTIVES* as an explanatory variable as well as the mentioned controls. As column (1) of table 3a indicates, firms that offer seniority-based pay are less likely to offer explicit incentives, even after controlling for different firm characteristics. This result confirms the findings of Barth (1997). Working with a sample of Norwegian workers, he finds that piece-rate workers have a negligible return to seniority in terms of wages. Column (2) analyzes the relationship between seniority-based pay and monitoring. Again, a negative relationship remains after controlling for firm characteristics. This result is similar to the findings of Hutchens (1987). Using US data, he shows that monitoring difficulties correlate positively with the application of deferred payment schemes.

¹⁰Around 10 per cent of the observations in the sample display no variation withing sectorial and regional dummies and are lost in the estimation.

Jobs that offer piece rate payments are conducive to monitoring (see Lazear, 1979). As Hutchens (1987) clearly explains, in this case, monitoring essentially takes the form of counting the units produced and then workers are paid accordingly. In column (3), we allow both *EXPINCENTIVES* and *MONITORING* as right-hand side variables. Moreover, we allow an interaction term between these two variables. The negative coefficient on these two variables remains in this specification. The coefficient of the interaction term is not statistically different from zero, suggesting that there is no additional effect from firms that invest in monitoring devices while provide incentives.

The variable *OLD* is significant in all specifications. That is, older firms are more likely to use seniority-based pay. This result is in line with the idea that the use of seniority-based pay is a more traditional way of providing incentives.

Table 3b reports the results when repeating the previous exercise using the variable *SENIORITYPAY1* as dependent variable. Overall the same results are found. All these results suggest that seniority-based pay and explicit incentives, as well as monitoring devices, act as substitutes. This implies that seniority-based pay is used as a motivation device and it is the main prediction of Lazear's theory. The intuition is simple: the more difficult a job is to supervise and the less resources devoted by the firm to the control of workers, the more likely it is that the firm relies on deferred payment.

As mentioned earlier, different personnel practices are chosen simultaneously by a firm. One possible way of solving this simultaneity problem is to estimate multivariate probits of the different incentive practices. In this case, the correlation coefficient between the different equations captures the relationship between the different practices. We estimate bivariate probit models in which *SENIORITYPAY2* and *EXPINCENTIVES*, and *SENIORITYPAY2* and *MONITORING*, respectively, are the dependent variables (columns (1) and (2) in table 4). We also estimate a trivariate probit model in which *SENIORITYPAY2*, *EXPINCENTIVES* and *MONITORING* are the dependent variables (column (3) in table 4).¹¹ As can be seen, the correlation coefficients between the variables *SENIORITYPAY2* and *EXPINCENTIVES*, and *SENIORITYPAY2* and *MONITORING* are negative and significant, providing further evidence that these are substitutive practices. The correlation coefficient between the variables *EXPINCENTIVES* and *MONITORING* is positive but not significant.

¹¹For estimation of this type of models see, for instance, Cappelari and Jenkins (2003).

[TABLE 4 HERE]

Once we have established that seniority-based pay is a substitute for other motivation devices, we analyze further the relationship between this policy and other personnel practices. Economic theory suggests that firms that decide to use seniority-based pay as an incentive device, rather than using explicit incentives, should complement the policy with other personnel practices that give the firm the necessary credibility to commit to future wages. As Hutchens (1987) states, delayed payment schemes should be accompanied by long job tenure. However, this should not be the case for firms that offer explicit incentives. Table 5a displays the estimates of trivariate probit models in which *SENIORITYPAY2*, *EXPINCENTIVES* and *MONITORING* are the dependent variables. In these regressions, different personnel practices are included. In particular, the use of short duration contracts is analyzed. The left-hand panel in table 5a displays the results for the variable *TC1* and the right-hand panel displays the results for the variable *TC2*.

[TABLE 5a HERE]

Overall, the regressions displayed in table 5a show that firms that opt for deferred incentives are less likely to use short duration contracts.¹² This result indicates a commitment to long employment relations that can be rationalized in terms of the incentive role of seniority-based pay practices. Instead, as expected, the coefficients of *TC1* and *TC2* are not in general significant for the equations in which the dependent variables are *EXPINCENTIVES* or *MONITORING*. The correlation coefficients between these variables are similar, although smaller, to those reported in table 4.

We next analyze different firing policies. As mentioned, these variables have fewer observations because only the firms that have been recently under a process of restructuring have to answer the questions related to firing policies. For this reason, we are forced to estimate separate probit models (rather than a trivariate probit) in which *SENIORITYPAY2*, *EXPINCENTIVES* and *MONITORING* are the dependent variables.¹³ Table 5b displays these estimates.

¹²Ordered probit estimates in which *SENIORITYPAY1* is the dependent variable provide similar results (available upon request).

¹³In these estimations, to maximize the number of observations, regional dummies correspond to the 17 Autonomous Communities instead of the 50 provinces.

[TABLE 5b HERE]

The left-hand panel of table 5b analyzes the *NOFIRE* variable. Firms that offer seniority-based pay are less likely to fire workers and more likely to find other solutions to avoid dismissal. However, when *EXPINCENTIVES* and *MONITORING* are the dependent variables, the coefficient of this variable is not significant. The middle-panel of table 5b analyzes the *EARLYRET* variable. Firms that offer seniority-based pay tend to offer early retirement more often, although the coefficient is not significant. The coefficient is not significant either for the other two regressions. Finally, the right-hand panel of table 5b analyzes the *FIRETC* variable. Firms that offer seniority-based pay also tend to fire their temporary workers more frequently than their permanent workers, although the coefficient is again not significant. For the other two regressions, the coefficient is not significant either. Overall these results suggest that firms that choose seniority-based pay also choose other personnel practices that imply long employment relationships, which is consistent with the idea that seniority-based pay is used to provide long-term incentives.

As mentioned before, there are alternative theories that predict a positive relationship between wages and seniority for reasons other than the provision of incentives. In particular, this could be the case in the presence of training policies. In what follows we estimate a probit model in which the dependent variable is *SENIORITYPAY2* (and an ordered probit in which the dependent variable is *SENIORITYPAY1*). In this model, we include the variable *TRAINING* as an explanatory variable. Table 6 displays the results of this exercise.

[TABLE 6 HERE]

The main result in this table is that training and seniority-based pay are negatively related. The coefficient is not statistically different from zero in the case of the probit model, but it is significant when using an ordered probit. This result suggests that firms that offer seniority-based pay are not more likely to train their workers than firms that do not pay according to accumulated tenure. Several caveats are worth noting. First, the variable *TRAINING* is a general measure of training and not necessarily training on firm-specific skills. Second, this variable captures training activities from the previous year and not overall

training activities nor training required in the current job.¹⁴

Of course, our findings do not rule out training as a mechanism that generates a positive correlation between wages and seniority or that trained workers receive higher wages through their tenure. From our sample, however, it does suggest (keeping these caveats in mind) that there are reasons beyond training that explain the practice seniority-based pay. In this paper, we have argued that there is evidence that seniority-based pay is used as an incentive device.

6 Conclusions

In this paper we have empirically tested the theory of long term implicit contracts using plant level data. In particular, we have analyzed the possible motivation role of seniority-based pay schemes. Unlike previous papers, we have used a direct measure of such firm practice.

Our main result is that firms that offer seniority-based pay are less likely to offer explicit incentives in the form of piece-rates. They are also less likely to invest in monitoring devices. This result holds after controlling for several firm characteristics. Another interesting result arising from our exercise is that firms that offer seniority-based pay are likely to engage in other personnel practices that imply long employment relationships. These practices make the firm's commitment to pay high future wages credible and therefore are complementary measures to implicit incentives. Overall, our plant level data provide empirical support to the implicit incentives theory proposed by Lazear (1979).

We think that in order to properly test personnel economics theories, plant level data on firm's practices is required. The data is costly to gather and has so far been scarce, but it contains valuable information that can shed new light on testing personnel economic theories.

¹⁴Barth (1997) has information on the job's required level of on-the-job training. He finds that firm-specific training has a negative effect on the tenure wage profile.

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Table 1. Variable Definitions and Descriptive Statistics

Variable	Definition	Mean	Std. Dev.
<i>SENIORITY PAY1</i>	2 = seniority mentioned first, 1 = seniority mentioned second, 0 = otherwise	0.372	(0.636)
<i>SENIORITY PAY2</i>	1 = wages set according to seniority, 0 = otherwise	0.287	(0.452)
<i>EXPINCENTIVES</i>	1 = explicit incentives provided, 0 = otherwise	0.619	(0.485)
<i>MONITORING</i>	1 = workers subject to high supervision, 0 = otherwise	0.396	(0.488)
<i>OLD</i>	1 = plant founded before 1980, 0 = otherwise	0.738	(0.439)
<i>STATESHARE</i>	1 = state owns a share of the firm, 0 = otherwise	0.034	(0.181)
<i>MULTINATIONAL</i>	1 = firm belongs to multinational group, 0 = otherwise	0.287	(0.452)
<i>LARGE</i>	1 = firm with more than 500 workers, 0 = otherwise	0.107	(0.309)
<i>UNION</i>	1 = unionization of workers above 60 %, 0 = otherwise	0.318	(0.467)
<i>WABOVE</i>	1 = wages above similar workers in similar sector and region, 0 = otherwise	0.419	(0.493)
<i>INTSALES</i>	1 = more than 50 % of sales sold abroad, 0 = otherwise	0.241	(0.428)
<i>TRAINING</i>	1 = training provided, 0 = otherwise	0.792	(0.406)
<i>TC1</i>	1 = share of temporary workers >0, 0 = otherwise	0.857	(0.348)
<i>TC2</i>	1 = share of temporary workers >20%, 0 = otherwise	0.385	(0.487)
<i>EARLYRET*</i>	1 = early retirement offered under workforce reduction process, 0 = otherwise	0.685	(0.465)
<i>FIRETC*</i>	1 = fire temporary workers under workforce reduction process, 0 = otherwise	0.488	(0.500)
<i>NOFIRE*</i>	1 = find alternative measures to dismissal under workforce reduction process, 0 = otherwise	0.657	(0.474)
Number of obs.			734

* For these variables, the number of observations is 178.

Table 2. Descriptive Statistics, by Seniority Based Pay

Variable	Seniority-Based Pay ¹		Non Seniority-Based Pay ²		p-value
	Mean	Std. Dev.	Mean	Std. Dev.	
<i>EXPINCENTIVES</i>	0.578	(0.495)	0.636	(0.481)	0.069
<i>MONITORING</i>	0.364	(0.482)	0.409	(0.492)	0.134
<i>OLD</i>	0.819	(0.385)	0.705	(0.456)	0.000
<i>STATESHARE</i>	0.061	(0.241)	0.022	(0.149)	0.004
<i>MULTINATIONAL</i>	0.289	(0.454)	0.284	(0.451)	0.454
<i>LARGE</i>	0.156	(0.364)	0.087	(0.283)	0.003
<i>UNION</i>	0.327	(0.470)	0.315	(0.465)	0.381
<i>WABOVE</i>	0.426	(0.495)	0.416	(0.493)	0.404
<i>INTSALES</i>	0.218	(0.413)	0.250	(0.433)	0.176
<i>TRAINING</i>	0.767	(0.423)	0.801	(0.399)	0.157
<i>TC1</i>	0.796	(0.403)	0.883	(0.321)	0.001
<i>TC2</i>	0.289	(0.454)	0.424	(0.494)	0.000
<i>EARLYRET</i> ³	0.768	(0.425)	0.633	(0.484)	0.029
<i>FIRETC</i> ³	0.507	(0.503)	0.477	(0.501)	0.470
<i>NOFIRE</i> ³	0.594	(0.494)	0.697	(0.461)	0.092
Number of obs.	211		523		

¹SENIORITYPAY2 = 1.

²SENIORITYPAY2 = 0.

³For these variables, the number of observations is 69 for Seniority-Based Pay and 109 for Non Seniority-Based Pay.

**Table 3a. Seniority-Based Pay and Explicit Incentives.
Probit Estimates**

Variable	(1)	(2)	(3)
<i>EXPINCENTIVES</i>	-0.296 (0.127)		-0.412 (0.162)
<i>MONITORING</i>		-0.269 (0.124)	-0.465 (0.208)
<i>EXPINCETIVES X MONITORING</i>			0.318 (0.259)
<i>OLD</i>	0.479 (0.145)	0.454 (0.144)	0.482 (0.146)
<i>STATESHARE</i>	0.242 (0.359)	0.255 (0.357)	0.155 (0.365)
<i>MULTINATIONAL</i>	-0.085 (0.148)	-0.097 (0.149)	-0.109 (0.150)
<i>LARGE</i>	0.116 (0.211)	0.074 (0.211)	0.110 (0.212)
<i>UNION</i>	0.076 (0.134)	0.078 (0.134)	0.095 (0.135)
<i>WABOVE</i>	-0.062 (0.124)	-0.078 (0.125)	-0.051 (0.125)
<i>INTSALES</i>	-0.039 (0.158)	-0.023 (0.158)	-0.009 (0.160)
Constant	-0.924 (0.541)	-0.914 (0.544)	-0.669 (0.556)
SECTOR DUMMIES	Y	Y	Y
REGION DUMMIES	Y	Y	Y
Log Likelihood	-347.895	-348.249	-344.934
Chi-squared	112.80	112.10	118.73
Number of obs.	654	654	654

Note. Standard errors in parenthesis

**Table 3b. Seniority-Based Pay and Explicit Incentives.
Ordered Probit Estimates**

Variable	(1)	(2)	(3)
<i>EXPINCENTIVES</i>	-0.236 (0.117)		-0.339 (0.149)
<i>MONITORING</i>		-0.276 (0.116)	-0.451 (0.191)
<i>EXPINCETIVES X MONITORING</i>			0.283 (0.239)
<i>OLD</i>	0.400 (0.137)	0.385 (0.136)	0.407 (0.137)
<i>STATESHARE</i>	0.109 (0.308)	0.122 (0.307)	0.032 (0.312)
<i>MULTINATIONAL</i>	-0.082 (0.137)	-0.092 (0.138)	-0.100 (0.138)
<i>LARGE</i>	0.079 (0.192)	0.042 (0.193)	0.062 (0.193)
<i>UNION</i>	0.105 (0.122)	0.109 (0.122)	0.120 (0.123)
<i>WABOVE</i>	-0.026 (0.116)	-0.036 (0.116)	-0.014 (0.117)
<i>INTSALES</i>	-0.007 (0.149)	0.003 (0.149)	0.018 (0.150)
Ancillary parameter 1	0.670 (0.497)	0.614 (0.500)	0.425 (0.509)
Ancillary parameter 2	1.630 (0.499)	1.579 (0.502)	1.394 (0.510)
SECTOR DUMMIES	Y	Y	Y
REGION DUMMIES	Y	Y	Y
Log Likelihood	-487.727	-486.886	-484.264
Chi-squared	160.69	162.37	167.62
Number of obs.	663	663	663

Note. Standard errors in parenthesis

Table 4. Multivariate Probit Estimates. Correlation Coefficients

	(1)	(2)	(3) ¹	
	<i>SENIORITY PAY2</i>	<i>SENIORITY PAY2</i>	<i>SENIORITY PAY2</i>	<i>MONITORING</i>
<i>EXPINCENTIVES</i>	-0.197 (0.074)		-0.193 (0.074)	0.089 (0.073)
<i>MONITORING</i>		-0.168 (0.073)	-0.158 (0.074)	
CONTROLS ²	Y	Y	Y	
Log Likelihood	-729.913	-759.300	-1138.631	
Chi-squared	196.03	190.25	291.32	
Number of obs.	734	734	734	

¹Simulated maximum-likelihood estimates using GHK smooth recursive simulator (100 random draws).

²As in Table 3a.

Note. Standard errors in parenthesis

Table 5a. Incentives and Other Personnel Practices. Trivariate Probit Estimates¹

	Dependent variables ²					
	(1)	(2)	(3)	(1)	(2)	(3)
TC1	-0.422 (0.173)	0.203 (0.174)	0.333 (0.168)			
TC2				-0.372 (0.136)	0.223 (0.128)	0.178 -0.124
CONTROLS ³		Y			Y	
Rho12		-0.183 (0.075)			-0.182 (0.075)	
Rho13		-0.147 (0.074)			-0.153 (0.074)	
Rho23		0.083 (0.073)			0.085 (0.073)	
Log Likelihood		-1133.683			-1133.065	
Chi-squared		297.76			298.32	
Number of obs.		734			734	

¹ Simulated maximum-likelihood estimates using GHK smooth recursive simulator (100 random draws).

² The dependent variables are: (1) = *SENIORITYPAY2*; (2) = *EXPINCENTIVES*; (3) = *MONITORING*.

³ As in Table 3a.

Note. Standard errors in parenthesis

Table 5b. Incentives and Other Personnel Practices. Probit Estimates

	Dependent variables ¹								
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
<i>NOFIRE</i>	-1.140 (0.552)	0.076 (0.482)	0.626 (0.375)						
<i>EARLYRET</i>				0.532 (0.516)	-0.004 (0.490)	-0.183 (0.384)			
<i>FIRETC</i>							1.042 (0.586)	-0.502 (0.493)	-0.453 (0.386)
CONTROLS ²	Y	Y	Y	Y	Y	Y	Y	Y	Y
Log Likelihood	-43.116	-42.863	-64.861	-44.998	-42.875	-66.203	-43.739	-42.355	-65.61
Chi-squared	64.38	49.76	32.58	60.61	49.74	29.89	63.13	50.78	31.08
Number of obs.	111	98	120	111	98	120	111	98	120

¹ The dependent variables are: (1) = *SENIORITYPAY2*; (2) = *EXPINCENTIVES*; (3) = *MONITORING*.

² As in Table 3a.

Note. Standard errors in parenthesis

Table 6. Seniority-Based Pay and Training

Variable	Probit (1)	Ordered Probit (2)
<i>TRAINING</i>	-0.262 (0.157)	-0.304 (0.146)
<i>OLD</i>	0.447 (0.144)	0.374 (0.136)
<i>STATESHARE</i>	0.322 (0.356)	0.190 (0.307)
<i>MULTINATIONAL</i>	-0.068 (0.149)	-0.060 (0.138)
<i>LARGE</i>	0.110 (0.210)	0.090 (0.192)
<i>UNION</i>	0.082 (0.134)	0.115 (0.122)
<i>WABOVE</i>	-0.07 (0.124)	-0.027 (0.116)
<i>INTSALES</i>	-0.034 (0.158)	-0.004 (0.148)
Constant	-0.958 (0.539)	
Ancillary parameter 1		0.615 (0.499)
Ancillary parameter 2		1.578 (0.501)
SECTOR DUMMIES	Y	Y
REGION DUMMIES	Y	Y
Log Likelihood	-349.221	-487.584
Chi-squared	110.15	160.98
Number of obs.	654	663

Note. Standard errors in parenthesis