Labor market rigidities and economic efficiency: considering labor as a dynamic input*

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Very preliminary and incomplete

Abstract

The objective of this paper is to evaluage the efficiency consequences of labor market rigidities. Firstly, we estimate a production function taking into account the duality of the Spanish labor market. We consider two types of labor input depending on the magnitude of the dismissal costs: a dynamic input determined by permanent contract workers and a variable non-dynamic input determined by the temporary workers. Secondly, we evaluate the effects of the 90's labor market reforms that removed the flexibility of temporary workers. To do that we estimate the gap between the marginal revenue product of labor and its marginal cost and we examine the changes in this gap during the nineties. The data used to conduct this analysis is a panel of Spanish manufacturing firms from 1990 to 2001. Our findings suggest that the gap for temporary workers had increased after the reforms, indicating a loss of efficiency. Moreover we analyze the relation between temporary contract workers and firm productivity, obtaining a non-lineal relationship.

Keywords: productivity, fixed-term contracts, permanent contracts, manufacturing sector.

JEL Classification: L22, L12

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INTRODUCTION

Traditional economic theory suggests that firms adjust employment to equate the marginal revenue product of labor to its marginal cost. However, in practice, firms are confronted with several rigidities that could prevent them from adjusting labor immediately to its optimal level. Job security provisions, such as dismissal cost, may discourage a firm from hiring when a positive shock pushes the marginal revenue product of labor above its wage because it shall now take into account the fact that some workers may have to be dismissed in the future if they are not adequate for the job or if demand turns down (Bertola, 1990; Hopenhayn and Rogerson, 1993). Or hiring could even diminish if job security provisions increased the insider power of incumbent workers, thus resulting in higher wages for insiders (Caballero and Hammour, 1997).

The effect of employment protection laws on economic performance has recently sparked an increasing debate among economists (Freeman, 2005). Beginning with the seminal work of Lazear (1990), there has been a broad and growing literature that explores the consequences of job security provisions, such dismissal costs, on the labor market performance and productivity.[1] Addison and Teixeira (2001) and Heckman and Pages (2004) summarized some of the findings obtained by different papers analyzing the effect of job security regulations on employment, unemployment, turnover, etc.[2] A lower number of papers have focussed on the effect of employment protection laws (EPL) on productivity, Autor et al. (2007) provides direct evidence that employment protections may reduce firm-level productivity, using establishment-level data from the Census Bureau. Dolado and Stucchi (2008) analyze the effect of temporary contracts in Spain on firms' TFP.[3] Their main findings are that firms with a larger share of temporary workers are less productive than those with a lower proportion.

There is another recent line of research that evaluates how changes in EPL has affected labor market outcomes in different countries; Eslava et al (2004) in Colombia; Hunt (2000) in German; Boeri and Garibaldi (2007) in Italy; Petrin and Sivadasan (2006) in Chile or Aguirregabiria and Alonso-Borrego (2009) in Spain. The general conclusions of these papers

[1]Lazer (1990) found that dismisal costs have negative effects on employment and activity rates, and a positive effect on unemployment, using a panel of OECD countries. Bentolila and Bertola (1990) and Bertola (1990) by means of calibration of theoretical models find that EPL has negligible effects on employment. Hopenhayn and Rogerson (1993), using US data, obtain that an introduction of dismissal costs would reduce employment significantly. More recently Messina and Valanti (2007) analize the impact of dismissal restriction on job flow dymanics across 14 European countries. Their results claim that stricter EPL reduces both the creation and destruction of jobs.

[2]Heckman and Pages (2004) had pointed out that "while the aggregate evidence on the effects of job security on the level of employment is inconclusive, the microstudies assembled here find a large and negative effect of job security on employment".

[3]None of this papers distinguish between temporary or permanent workers in the estimation of the production function.

indicate a positive effect of those regulations that increase labor market flexibility.

Under the belief that employment protection laws negatively affects economic performance, during the eighties of the last century a number, several countries had reformed their labor markets. These reforms introduced two tier systems, as the increase labour market flexibility took place mainly through a series of marginal reforms that liberalized the use of temporary (fixed term) contracts while leaving unchanged the legislation applying to permanent (open-end) employment (Boeri and Garibaldi, 2007).

Spain was not alien to the process and, in 1984, it relaxed the labor market by allowing employers to hire fixed-term workers without restrictions (Dolado et al., 2008). But the Spanish labor market evolved differently than the rest of the EU countries after implementing these reforms. On the one side, it continues be one of the developed countries with the most stringent regulation for permanent contracts[4]. On the other side, it has the highest share of fixed term-contract workes, which entail much lower dismissal costs (Dolado, et al. 2002).

During the nineties, two countervailing reforms (1994 and 1997) were aimed to reduce the incidence of temporay employment in the Spanish economy and thus the duality of the labor market[5].

In this paper we use Spanish manufacturing data to analyze two issues. First, we use the labor market reforms that took place in the mid-90's to discusss whether tightening the requirements to hire fixed-term contract workers had efficency consequences. To do this we follow the gap approach developed by Petrin and Sivadasan (2006). The gap between the marginal revenue product of labor and its marginal cost is a way to assess the impact of rigidities in the labor market on efficiency (Gali et al. 2007). This gap should be zero in a totally flexible labor marker or should decrease when reforms liberalize the labor markets. Petrin and Sivadasan (2006) suggest that this gap should shrink toward zero if regulations diminish labor adjustment cost or increase from zero if these regulations introduce greater rigidities, negatively affecting efficiency. Second, we analyze whether there is a negative association between the share of temporary employment and productivity.

In order to accomplish the above issues we need to estimate a production function. Empirical papers dealing with the estimation of production functions assume generaly, that labor is a non-dynamic and totally variable input. However, this assumption is not supported in Spain, mainly due to the duality of its labor market. Our basic framework for estimation is taken from Olley and Pakes (1996) and Ackerberg et al. (2008), but we modify their estimation tecniques to account for the special features of the Spanish labor market. We consider two types of labor inputs, on the one hand, permenent employment considered

[4]Bentolila and Dolado (1994) had found deep differences in mandatory dismissal payments among Europan countries for fair and unfail dismissals. France, Greece, Portugal, and Spain are the countries with the most strigent regulation and Denmark and the UK the less severe.

[5]See Dolado et al. (2002) for an evaluation of the main aspects of these reforms and their results.

as a dynamic input due to: it is costly to adjust due to the high dismissal costs and past levels affect the current decisions independent of current costs and demand conditions. On the other hand, temporary employment, considered as a non-dynamic variable input, given that this type of labor contract is short-term, with no guarantee of renewal and with no dismissal costs at the end of the contract.

The data used to conduct this analysis is a panel of Spanish manufacturing firms from 1990 to 2001 provided by the Firms Strategies Survey (ESEE, Encuesta Sobre Estrategias Empresariales). The advantages of this survey are that it recovers information about the firm's output price and the labor costs without including the dismissal costs. On the one hand, Feldstein (2008) shows the importance of using the firm's output price to deflate the marginal revenue product as well as that firm's labor cost, which are the basic components for estimating the gap. On the other hand, deflating total revenue by the firm's output price eliminates the unobservable relative price shocks in the estimation of the production function equation that arises when it is deflacted by a general output price index (de Loecker, 2007; Pakes, 2008). Finally, the availability of labor cost net of dismissal costs gives a measure of the marginal cost of labor. If these labor cost were to include dismissal costs then average wages would be higher in those firms dismissing workers, and this would create problems when interpreting the gap between the marginal revenue product of labor and the worker's compensation.

The rest of the paper is organized as follows. Section 2 provides a brief discussion of employment protection regulation in Spain. Section 3 presents the dataset and some empirical facts on temporary worker flows and the effectiveness of the regulatory policies. In section 4 we discuss the econometric methodology and in section 5 we present the main results. We conclude in the last section.

TWO LABOR INPUTS DEFINED BY EMPLOYMENT PROTECTION LAWS

Under the belief that EPL could affect the performance of the labor market, during the eighties several European countries put forward a set of labor reforms to introduce more flexibility to the process of hiring and laying-off workers by the firms[6]. The main characteristics of these reforms was to relax the restrictions on the use of fixed-term contract workers and leave basically unchanged the employment protection for permanent workers.

Employment protection legislation includes all those provisions that increase the cost of

[6] Several european countries as France, Germany, Greece, Italy, Netherlands, Portugal and Spain increased the flexibility of their labour markets liberalizing temporary contracts. Although regulations vary, a common feature of fixed-term contracts is that severance pay and dismissal protection are lower than those for indefinite or permanent contracts. Since their introduction, fixed-term contracts have accounted for most new hirings in these countries (OECD, 1993).

dismissing or hiring a worker. For example, these provisions include monthly severance payment, lay-off procedures, the inability to use some type of working contracts, the restrictions in the amount of working hours, etc. There is a great diversity of employment protection regulations between countries, Figure 1 shows the OECD index which ranks countries from less to more job protective (Employment Outlook, 1999). The resulting portrait shows that southern European countries stand out for having relatively strict employment protection while the English speaking countries face the least protective ones[7]

The liberalizing process in Spain began in 1984 with the approval of a bill that relaxed the restrictions on the use of fixed-term contract workers. Before 1984, firms could only use this type of contract to account for the short run demand fluctations. This new legislation authorized the use of fixed-term contracts to cover basically any type of labor needs by the firm. The implicit target of this legislation was to diminish labor adjustment cost because fixed–term contract workers received no dismissal payment at the end of the contract or 12 days wages per year worked if the worker is firing before, which could not be appealed in labour court[8]. On the other side, this legislation did not modify the employment regulation of permanent workers[9].

The share of temporary workers on total employment surge from less than 10% in 1984 to more than 30% in the 1990s. In other terms, under this new scenario firms were more prone to demand fixed-contract workers in contraposition to permanent workers. One of the reasons for this behavior could be the fact that Spain is one of the developed countries with the highest expected discount cost of firing a worker (Heckman and Pages 2000). This is also suggested by the results shown in Figure 2, where there is a clear correlation between the employment protection regulation and the share of temporary workers -i.e. Spain has the highest share of temporary workers and one of the stringest EPL index.

During the nineties, Spain undertook two labor reforms, 1994 and 1997, aimed to reduce the use of fixed-term contracts. The first one restored the principle of causality in the application of temporary contracts (i.e. there need to be an objective cause to use them) and also offered fiscal incentives for their conversion into permanten contracts. Despite of this reform, temporary employment continued to increase until 1997 either because of lack of enforcement or because of the existence of a bunch of other type of temporary

[7] There are some institutional differences that would explain the difference. In particular, the former countries, such as Spain, Portugal or France, are characterized for having labor codes based on the civil law system regulating each of the permissible types, duration and conditions of labor contracts. The law in the latter is used to basically enforce privately agreed contracts.

[8] Fixed-term contract tends to have a very short duration (6-12 months) and have a maximun of renewal of three years.

[9] Mandatory severance payments for permanent workers were 20-day wages per year of tenure (up to a maximum of 12 month of wages) if the dismissal was considered fair, and 45 days wages per year of tenure (up to a maximum of 42 months of wages) if the dismissal is unfair. Workers can always apeal to labour courts, which tend to rule in favor of workers. Over 70 percent of terminations appealed to courts between 1986 and 2003 were ruled in favor of workers (Galdon-Sanchez and Güell, 2000).

contracts that firms could use to adjust its employment needs. The 1997 reform introduced a new permanent contract with lower dismissal costs and fiscal incentives for all those new transformations[10].

These reforms were not too effective in reducing the share of temporary workers in the Spanish economy, i.e. the share fell from 35.4% in 1995 to 32% in 2001 (Dolado et al. 2000)[11].

In sum, these facts suggest that firms are confronted with rigidities when trying to adjuts permanent workers but not when adjusting temporal workers.

A FIRST APPROXIMATION TO THE DATA

The primary interest of this section is to discuss the empirical regularities in the adjustment of labor input taking into account the facts that have been discussed in the previous sections. In particular, if temporary workers do not suffer of serious adjustment cost we should observe a higher frequency of adjustment compared with permanent workers (Bertola et al., 2000).

The data set used in the application that follows comes from the Encuesta Sobre Estrategias Empresariales (ESEE) survey, a firm-level survey of Spanish manufacturing sponsored by the Ministry of Industry. Our sample is an unbalanced panel from 1991 to 2001 representative of Spanish manufacturing firms. The sample period covers a complete industrial cycle, ranging from the end of a boom of the Spanish economy (1991), a short but strong downturn (1992-1993) and the following economic growth that continue all the period. The panel of firms contains 17,395 observations that correspond to more than 2100 firms observed an average of 8 years. A first characteristic of the data set is that at the beginning of this survey in 1990, 5% of firms with up to 200 workers were sampled randomly by industry and size strata. All firms with more than 200 workers were asked to participate, and the rate of participation reached approximately 70% of the population of firms [12]. A second characteristic of the data set is that in subsequent years the initial sample properties have been maintained. In other term, exit attrition has been mitigated by substituting exit manufacturing firms by newly created firms following the same sampling criteria as in the base year (Jaumandreu and Doraszelski, 2009).

Finally, this data base includes information on capital stock, materials, production (sales

[10] The calculation of the severance payment fell from 42 to 33 days per year worked and from a maximum of 42 months to 24 months. Second, there was a significant reduction on employers payroll taxes for two years for all those new transformations. Any workers except for unemployed aged 30 to 45 years old could be hired under the new permanent contract. Moreover, there was a significant reduction on employers payroll taxes for two years for all those new transformations.

[11] There are a number of recent papers that try to evaluate the effectiveness of these reforms in promoting permanent employment, i.e. Dolado et al (2002), Kugler et al (2003) or Méndez (2008).

[12] In the Appendix we give a more detailed description of the survey.

and inventories) as well as on the price changes of output and inputs and the capacity utilization. All this information makes the ESEE especially adequate to conduct our analysis.

The survey has information on a firm-year bases of the number of workers by type of contract (temporary or permanent). For temporary contract workers firms reports the number of workers each quarterly. To maintain measurement consistency, we have calculated temporary employment in annual terms by obtaining the simple average of the quarterly employment. For permanent contract workers firms reports the number of full and part-time workers. In this case we obtain the average number of permanent workers as the sum of all full time workers and half of part-time workers.

Table 1 reports the number of observations by firm size and the distribution of workers by type of contract. Overall, approximately two of every five workers in the manufacturing industry are fixed term workers. However, there are important differences with respect to the size of the firm. The median of temporary workers per firm is only one of every ten workers in big firms but reaching to 4 of every ten workers for small and medium firms. In other terms, it seems as if termporary workers in big firms are only marginal while in small firms they play an important role in production.

In Table 2 we present the estimated coefficents obtained, from regressing the share of temporary employment on variables that capture the dynamism of the firm's market, the capacity utilization, the age of the firm and year dummies. As could be expected, the share of temporary workers is positively related to increases in demand, captured either by a higher capacity utilization or by the firm being confronted with an expansive market. Additionally, younger firms tend to have a higher share of temporary workers than older firms, i.e. risk factors in a context of labor adjusment costs could explain this fact. The time dummies show that the share of temporary employment in the Spanish industry reached its peak in 1993 and started falling after the 1994 labor reform that introduce restrictions for hiring temporary workers.

Finally, the theory argues that dismissal costs should discourage permanent labor adjustment. Therefore, we should observe a higher adjustment frequency for temporary than for permanent workers. Empirical studies have found that labour turnover tend to be negatively related to EPL ranking. In the U.S. and Canada, for example, labor turnover is about twice as high as in most European countries (Bertola, Boeri and Cazes, 2000).

In order to measure employment flows of temporary and permanent jobs in Spanish manufacturing firms, we use the growth rate of employment proposed by Davis and Haltinwanger (1992) defined as the change in firm employment form t-1 to t divided by the average of firm employment at time t and $t-1$,

$$g_{it}^{J} = \frac{n_{it}^{J} - n_{it}^{J}}{x_{it}^{J}}$$

where $J = T$ for temporary employment or P for permanent, n_{it} is the number of workers of the firm i in the year t and x_{it} is the average of firm employment at time t and $t-1$.This growth rate measure is symmetric at about zero, and it has a closed interval [-2,2][13]. The value -2 corresponds to a firm that dismiss all the workers (or an exit firm) and the value 2 corresponds to firms that hire all the workers (or an entry firm).

In Figures 4 and 5 we present an histogram showing these employment flows distinguishing between the size of the firms. Overall, these figures support what could be expected under the existence of adjustment cost of permanent workers: the net employment flow magnitudes for temporary workers are significantly higher than for permanent contracts. Moreover, small and medium firms adjust significantly more its temporary workers than big industries.

In sum, the above discussion support our argument that in the Spanish manufacturing firm there are two types of labor input. One, temporary workers, with low dismissal costs and a high frequency of adjustment. The other one, permanent waorkers, with a lower frequency of adjustment and important dismissal or adjustment costs. Moreover, the important share of temporary workers is concentrated in small and medium firms, i.e. only a small fraction of workers in big firms are temporary workers. Given this facts, we will work only with small and medium size firms.

PRODUCTIVITY ESTIMATION

Traditionally, productivity has been understood as output differences between firms that cannot be explained by input differences: one firm is more productive or efficient than another if it is able to produce more output using the same inputs or same output with less inputs (Shy, 1995). However, the measurement of productivity is a difficult task for an analyst. In general, not only the production technology of each firm is not observed, but neither output nor inputs quantities nor firm's prices or market power, etc. A significant set of assumptions are needed in order to recover productivity from the estimation of the production function and the credibility of the estimator profoundly depends on the credibility of these assumptions (Manski, 1995). In this paper we follow the empirical strategy developed by Olley and Pakes (1996) but introducing the modifications suggested by Ackelberg et al. (2008).

In what follows we present step by step the problems we are confronted with the estimation of the production function and how we deal with them. Let the firm's i production function at time t be given by

$$Q_{it} = L_{it}^{\beta_l} K_{it}^{\beta_k} M_{it}^{\beta_m} \exp\left(\beta + \omega_{it} + \eta_{it}\right)$$

where Q_{it} stands for quantity produced by firm i at time t, L_{it} is the labor input, K_{it} is capital, β_l, β_k are the parameters of the production function and the constant term β captures the mean productivity across firms.

[13] This measure is monotonically related to the conventional growth rate measure, and the two measures are approximately equal for small growth rates (see Davis and Haltinwanger, 1992).

The firm's managerial ability, its expected down-time due to machine repairments or breakdowns are capture through ω_{it}, which is observed or predictable by firms when they choose inputs or take exit decisions but is not by the analyst. This term is usually defined as productivity, i.e. the differences in output not due to inputs. Finally, η_{it} represents all those shocks that affect production but can not be anticipated or predicted by the firm.

Taking natural logs we obtain

$$q_{it} = \beta + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \omega_{it} + \eta_{it} \tag{(1)}$$

where small letters represent variables in logs.

There are two usually discussed identification problems that prevent us of estimating the parameters of the production function. The first one arise from using an industry price deflator to define real values instead of the firm's output price (Klette and Griliches, 1996; De Loecker, 2008; Feldstein, 2008). Given that neither the firm's physical output nor its price are reported in surveys, real quantity is defined by deflating total revenue by an industry price deflator. Using this index the firm's log of observed real revenue is given by

$$\widetilde{r}_{it} = r_{it} - p_{It} = q_{it} + p_{it} - p_{It}$$

where p_{it} is the firm's specific log price index and p_{It} is the industry price index. Sustituting this expressing in equation (1) we get

$$\widetilde{r}_{it} = \beta + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + (p_{it} - p_{It}) + \omega_{it} + \eta_{it}$$

where $(p_{it} - p_{It})$ is not observe and captures the change in the firm's relative price due, for example, to the firm's market power or fruit of an unexpected demand shock. Notice that even if ω_{it} were to be identically zero for all firms, the production function parameters would not be identifiable due to correlation between inputs and the unobservables in $(p_{it} - p_{It})$. For example, if we assume that firm faces a constant elasticity demand curve conditional on the output of the other firms, the coefficients estimated from the above equation will reflect the original production function coefficients divided by one minus the inverse elasticity of demand[14].

The solution traditionally given to this problem has been to ignore the relative price variation term, implicitly assuming that is negligible, $(p_{it} - p_{It}) \simeq 0$ for all i, t, I [15]. The second solution is to follow a more structural modelization in the sense of introducing more assumptions in order to model the demand side of the market and plug-in the demand variables and unobservable shocks in the above equation (de Loecker, 2008).

[14] If we do not deflate by the firm's output price, the empirical equation includes the term $(p_{it} - p_{It})$. If the demand function is $Q_{it} = P_{it}^{\gamma}$, taking logs and sustituting $p_{it} = \frac{1}{\gamma} q_{it}$ then empirical equation identifies the production function parameters divided by one minus the inverse of the elasticity of demand.

[15] Jaumandreu and Mairesse (2004) compare the estimation procedures using an industry price index and a firm specific price index to deflate revenue and find no significant difference between the two methods.

In our empirical specification, the survey we use reports the price of each of the five most important products of the firm as well as its share in the firm's total revenue. We use these price data to obtain a weighted firm's output price index to deflate total revenue product.

The second identification problem that affects the estimation of equation (1) arises from the correlation between the unobserved productivity and input demand. There are two sources of endogeneity. The first one arises because the firm knows the value of ω_{it} when takes its inputs decisions at time t. Therefore, if input demanded at time t affect the output at time t, there is a traditional omitted variables endogeneity problem: there is an unobservable variable driving some of the correlation between outputs and inputs. The second one appears as a consequence of sample selection: the unobservable productivity shock is behind the decision to stay or to exit the market. That is, there is a selectivity bias emerging from the fact that the values of ω_{it} influence the decision of staying or exiting the market.

Olley and Pakes (1996) propose a method based on a set of assumptions that takes care of both of these endogeneity problems. The first assumption is concerned with characterizing two types of inputs. Dynamic inputs are those whose decisions at a particular moment of time affect future profits of the firm, i.e. inputs that are characterized by high adjustment cost, such as capital. Non-dynamic input decisions have no lasting effect on future profits. For example, in their original paper they consider labor as a non-dynamic input. The second assumption refers to the timing when input decisions are taken. It is assumed that decisions on dynamic inputs for period t are taken in period $t-1$, i.e. once the value of ω_{it-1} is known. A third assumption is that ω_{it} evolves exogenously as a first order Markov process. Given the information available to the firm at time t, $\mathcal{I}_{t-1}$, which includes past realizations of ω_{it}, the distribution of productivity at time t can be written as

$$\Pr\left(\omega_{it}|\mathcal{I}_{t-1}\right)=\Pr\left(\omega_{it}|\omega_{it-1}\right).$$

This assumption implies that the expected unobserved productivity at time t can be written as

$$\omega_{it}=E\left(\omega_{it}|\omega_{it-1}\right)+\varepsilon_{it} \qquad ((2))$$

where the error term, ε_{it}, can be interpreted as an unexpected productivity shock. By definition, $E\left(\varepsilon_{it}g\left(\omega_{it-1}\right)\right)=0$ for any function g measurable in $\mathcal{I}_{t-1}$, implying that this shock is uncorrelated with those dynamic inputs whose demands decisions were taken in period $t-1$.

Under the assumption that firms maximize its future expected profits, it is possible to obtain a relationship between investment with the unobservable productivity and dynamic inputs,

$$i_{it}=f_t\left(\omega_{it},k_{it}\right)$$

where, assuming monotonicity in this relationship, we can invert the above function to obtain the productivity as a function of observable variables

$$\omega_{it} = h_t \left(i_{it}, k_{it} \right) \tag{(3)}$$

Using the above assumptions, the estimation procedures is decomposed in two steps. In the first steps, the parameters of the non-dynamic inputs are estimated. Sustituting (3) in (1) we obtain

$$\begin{aligned} q_{it} &= \beta + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + h \left(i_{it}, k_{it} \right) + \eta_{it} & (\ ) \\ &= \beta_l l_{it} + \beta_m m_{it} + \phi_t \left(i_{it}, k_{it} \right) + \eta_{it} & ((4)) \end{aligned}$$

and following a partial linear model estimator the parameters β_l, β_m can be consistently estimated. Additionally, in this first step we obtain an estimate of $\phi_t \left(i_{it}, k_{it} \right)$.

The first order Markov assumption is used to obtain a consistent estimate of β_k in the second step. Given that

$$\begin{aligned} \omega_{it} &= E \left(\omega_{it} | \omega_{it-1} \right) + \varepsilon_{it} \\ &= h \left(\omega_{it-1} \right) + \varepsilon_{it} \end{aligned}$$

where $h(\cdot)$ is an unknown function and that

$$\omega_{it} = \phi_t \left(i_{it}, k_{it} \right) - \beta_k k_{it}$$

then

$$\phi_t \left(i_{it}, k_{it} \right) = \beta_k k_{it} + h \left(\phi_{t-1} \left(i_{it-1}, k_{it-1} \right) - \beta_k k_{it-1} \right) + \varepsilon_{it}. \tag{(5)}$$

The parameter β_k can be estimated using the information obtain in the first step and approximating the unknown function h by means of a series expansion.

However, Ackerberg et al. (2008) argue that the original assumptions of the OP model should be partially modified to allow the identification of the production function parameters. They argue that without further assumptios the parameters are not identified due to a problem of multicollinearity. If labor is a non-dynamic input, then it might be chosen according to

$$l_{it} = g_t \left(\omega_{it}, k_{it} \right)$$

and given that $i_{it} = f_t \left(\omega_{it}, k_{it} \right)$, we have

$$l_{it} = b_t \left(i_{it}, k_{it} \right).$$

This implies that in the first step of the OP method we can not identify the labor parameter because labor is a function of the same variables as the non-parametric equation (4), i.e. they are collinear.

Ackerberg et al. (2008) suggested to assume a particular timing in the non-dynamic input demand decisions in such a way that they are taken without full knowledge about ω_t. In other terms, the decisions related with this non-dynamic labor or material input should be done without perfect information about what the actual unobserved productivity, i.e. they are a function of a different information set than investment.

In order to use the OP method with Ackerberg et al. (2008) suggestion and taking into account the characteristics of the Spanish labor market we decompose labor in two different inputs. We consider fixed term or temporary labor contracts as a non-dynamic input and whose decisions are made without perfect knowledge of the actual value of productivity. This fixed term labor contracts are usually demanded to cover unexpected demand shocks which could be assumed to be independent of actual productivity (de Loecker, 2008; Fernandez and Pakes, 2008; Cooper et al. 2003). Long term or permanent labor contracts is considered to be a dynamic labor input which is subject to adjustment costs, i.e. dismissal costs. Therefore, equation (1) is rewritten as

$$q_{it} = \beta + \beta_T l_{it}^T + \beta_P l_{it}^P + \beta_k k_{it} + \beta_m m_{it} + \omega_{it} + \eta_{it} \qquad ((6))$$

where l_{it}^T stands for temporary employment and l_{it}^P stands for permanent employment. Taking into account that permanent employment is a dynamic input, we have

$$i_{it} = f_t \left(\omega_{it}, k_{it}, l_{it}^P\right)$$

and therefore substituting in the last equation we get

$$\begin{aligned} q_{it} &= \beta + \beta_T l_{it}^T + \beta_p l_{it}^P + \beta_k k_{it} + +h\left(i_{it}, k_{it}, l_{it}^P\right) + \eta_{it} \\ &= \beta_T l_{it}^T + \beta_m m_{it} + \phi_t \left(i_{it}, k_{it}, l_{it}^P\right) + \eta_{it}. \end{aligned}$$

The estimation procedure is the same as before with the only difference that in the second step β_P and β_k are estimated throught

$$\omega_{it} = \phi_t \left(i_{it}, k_{it}, l_{it}^P, m_{it}\right) - \beta_P l_{it}^P - \beta_k k_{it}.$$

Naturally, an alternative to the above method would be to directly follow Akerberg's et al. (2008) two stage procedure. That is, under this method we have that

$$i_{it} = f_t \left(\omega_{it}, l_{it}^T, l_{it}^P, m_{it}, k_{it}\right)$$

and so, inverting and substituting in the real revenue equation, we get

$$q_{it} = \beta_T l_{it}^T + \beta_P l_{it}^P + \beta_k k_{it} + \beta_m m_{it} + h_t \left(i_{it}, l_{it}^T, l_{it}^P, m_{it}, k_{it}\right) + \eta_{it}$$

or

$$q_{it} = \phi_t \left(i_{it}, l_{it}^T, l_{it}^P, m_{it}, k_{it}\right) + \eta_{it}$$

with $\phi_t \left(i_{it}, l_{it}^P, l_{it}^T, m_{it}, k_{it}\right) = \beta_T l_{it}^T + \beta_P l_{it}^P + \beta_k k_{it} + \beta_m m_{it} + h_t \left(i_{it}, l_{it}^T, l_{it}^P, m_{it}, k_{it}\right)$. In the first stage the function $\phi_t(\cdot)$ is nonparametrically estimated. The parameters of the production function equation are recovered in the second stage, assuming that the productivity follows a first-order Markov process,

$$\omega_{it} = E\left(\omega_{it}|\mathcal{I}_{it-1}\right) + \varepsilon_{it} = E\left(\omega_{it}|\omega_{it-1}\right) + \varepsilon_{it}$$

where ε_{it} is mean independent of the information at $\mathcal{I}_{it-1}$. The time to build assumption implies that capital was chosen at or prior to $t-1$. Given that workers suffer from some type of adjustment cost also, we could either assume that their demand is decided at $t-1$ or that they are chosen without full knowledge of ω_{it} (see Ackerberg et al, 2008). Hence, we could state the following moment conditions to identify the parameters,

$$E\left[\varepsilon_{it}| \begin{array}{c} k_{it} \\ l^P_{it-1} \\ l^T_{it-1} \\ m_{it-1} \end{array}\right] = 0$$

To recover the implied $\varepsilon'_{it}s$ for any value of the parameters $(\beta_{l^T}, \beta_{l^P}, \beta_k, \beta_m)$ we first obtain

$$\omega_{it}\left(\beta_{l^T},\beta_{l^P}, \beta_k, \beta_m\right) = \widehat{\phi}_t\left(z_{it}\right) - \left(\beta_T l^T_{it} + \beta_P l^P_{it} + \beta_k k_{it} + \beta_m m_{it}\right)$$

where $\widehat{\phi}_t\left(z_{it}\right)$ was estimated in the first stage. Secondly, we regress nonparametrically $\omega_{it}\left(\beta_{l^T},\beta_{l^P}, \beta_k, \beta_m\right)$ on $\omega_{it-1}\left(\beta_{l^T},\beta_{l^P}, \beta_k, \beta_m\right)$ from where we obtain $\varepsilon_{it}\left(\beta_{l^T},\beta_{l^P}, \beta_k, \beta_m\right)$ and minimize

$$M = \frac{1}{TN}\sum_t\sum_i \varepsilon_{it}\left(\beta_{l^T},\beta_{l^P}, \beta_k, \beta_m\right)\cdot\begin{pmatrix} k_{it} \\ l^T_{it-1} \\ l^P_{it-1} \\ m_{it-1} \end{pmatrix}$$

to obtain the estimator of $\left(\beta_{l^T},\beta_{l^P}, \beta_k, \beta_m\right)$[16].

In Table 3 we present the present the results of estimating the production function decomposing labor in two inputs: permanent labor and temporary labor. Columns 1-3 report the OLS estimator for each of the 10 sectors considered. Columns 4-6 report the coefficients Olley-Pakes estimator under the Ackerberg's et al. assumptions and in the last three columns we present the estimated coefficients using Ackerberg's et al. (2008) method.

Overall, what we observe in most sectors when we move from OLS estimator to O-P and Ackerberg's is an increase in the estimated coefficient of capital and a decrease in the estimated coefficient of permanent and temporary labor input -with some few exceptions. Moreover, temporary employment turns out to be non-significant in most of the industries when applying the Ackerberg's et al. method.

[16]The estimation procedure was programmed in Tomlab. Standard errors were estimated through a bootstrap procedure.

ASSESING THE EPL DISTORTIONS

Without any market restrictions, firms respond to firm-level productivity and wage shocks by choosing a level of labor that equates marginal revenue with the wage. Dismissal costs drive a wedge between the marginal revenue product of labor and its marginal cost (Petrin and Sivadasan, 2006).

$$G_{it}^{J} = \frac{\partial Q_{it}}{\partial L^{J}} - \frac{w_{it}^{J}}{P_{it}}$$

where $J = P, T$ is the type of labor contract; $\frac{\partial Q_{it}}{\partial L^{J}}$ is the marginal product of labor, MP_{it}^{J}, and w_{j}^{J} is the worker's wage deflated by the firm's price. This gap will be zero in a setting with price-taking firms and no distortions.

This gap will be different from zero in a setting with imperfect competetion or labor market restraints. We start focusing on the value of this gap for permanent and temporary employment and then, we evaluate the changes in these gaps as a response to the Spanish labor market reforms in the nineties. We expect an increase in the absolute value of the gap when a labor reform reduce the flexibility of the labor market.

In order to measure the gap we need estimate the two components: the marginal revenue product of labor and the wage for each of the labor contracts workers. The first component is obtained from the estimated parameters of the production function as,

$$\frac{\partial Q_{it}}{\partial L_{it}^{j}} = \beta_L \frac{Q_{it}}{L_{it}^{j}} = \beta_L \frac{\exp\left(\beta_T l_{it}^{T} + \beta_P l_{it}^{P} + \beta_k k_{it} + \beta_m m_{it} + \omega_{it}\right)\exp\left(\eta_{it}\right)}{L_{it}^{j}}$$

where η_{it} is an unexpected idiosyncratic shock or measurement error. In order to recover the unobserved productivity, ω_{it}, we use the first step of the Olley and Pakes (1996) or Ackelberg et. al (2008) method,

$$\widehat{\omega}_{it} = \phi_t\left(i_{it}, k_{it}, l_{it}^{P}, m_{it}\right) - \widehat{\beta}_P l_{it}^{P} - \widehat{\beta}_k k_{it}.$$

or

$$\widehat{\omega}_{it} = \widehat{\phi}_t\left(i_{it}, k_{it}, l_{it}^{T}, l_{it}^{P}, m_{it}\right) - \left(\widehat{\beta}_T l_{it}^{T} + \widehat{\beta}_P l_{it}^{P} + \widehat{\beta}_k k_{it} + \widehat{\beta}_m m_{it}\right)$$

which, in this last case, is equivalent to a fully non-parametric approximation to the production function, given that the parameters are consistent.

The second component of the gap is the marginal cost of labor. From the survey we cannot distinguish whether the wage bill corresponds to temporary or permanent workers. But we know that, by definition, the total labor costs of firm i at year t is $W_{it} = W_{it}^{P} L_{it}^{P} + W_{it}^{T} L_{it}^{T}$. Assuming that temporary wages are industry specific (Aguirregarabiria and Alonso, 2009), we have that[17],

[17] We deflact the firm's workers' cost using the firms' output price, as Feldstein (2008) suggest.

$$\frac{W_{it}}{L_{it}^P} = W_{it}^P + W_{it}^T \left(\frac{L_{it}^T}{L_{it}^P} \right)$$

we observe $\frac{W_{it}}{L_{it}^P}$ and $\frac{L_{it}^T}{L_{it}^P}$, but we do not observe W_{it}^P or W_{it}^T. If the wage of permanent workers were mean independent of the share of temporary workers, we could estimate the value of W_{it}^T by running this regression,

$$\frac{W_{it}}{L_{it}^P} = \sum_{t=1}^{T} \alpha_t \frac{L_{it}^T}{L_{it}^F} D_t + \mu_i + \tau_t + \varepsilon_{it}$$

where W_{it} is the total wage bill of the firm, α_t is the estimator of the wage of temporary workers, D_t are time dummies. We assume that the wage of permanent workers is: $W_{it}^P = \mu_i + \tau_t + \varepsilon_{it}$, where μ_i is a firm specific effect and τ_t is a time effect.

Using this approximation to the wages we are able to define the gap for the permanent and temporary workers as

$$\begin{aligned} G_{itP} &= \frac{\partial Q_{it}}{\partial L^P} - \frac{w_{it}^{L^P}}{P_{it}} \\ G_{itT} &= \frac{\partial Q_{it}}{\partial L^T} - \frac{w_{it}^{L^T}}{P_{it}} \end{aligned}$$

In general, wages are highly indexed if they are settled in collective agreements for different unions. Feldstein (2008), for example, argues the gap could be different from zero by the fact wage that increases lag behind productivity gains. Taking this indexation fact into account, we define an alternative gap based on the workers' wage in the previous period.

In the first two columns of Table 4 we present the average wage by year for permanent and fixed term contract workers, expressed in thousand pesetas 1990, as obtained from the above decomposition. These numbers are in line with the average wages in the economy during the nineties, i.e. in 1992 the wage of a permanent worker was 2,744,000 pesetas and 1,630,000 for a temporary worker and in 2002 these figures were 3,666,730 and 2,225,125 respectively (INE, Encuesta de Estructura Salarial). These figures are very similar to those obtained by Aguirregarabiria and Alonso (2009) for the overlapping years.

The unconditional gap average for fixed and temporary workers is presented in Table 5. On average, the gap for permanent workers is negative, meaning that firms would have been interested in diminishing the number of this type of workers and, maybe because of adjustment cost, they were not able to do so. Observe that this gap for permanent workers clearly follows the economic cycle. The higher value is reached during the 1992 and 1993 economic crisis.The gap is decreasing until 1997, the lower value in the whole period.

On the other hand, the unconditional gap average for temporary workers is positive and shows a pattern that coincides with the two labor market reforms that restricted the hiring of temporary workers. Until 1994, the use of temporary contracts was completely liberalized in Spain, and firms did not have have not any restrictions in using this type of contract, without dismissal costs. The value of the gap until this year is the lowest throughout all the period. In 1994, the labor reform considerably restricted the use of temporay contracts. Although, as many authors have showed, this reform was not very effective (Dolado et al. 2002). The gap significantly increased after the 1997 labor market reform, which again imposed restrictions on the hiring of temporary workers and incentivated the transformation from temporary to permanent contracts for a specific group of workers. Overall, these numbers could suggest that firms may have been interested in changing the mix of their labor input, increasing the number of temporary workers (those with no dismissal costs) and diminishing the number of permenent workers. The adjustment cost could have prevented them fom carrying on with this decision.

Table 6 reports the coefficients of different regressions where the absolute value of the gap is the dependent variable. The three first columns present the results of three different specifications of the gap for permanenet and the last three for temporary employment. All regresions include two period dummies that cover the two market labor reforms of the nineties (1994 and 197), one for 1995-1997 and one for 1998-2001. The first one restricted the requisites needed for a firm to hire temporary workers. The second reform also included a decrease in dismissal cost for some specific demographic groups if they were hired as permanent workers as well as for transformations of temporary workers to permanent workers. The fixed effect allows for firm specific base period gaps, so the magnitudes of the period dummies are identified by within-firm variation in the mean gap over time.Columns 2,3, 5 and 6 also include the industry output growth rate as a control[18]. The results suggest that the base period gap was around one million pesetas in the aggregate gap measure and around one million five hundred thousand pesetas for the permanent workers gap measure. During both periods the absolute value of the gap increased significantly in statistical terms, i.e. around 50,000 pesetas in the first period and 150,000 pesetas in the second period.

Productivity and share of temporary workers

In this section we examine the changes in aggregate productivity during the nineties and assess the relationship between the share of temporary contract workers and productivity growth. To measure the aggregate productivity we conduct the Olley and Pakes (1996) decomposition, which quantifies what part of aggregate productivity reflects the productivity of the average plant every year and what part captures the realocation of activity in the more productive firms:

$$TFP_t = \overline{TFP}_t + \sum \left(s_{it} - \overline{s}_t\right)\left(TFP_{it} - \overline{TFP}_t\right)$$

[18] These specifications follow closely the ones proposed by Petrin and Sivadasan (2006).

where TFP_t is aggregate total factor productivity for each industry in year t. These aggregate measures correspond to weighted averages of our firm level measures TFP where the weights are market shares; $\overline{TFP}_t$ is the cross-sectional (unweighted) averages of total factor productivity measures across all firms in that sector in year t; TFP_{it} is total factor productivity measuresof firm i at time t estimated as described before; s_{it} is the share of plant i's output and $\overline{s}_t$ is the cross sectional unweighted average of the shares.

Table 7 presents the above decomposition when productivity is obtain from each of the methods estimated in the last section. As can be observed, there is a difference in the level of the weighted TFP when using the different estimates of productivity, but the qualitative findings are the same. Overall, the average weighted TFP has been practically stable during the nineties for the small-medium Spanish manufacturing industry, i.e. it increased approximately one percent in the nineties. Moreover, the contribution of the cross-sectional term is only marginal in the decomposition, similar to what has been observed in US (Foster et al., 2001). In other terms, mostly all of the weighted average TFP is caputred by the unweighted average TFP and not by a reallocation of production to most productive firms. Despite this fact, the cross-product term increased during the decade in a significant way, i.e. it more than doubled its contribution in the decomposition. This means that there is an increasing, though marginal, reallocation of production to more productive firms. The question is whether the lack of flexibility in the labor market have hindered this reallocation.

In order to assess the relationship between the share of temporary employment and productivity growth, we report in Table 9 the results of three regresions for TFP, TFP growth and the cross–product term of the productivity decomposition. All regresions include the contemporaneous share of temporary workers and the square and the lags of productivity. Aditionally each regresion includes age, age square, human capital, foreing capital and market dinamism as controls. Moreover, we include a set of dummy variables for each cell defined by the industry-age-size (Angrist and Krueguer, 1991; Bond)[19].

The expected sign of the relationship between productivity measures and temprary workers is not clear. For example, Dolado and Stucchi (2008) argue that the level of effort exerted by a temporary worker will depend on the conversion rate, i.e. the probability of the firm converting fixed term contract to a permanent contract. If this probability is low, then temporary workers will make less effort, thereby negatively affecting the firm's productivity. However, in the spirit of Shapiro and Stiglizt (1986) model, if the pool of temporary workers is large, workers could exert high levels of efforts in order to be the one whose contract is converted. This could also be the case if the employment turnover of one of these temporary workers by new firms depends on the workers' effort reputation, , i.e. many of them are hired through temporary work agencies, and a good reputation could increase the

[19] Here we follow an approach similar to Dolado and Stucchi (2008), but instead of estimating a conversion rate, which is constant for a cell defined by the industry-age-size cell, we introduce a set of dummy variables for each of these cells

employment spells.

As shown in columns 1 and 2 (O-P estimation) and 4 and 5 (ACF estimation) of Table 8, the relationship between the share of temporary employment and productivity seems to be nonlinear. In other terms, its impact on productivity changes as the share of temporary employment increases. Initial low levels of temporary workers negatively affect the productivity measure but, as the pool of temporary workers increase, the effect on productivity becomes positive. This fact is not usually taken into account when trying to measure the relationship between TFP and the share of temporary workers. When considering total factor productivity or its growth rate as dependent variables, a low share of temporary workers negatively affects these productivity measures. However, as the share gets larger, the impacts turn to be positive. When the firm has a high percentage of temporary workers, the level of TFP as well as its rate of change is positively affected by this share.

We additionally regress the cross–product term of the productivity decomposition, which accounts for the reallocation of production toward more productive firms. Columns 3 and 6 of Table 8 reports the estimated coeficients. In this case, the efect of the share of temporary employment is reversed. Temporay employment positively affects the reallocation of production, but this effect becomes negative when this share is large.

CONCLUSIONS

Employment protection legislation introduce adjustment cost that diminishes the flexibility of labor. Spain constitutes an interesting case of duality in the labor market. On the one hand, it is one of the developed countries with the highest expected discount cost of firing a worker. On the other hand, Spain has the highest ratios of temporary contract workers of the OECD countries. These fixed-term contract tend to have a very short duration (6-12 months) and have a maximum of renewal of three years. They have very low or no dismissal costs. Temporary contract workers are usually less experience due to the limit duration of the contracts and the firms' incentives to invest in training is always lower. These contracts ares typically used for tenured positions and only the most productive workers are those whose contracts become permanent.

We use this fact to estimate the production functions with fixed term contract labor as a non-dynamic input and permanent contracts as a dynamic input. Using the estimated parameters of the production function discuss some efficiency issues of the 90's labor reform aimed to reduce the share of temporary workers. We firstly estimate the gap between the marginal revenue product of labor and wages. Our findings suggest that this gap is decreasing in the share of temporary employment. Secondly we analyse.the relationship between the share of temporary employment and productivity measures, finding that this relationship is nonlinear, which implies that the effect of temporary employment on productivity depends on the level.

APENDIX 1: FIRM PRICE DEFLACTOR FOR MULTIMARKET FIRMS.

Firms report the percentage of change in the markets in which they operate (r_k^T), that is: $r_t^k = \frac{p_t^k - p_{t-1}^k}{p_{t-1}^k}$. Firms also report the share of sales in each market. If R_t represents revenues (or value added) of firm in period t, the deflacted revenue will be:

$$R_{t_0} = R_{t=\tau} \prod_{t=1}^{\tau} \left[\sum_{j=1}^{J} \frac{s_t^j}{(1 + r_t^j)} \right]$$

where:

R: firm revenues

J: number of markets.

τ: number of years.

s_t^j: share of sales declared by the firm in the market j and period t.

r_t^j: price variation declared by the firm, in the market j and period t.

APENDIX B: SURVEY AND VARIABLE DEFINITION

The ESSE is a panel of firms contains that contains 17,395 observations that correspond to more than 2100 firms observed an average of 8 years. A first characteristic of the data set is that at the beginning of this survey in 1990, 5% of firms with up to 200 workers were sampled randomly by industry and size strata. All firms with more than 200 workers were asked to participate, and the rate of participation reached approximately 70% of the population of firms. A second characteristic of the data set is that in subsequent years the initial sample properties have been maintained. On one hand, newly created firms have been added annually with the same sampling criteria as in the base year. On the other hand, exiting firms have been recorded in the sample of firms surveyed each year. Therefore, due to this entry and exit process, the data set is an unbalanced panel of firms.

Variable definition

- Age. The age of the firm is the difference between the current year and the year of birth declared by the firm.
- *Capital.* Capital at current replacement values K_{it} is computed recursively from an initial estimate and the data on current investments in equipment goods I_{it}. We update the value of the past stock of capital by means of the price index of investment in equipment goods p_{It} as $K_{it} = (1-\delta)\frac{p_{It}}{p_{It-1}} K_{it-1} + I_{it-1}$ where δ is an industry-specific estimate of the rate of depreciation. Capital in real terms is obtained by deflating capital at current replacement values by the price index of investment in equipment goods.

- *Investment*: value of current investments in operative capital, that is, we consider equipment goods, excluding buildings, land, and financial assets. The magnitude is deflated by the price index of investment (the equipment goods component of the index of industry prices computed and published by the Spanish Statistic Institute, INE).

- *Market dynamism.* Firms are asked to assess the current and future situation (slump, stability, or expansion) of up to 5 separate markets in which they operate. The market dynamism index is computed as a weighted average of the responses.

- *Materials*: value of intermediate consumption (including raw materials, components, energy, and services) deflated by a firm-specific price index of materials.

- *Output.* Value of produced goods and services computed as sales plus the variation of inventories deflated by a firm-specific price index of output.

- *Permanent employment.* Number of full time plus half of part time permanent workers at December 31st.

- *Temporary employment.* Workers hired under fixed term contract at December 31st. When firms report that the proportion of fixed term contract varies during the year, this variable is the average of the temporary workers hired in each quarter.

- *Wage.* Wage cost computed as total labor cost excluding dismissal costs divided by total workers.

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Table 1. Observations and temporary workers by size

	Total	$\leq$ 200 workers	>200 workers
N^o observations	18966	12799	6167
Firms with temporary workers	81.8%	77.7%	90.3%
Share of temporary workers			
Average	22.0%	32.3%	17.2%
Median	19.4%	25.8%	12.1%

Table 2. *Share of temporary workers in manufacturing firms*

	≤ 200 workers		>200 workers	
	Coef	T-ratio	Coef	T-ratio
Constant	24.65	(12.3)	14.4	(5.3)
Capacity utilization	0.04	(2.8)	0.07	(4.1)
National firm	8.60	(13.1)	3.78	(9.1)
Size				
≤20 workers	-	-	-	-
21-50	5.47	(11.1)	-	-
51-100	5.36	(7.7)	-	-
101-200	1.91	(2.8)	-	-
201-500	-	-	-	-
$>$ 500	-	-	-2.59	(-6.2)
Year				
1991	-	-		
1992	0.56	(0.6)	-0.48	(0.6)
1993	0.34	(0.3)	-2.40	(-2.6)
1994	-0.87	(-0.9)	-3.67	(-4.1)
1995	-1.56	(-1.6)	-2.79	(-2.9)
1996	-1.41	(-1.4)	-3.76	(-4.1)
1997	-3.25	(-3.4)	-2.92	(-3.1)
1998	-4.11	(-4.2)	-3.53	(-3.8)
1999	-5.95	(-6.1)	-4.37	(-4.7)
2000	-6.7	(-6.9)	-2.85	(-3.2)
2001	-7.57	(-7.6)	-2.62	(-2.8)
Demand Shocks				
Slump	-	-	-	
Estability	3.71	(6.9)	2.81	(5.2)
Expansion	6.45	(10.5)	5.35	(9.3)
Age				
Entrant	-	-	-	-
Stablish	-9.20	(11.0)	2.94	(-2.3)
Mature	-21.7	(-28.2)	-0.49	(-0.4)
Industry dummies	included		included	
N. Observations	12799		6167	
R^2	18%		14%	

Table 3. Production function estimation.

	OLS				O-P				Ackelberg			
	Capital	Labor P	Labor T	Materials	Capital	Labor P	Labor T	Materials	Capital	Labor P	Labor T	Materials
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)				
1. Food, drink & tobacco	0.066	0.160	0.035	0.747	0.099	0.138	0.035	0.739	0.099	0.117	0.032	0.727
	(0.015)	(0.021)	(0.010)	(0.015)	(0.020)	(0.025)	(0.010)	(0.017)	0.035	0.040	0.021	0.044
Returns to scale	1.01				1.01	0.847			0.975	0.603		
2. Textile, leather, shoes	0.074	0.238	0.079	0.5876	0.084	0.155	0.065	0.574	0.083	0.105	0.051	0.597
	(0.017)	(0.022)	(0.013)	(0.019)	(0.028)	(0.035)	(0.012)	(0.019)	0.032	0.039	0.021	0.036
Returns to scale	0.97				0.88	0.002			0.836	0.002		
3. Timber & furniture.	0.065	0.144	0.037	0.729	0.109	0.164	0.042	0.699	0.182	0.114	0.029	0.574
	(0.020)	(0.026)	(0.015)	(0.030)	(0.027)	(0.035)	(0.015)	(0.033)	(0.080)	(0.074)	0.026	0.134
Returns to scale	0.97				1.01				0.889	0.178		
4. Paper & printing	0.143	0.208	0.046	0.612	0.136	0.219	0.040	0.613	0.164	0.209	0.031	0.584
	(0.022)	(0.040)	(0.015)	(0.035)	(0.033)	(0.052)	(0.016)	(0.037)	0.045	0.075	0.023	0.061
Returns to scale	1.01				1.01				0.987			
5. Chemical products.	0.122	0.175	0.038	0.701	0.120	0.150	0.032	0.681	0.147	0.181	0.011	0.668
	(0.020)	(0.030)	(0.014)	(0.033)	(0.043)	(0.043)	(0.014)	(0.032)	(0.058)	(0.068)	(0.014)	(0.055)
Returns to scale	1.04				0.98				1.01	0.847		
6. Non metalic minerals	0.092	0.217	0.071	0.643	0.025	0.142	0.085	0.621	0.157	0.150	0.040	0.637
	(0.017)	(0.034)	(0.019)	(0.029)	(0.039)	(0.049)	(0.020)	(0.026)	0.048	0.065	0.029	0.086
Returns to scale	1.02				0.87				0.984	0.840		
7. Metal products	0.102	0.133	0.049	0.691	0.124	0.098	0.044	0.672	0.154	0.126	0.020	0.539
	(0.013)	(0.022)	(0.011)	(0.020)	(0.002)	(0.031)	(0.011)	(0.021)	(0.044)	(0.060)	(0.023)	(0.117)
Returns to scale	0.98				0.94				0.849	0.026		
8. Agric. & ind. mach.	0.072	0.243	0.060	0.640	0.079	0.236	0.061	0.630	0.114	0.296	0.044	0.590
	(0.021)	(0.043)	(0.019)	(0.035)	(0.033)	(0.056)	(0.018)	(0.032)	(0.045)	(0.117)	(0.036)	(0.088)
Returns to scale	1.02				1.01				1.04	0.732		
9. Office, comp. & elec.	0.057	0.274	0.089	0.653	0.091	0.232	0.084	0.648	0.100	0.133	0.033	0.682
	(0.031)	(0.050)	(0.022)	(0.045)	(0.052)	(0.063)	(0.020)	(0.042)	(0.053)	(0.093)	(0.026)	(0.073)
Returns to scale	1.07				1.06				0.948	0.656		
10. Vehicles & acces.	0.084	0.203	0.095	0.614	0.054	0.170	0.096	0.623	0.101	0.225	0.044	0.534
	(0.041)	(0.039)	(0.023)	(0.072)	(0.051)	(0.074)	(0.024)	(0.068)	(0.057)	(0.127)	(0.029)	(0.169)
Returnstoscale	1.00				0.94				0.904	0.626		

Note: all regresions include year and regional dummy variables. age and economic cycle as described by the firm; regression are done with firm with 200 or les workers, with positive investment and being more than two periods in the survey. The standard errors obtained after 100 bootstraps.

Table 4. Estimated wages for permanent and temporary contracts

Year	Permanent	Temporary	R
1991	2773,25	1818,69	0,655
1992	2905,04	1704,04	0,587
1993	2956,46	1812,51	0,613
1994	2919,49	1652,74	0,566
1995	2949,48	1861,77	0,631
1996	2983,71	2069,34	0,694
1997	3049,78	1824,86	0,598
1998	3176,70	1984,40	0,625
1999	3137,93	2001,98	0,638
2000	3152,24	1945,29	0,617
2001	3205,75	2018,16	0,630

Table 5

Estimated Gap average for permanent and temporary contract workers (ACF)

Year	Permanent	Temporary
1991	-414,63	116,49
1992	-595,53	298,44
1993	-643,42	278,92
1994	-501,67	302,40
1995	-402,76	708,62
1996	-339,24	342,20
1997	-316,44	1018,56
1998	-363,31	1223,96
1999	-350,51	822,75
2000	-396,45	1019,62
2001	-422,15	857,16

Table 6

The absolute value of the gap

ACF.	G^P	G^P	G^P	G^T	G^T	G^T
Base period gap 1991-1994	1385.6 (17.79)	1400.42 (22.93)	1411.872 (18.218)	1871.8*** (44.786)	1911.83*** (56.5545)	1899.62*** (44.5806)
Increase in gap 1995-1997	93.82*** (25.90)	62.74** (27.90)	42.858^{+} (24.118)	137.685** (67.26)	183.425** (74.497)	144.252** (64.097)
Increase in gap 1998-2001	127.65*** (32.96)	114.29*** (37.21)		523.842*** (84.99)	476.45*** (93.420)	
Industry output growth rate		−37.259 (53.421)	7.0669 (56.55)		−338.68** (133.28)	−87.994 (134.91)
Trend 1997			37.902*** (11.923)			196.374*** (29.855)
Olley and Pakes						
Base period gap 1991-1994	1353.78*** (17.414)	1363.42*** (21.756)	1375.784*** (17.6731)	2830.33*** (83.213)	2881.91*** (100.05)	2980.50*** (80.997)
Increase in gap 1995-1997	56.051** (26.16)	23.545 (28.209)	5.849 (23.977)	427.03*** (117.13)	459.54*** (122.13)	253.015** (106.04)
Increase in gap 1998-2001	99.481*** (31.275)	87.937** (34.51)		1436.49*** (159.206)	1374.83*** (169.94)	
Industry output growth rate		−3.0313 (47.48)	25.73 (50.690)		−194.773 (228.17)	389.85^{+} (235.11)
Trend 1997			26.749** (11.264)			484.07*** (55.781)
Observations	9941	8162	8162	9941	8162	8162

Table 7

Productivity descomposition

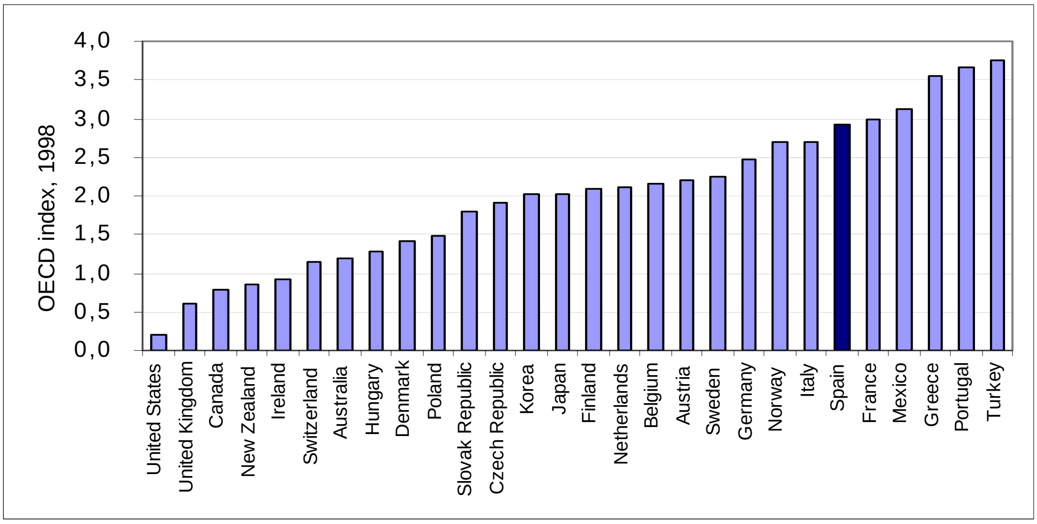
	Olley Pakes productivity			ACF productivity		
Year	Weight	Unweight	Cross Term	Weight	Unweight	Cross term
1991	2.057	2.042	0.015	2.472	2.387	0.086
1992	2.047	2.024	0.023	2.460	2.367	0.094
1993	2.043	2.017	0.026	2.447	2.350	0.097
1994	2.065	2.013	0.051	2.477	2.350	0.127
1995	2.068	2.019	0.049	2.479	2.359	0.120
1996	2.086	2.023	0.063	2.498	2.365	0.132
1997	2.076	2.024	0.053	2.502	2.377	0.125
1998	2.072	2.018	0.054	2.503	2.373	0.131
1999	2.073	2.019	0.054	2.498	2.373	0.125
2000	2.081	2.021	0.060	2.504	2.369	0.135
2001	2.078	2.012	0.065	2.494	2.358	0.136

Table 8

Share of Temporary Employment and Productivity

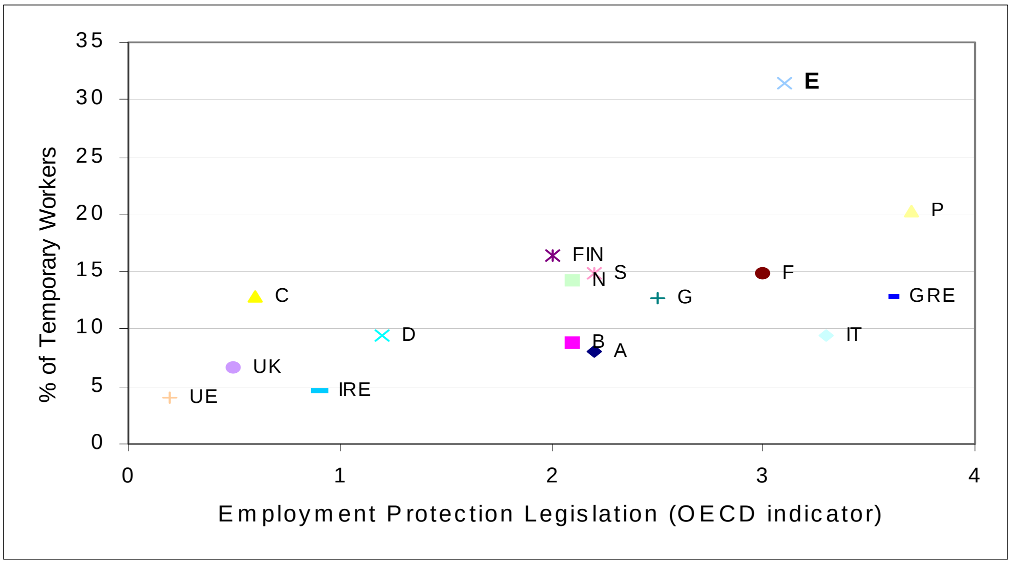
	Olley and Pakes			ACF		
	TFP	$\triangle$TFP	CP	TFP	$\triangle$TFP	CP
Share_t	−0.1681 (0.031)	−0.0598 (0.010)	0.0310 (0.043)	−0.0742 (0.031)	−0.0263 (0.009)	0.0775 (0.040)
ShareQ_t	0.2178 (0.042)	0.0790 (0.014)	−0.0408 (0.054)	0.1307 (0.042)	0.0451 (0.012)	−0.0930 (0.053)
CP_{t-1}			0.8368 (0.037)			0.8513 (0.031)
$\triangle\text{TFP}_{t-1}$		−0.2342 (0.091)			−0.1761 (0.087)	
TFP_{t-1}	0.5670 (0.075)	−0.0521 (0.030)	0.1241 (0.030)	0.5692 (0.078)	−0.0605 (0.027)	0.1297 (0.091)
TFP_{t-2}	0.24711 (0.077)	0.0036 (0.030)	−0.0944 (0.024)	0.2726 (0.078)	0.0184 (0.027)	−0.0874 (0.090)

Figure 1. Employment protection legislation Index (OECD, 1999)



Source: Employment Outlook, OECD, 1999

Figure 2. Temporary workers and Employment Protection Legislation.



Source: Employment Outlook, OECD, 1999

Figure3. Kernel density of the proportion of fixed-term contract workers by size.

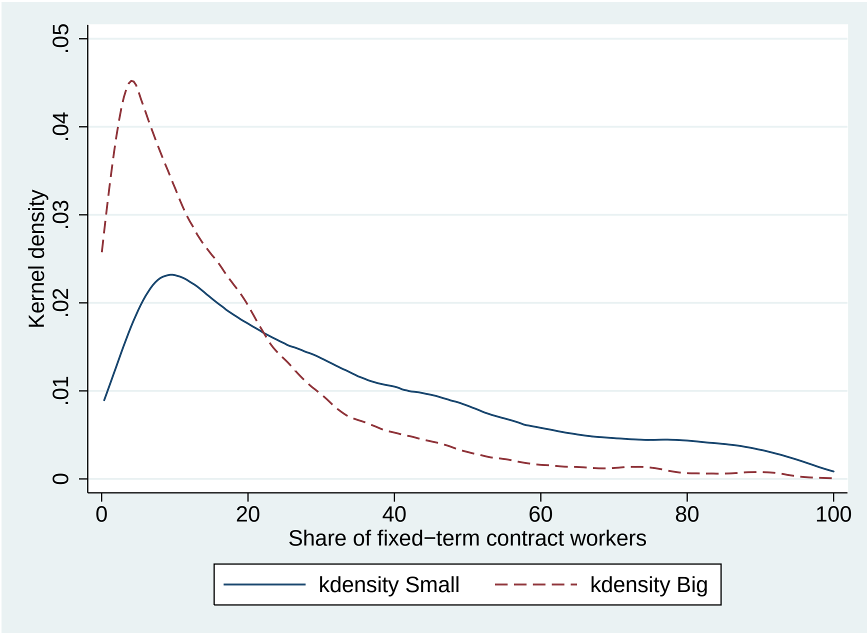
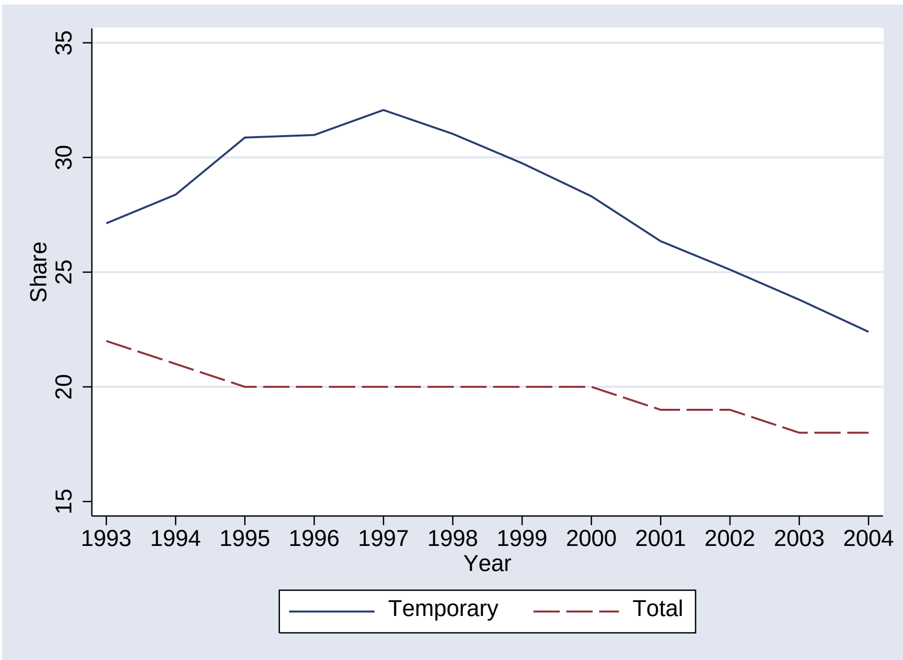


Figure 4: Share of employment in the industry and average proportion of temporary workers in the industry..



Source: Active Population Survey (INE)