Innovation and job creation in a dual labor market: Evidence from Spain

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Innovation and job creation in a dual labor market: Evidence from Spain *

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Abstract

This paper studies the effect of product and process innovations on the creation of jobs in the Spanish manufacturing sector over the period 1991-2005. We also use a change in the Employment Protection Legislation (EPL) in 1997 to study the effect of innovations on permanent and temporary workers before and after that change. We find that both product and process innovation created jobs in the Spanish manufacturing sector. Additionally, we find that before the change in the EPL in 1997 innovations did not affect the number of permanent workers and all the increase in employment was explained by the increase in the number of temporary workers. After the change in the labor regulations, innovations increased both the number of temporary and permanent employees. Interestingly, while the increase in temporary workers takes place after one year of the innovations, the increase in permanent workers occurs mainly two year after the innovations.

Keywords: Product Innovation, Process Innovation, Employment, Temporary Workers.

JEL Classification: J21, J38, L60, O31

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1 Introduction

The fear that technical progress and innovation would destroy jobs has been present in the public opinion for a long time. However, the effect of innovation on employment is not straightforward; it depends on the market structure and the type of innovation the firm introduces. In general, the introduction of a new or significantly improved product increases employment via an increase in demand. However, if after the innovation the innovator enjoys of market power, it can set prices that maximize its profits but imply a reduction in output. Therefore, the net effect can be a contraction in employment. The effect of process innovation can also be ambiguous. Even if the innovation is labor-saving, the efficiency gain due to the innovation can induce to set lower prices and therefore to increase demand and employment (Harrison, Jaumandreu, Mairesse, and Peters (2008); Hall, Lotti, and Mairesse (2006)).

Although the effect of innovation on employment is not straightforward, several studies have shown that the fear that innovation would destroy jobs has no empirical support. Harrison, Jaumandreu, Mairesse, and Peters (2008) pose a simple model that relates employment growth to process innovations and to the growth of sales separately due to innovative and unchanged products. They estimate their model for the manufacturing and service sectors in France, Germany, Spain and the UK. They find that the increase in employment due to product innovations is large enough to compensate the negative effect of process innovations. The results are similar across coun-

tries, although there emerge some interesting differences. For example, they find no evidence for a displacement effect of process innovation in Spanish manufacturing. They suggest that this result can be possible explained by a greater pass-through of productivity improvements in lower prices. This finding is in line with previous evidence for Spain presented by Alonso and Collado (2002) who found that innovative firms tend to create more and destroy less employment than non-innovative firms. Hall, Lotti, and Mairesse (2006) and Benavente and Lauterbach (2008) estimate the model in Harrison, Jaumandreu, Mairesse, and Peters (2008) for Italy and Chile, respectively, and find similar results.

On the other hand, the evidence on the type of jobs that is created or destroyed by innovation is scarce. Because of the uncertainty about the success of the innovation and the dismissal costs it is sensible to expect that, at least at the beginning, most of the job creation occurs with fixed-term contracts. If the innovation is successful, it is possible to expect that those temporary workers receive an open-ended contract. However, it can also be the case that new products or processes require workers with specific skills and those workers require open-ended contracts. In that case, it is possible that innovations create jobs with open-ended contracts even from the beginning. The type of employment that it is created or destroyed by innovation is particularly important in Spain. In the early eighties the unemployment rate in Spain was around 20 per cent and a change in the Employment Protection Legislation (EPL) in 1994 allowed firms to offer fixed-term contracts to any unemployed worker. As a consequence, the proportion of temporary

workers soared up to 35 per cent during the nineties. Aiming at reducing the proportion of temporary workers, the EPL was changed in 1994, 1997, and 2001. There is a wide literature about the proportion of temporary workers in Spain. For example, Dolado, Garcia Serrano, and Jimeno (2002) provides an analysis of why this rate remained so high after the reforms; Amuedo-Dorantes (2000) and Güell and Petrongolo (2007) study the conversion rate from temporary workers into permanent workers, and Dolado and Stucchi (2009) study the effect of the high proportion of temporary workers and low conversion rates to permanent workers on firms' productivity.

In this paper, we study the effect of product and process innovations on the total number of workers and on the number of permanent and temporary workers. We use data from the Survey on Business Strategies (ESEE). This survey provides us with a representative sample of the Spanish manufacturing sector for the period 1991-2005. The period of time is long enough to study the effect of innovation several years after the innovation take place. Another important characteristic of our dataset is that it covers a period in which the EPL was changed in Spain and therefore it allows us to study the effect of innovation on the composition of employment before and after the change in regulation.

Our results are in line with Harrison, Jaumandreu, Mairesse, and Peters (2008), both product and process innovation increased employment in the Spanish manufacturing sector. This finding shows that Harrison, Jaumandreu, Mairesse, and Peters (2008) results are robust even after controlling

for the effect of the business cycle, changes in regulation, and any other time varying factor that affect all the firms in the same industry and the effect of any time invariant non-observed firm characteristics. Analyzing the period 1991-2005 we conclude that after the innovation firms hire temporary workers and after evaluating the success of their innovation they hire permanent workers or convert fixed-term contracts into open-ended contracts. This conclusion hides an interesting pattern. Before the change in EPL in 1997, after the innovation firms hired temporary workers and were reluctant to offer open-ended contracts. In fact, before 1997, even after two years of the innovation, innovating firms only increased the number of temporary workers. After the EPL change in 1997, innovating firms were willing to offer open-ended contracts. After one year of the innovations they mainly hired temporary workers and after two years of the innovation they hired permanent workers.

The rest of the paper is organized as follows. Section 2 describes the dataset and provides descriptive statistics. Section 3 presents the econometric model and the estimates of the effect innovations on employment. Section 4 presents the results before and after the change in the EPL in 1997. Finally, section 5 concludes.

2 Data and Descriptive Statistics

2.1 Data

We use individual firm data from the Survey on Business Strategies (Encuesta sobre Estrategias Empresariales, ESEE) which is an annual survey on a representative sample of Spanish manufacturing firms. The sample period is 1991-2005. In the base year, firms were chosen according to a sampling scheme where weights depend on their size category. All firms with more than 200 employees are surveyed and their participation rate in the survey reached approximately 70 percent of the overall population of firms in this category. Likewise, firms with 10 to 200 employees were surveyed according to a random sampling scheme with a participation rate close to 5 percent. This selection scheme was applied to each industry in the manufacturing sector.

Another important feature of the survey is that the initial sample properties have been maintained in all subsequent years. Newly created and exiting firms have been recorded in each year with the same sampling criteria as in the base year. Therefore, due to this entry and exit process, the dataset is an unbalanced panel of firms.

2.2 Descriptive statistics

Table 1 shows the descriptive statistics. The first two columns show the mean and standard deviation of the main variables for small and medium sized enterprises (SME). Columns 3 and 4 do the same for large firms. Panels A, B, and C show the descriptive statistics for all the firms in the sample, for firms that do not innovate and firms that at least introduced one product or process innovation between 1991 and 2005.

The total number of firms is 2,373 (1,608 SMEs and 765 large firms).[1] Large firms are older than SMEs; their average age is 31 years and the average age of a SME is 13 years. Large firms have lower proportion of temporary workers. While SMEs have in average 35 permanent workers and 11 temporary workers (3 permanent workers per temporary worker), large firms have in average 642 permanent workers and 90 temporary workers (7 permanent workers per temporary worker). The proportion of innovations is also higher in large firms; 36 per cent of the observations of large firms have a process innovation without changing their product and 40 per cent of them have a product innovation. In SMEs these numbers are 20 per cent and 19 per cent, respectively.

Out of the 2,373 firms, 461 (399 SMEs and 62 large firms) never did a product or process innovation and 1,912 (1,209 SMEs and 703 large firms) innovated at least once. When comparing innovators with non-innovators

[1] We are interested in the effect of innovations on employment after one and two years of the innovation and therefore we use firms with three or more consecutive observations.

we observe that innovators are larger (even between each size category). However, they are similar in terms of age and the proportion of temporary workers.

3 The effect of innovations on employment

We are interested in measuring the effect of process and product innovations on the creation of jobs and on the type of jobs that is created by the innovations. To observe the displacement effect of process innovation, we follow Harrison, Jaumandreu, Mairesse, and Peters (2008) and classify innovations in "only process innovation" and "product innovation". In many situations, a new or improved product requires changes in the production process; therefore we allow "product innovation" to include process innovations. However, we define "only process innovation" to capture the effect of a new process producing the same products. Therefore, the estimating equation is given by

$$y_{it} = \alpha_1(L)p_{it} + \alpha_2(L)d_{it} + \gamma x_{it} + w_{jt} + w_i + w_{it} \tag{1}$$

where: (i) y is the log of the value of variable on which we are interested in addressing the effect of innovation for firm i in period t -i.e. the total number of employees, the number of permanent workers, and the number of temporary workers. (ii) p_{it} is a dummy variable that takes value one when the firm introduces a new process without changing its product, (iii) d_{it} is a dummy variable that takes value one when the firm introduces a new product. (iv)

$\alpha_1(L)$ and $\alpha_2(L)$ are lag polynomials that reflect the fact that innovation can take a time to show the effect on employment. To avoid endogeneity we consider lag polynomials without the contemporaneous effect -i.e, lag polynomials are of the form $(\alpha_1 L + \cdots + \alpha_k L^k)$ with $j = 1, 2$. (iv) x_{it} is a set of control variables that includes the real value of production (in logs), the age of the firm (in logs), and the square of the log of age. (v) w_{jt} is a set of time varying non-observed factors that affect all the firms in industry j in the same way; to capture these factors we include the interaction between industry and year dummies. Note that these variables are capturing changes in regulation, the effect of the business cycle and of any other time varying factor affecting all the firms in same industry. (vi) w_i are time invariant unobserved firm characteristics, and (vii) w_{it} is an error term not correlated with explanatory variables.

We estimate equation (1) controlling by firm fixed effects. Therefore, given that firms do not change from industry, it is not necessary to include industry dummies. Given that both process and product innovation are dummy variables, the fixed effect estimator is equivalent to the Difference-in-Differences estimator of the treatment literature. Therefore, for each firm we are first comparing the change in employment from one year to the other and then we are comparing those changes between innovators and non-innovators.

Table 2 shows the estimates of equation (1). For each dependent variable we consider two models with different lag polynomials in equation (1). In the first one, we consider $k = 2$ and therefore we study the effect of innovations

in $t-1$ and $t-2$ on current total, permanent, and temporary employment. In the second model, we consider $k = 3$ and therefore we study the effect of innovations in $t-1$, $t-2$, and $t-3$ on current total, permanent, and temporary employment.

Table 2 shows the robust standard errors below each coefficient. The effect of innovation on the total number of employees is positive and significant both for process and product innovations. This result shows that Harrison et al (2008) findings are robust even after controlling for the effect of the business cycle, for any time-varying non-observed factors affecting homogeneously to all the firms in the same industry and time invariant non-observed firm's characteristics.

It is interesting to note that both process and product innovation generate jobs one and two years after the innovation. However, after two years of the innovations there are no additional effects on employment. Therefore, from now on we concentrate our attention in the models with only two lags for the innovations -i.e. $k = 2$. A product innovation increases total employment in average by 1.73 and 1.66 per cent after one and two years of the innovation.[2] Similarly, a process innovation increases total employment in 1.83 and 1.42 per cent after one and two years, respectively.

After one and two years of a product innovation, firms increase the num-

[2]The coefficient of innovation can be interpreted as percentage because process and product innovation are dummy variables and all the dependent variables are in measured in logarithms.

ber of permanent workers in average by 1.5 and 1.3 per cent, respectively. The effect on temporary workers is larger but only occurs one year after the innovation. According with our estimates, firms increase the number of temporary workers in average by 6.8 per cent one year after a product innovation.

The effect of process innovation is similar for temporary workers. After one year of a process innovation firms increase the number of temporary workers in 9.5 per cent. However, the effect on permanent workers is different; the increase in the number of permanent takes time and it is smaller. Firms wait two years to increase the number of permanent workers and when they increase the number of permanent workers they do in only 1.2 per cent.

4 The effect of innovations on employment before and after the 1997's EPL change

What previous paragraph shows is that Spanish manufacturing firms are reluctant to offer open-ended contracts even after two or three years after the innovation. After considering that Spain is the European country with the highest rate of temporary workers this is not surprising. In this section, we study how the firms' willingness to offer open-ended contracts after the innovations depends on the difference in the dismissal costs between temporary and permanent workers.

In the early eighties the unemployment rate in Spain was around 20 per cent. Therefore, in 1984 the EPL was changed to allow the use of fixed-term contracts to hire unemployed workers. As a consequence, the proportion of temporary workers soared and in the nineties Spain was the European country with the highest proportion of temporary workers (around 30 per cent). The EPL was reformed again in 1994, 1997, and 2001 aiming at reducing the proportion of temporary workers. The reform in 1994 restricted the use of temporary contract to certain workers and introduced fiscal incentives for firms offering open-ended contract. The reform in 1997 introduced additional restrictions to the use of temporary contracts, expanded the range of workers that firms can offer open-ended contract and receive the subsidy, and reduced the dismissal cost of new permanent contracts for unemployed workers aged between 18 and 29 or more than 45, disabled or long-term unemployed workers. The quantity of wages' days of indemnities in case of unfair dismissal was reduced from 45 to 33.[3] Finally, the reform in 2001 extended the range of workers that were eligible for the new permanent contract with lower dismissal costs.[4]

In what follows we analyze if after the reduction in the dismissal costs introduced in the EPL change in 1997 firms are more willing to hire permanent workers after their innovations. We consider 1997 because in that year the dismissal cost for new permanent contracts was reduced. To evaluate

[3]Even when the change was only for unfair dismissals, the change was significant because around 72 per cent of cases that went to court were declared unfair. (Galdón-Sánchez and Güell (2000))

[4]For a more detailed analysis of the changes in the EPL see Güell and Petrongolo (2007).

this effect we estimate the equations in Table 2 before and after 1997. Table 3 shows the results of these estimations.

The first panel of Table 3 shows the estimations for the period 1991-1997. During this period the effect of innovation on the total number of employees was similar than for the whole period. However, all the impact was through temporary workers. After one year of the innovation, the number of temporary workers increased in 13.7 per cent and 7.4 per cent in the case of process and product innovations. The effect of process and product innovations on permanent workers one and two years after the innovation was zero.

The second panel of Table 3 shows the estimation for the period 1998-2005. Interestingly, after the change in the EPL in 1997 firms changed their willingness to offer open-ended contracts after the innovation. The effect of a process innovation was translated in an increase in 1.7 per cent of permanent workers after two years of the innovation. The effect of product innovation on permanent workers was larger; 2.3 per cent after one year of the innovation and 2.7 per cent after two years of the innovation. The effect of innovations on temporary workers was again concentrated one year after the innovations but was smaller than the effect before the EPL change and smaller than the effect during the whole period. In this period, one year after a product innovations firms increased the number of temporary workers in 5.34 per cent and after a process innovation in 5.28 per cent. Unfortunately, our dataset do not have information about the conversion of temporary workers into permanent workers. A negative sign in the coefficient of temporary workers and a posi-

tive sign in the coefficient of permanent workers might be a signal that some temporary workers were converted into permanent workers. After two years of the process and process innovations we observe this pattern; however, the negative sign for temporary workers is statistically non-significant.

The effect of product innovation on total employment after 1997 is similar to the effect before 1997. However, the effect of process innovation is different. After 1997 the effect of process innovation on total employment both after one and two years is not significant at 10 per cent. The t-value of the second lag of process innovation on total employment is 1.83 and therefore it is possible that total employment increases in 1.1 per cent two years after the process innovation. However, even in this case, the effect on total employment of a process innovation after one year is considerably lower than before the change in the EPL. This can be explained by the lower effect of process innovation on temporary workers which in turn shows the restrictions to fixed-term contracts introduced by the change in EPL.

5 Conclusions

In this paper we presented evidence about the effect of product and process innovation on employment in the Spanish manufacturing sector over the period 1991-2005. In 1997 the EPL was changed to reduce the proportion of temporary workers; the change in the EPL included a reduction in the dismissal cost for new permanent workers and restrictions to temporary

contracts. We used this change to evaluate the effect of innovations on the number of permanent and temporary workers before and after the change in the EPL.

Our findings confirm the results of Harrison, Jaumandreu, Mairesse, and Peters (2008), both product and process innovation created employment in the Spanish manufacturing sector. Moreover, we show that their findings are robust even after controlling for the effect of any time varying non-observed factor at the industry level and for time invariant non-observed firm characteristics. Additionally, we found that the effect on temporary workers was larger than on permanent workers. We also found a difference in the moment in which the effect occurs. While the effect on temporary workers takes place only one year after the innovation, the effect on permanent workers takes place mainly two years after the innovations.

Studying the impact of innovation on employment before and after the EPL change in 1997, we found that before 1998 all the impact of innovation on employment was through an increase in temporary workers. During this period firms were reluctant to offer open-ended contracts to new workers (or to their temporary workers). However, after the EPL change the impact of product and process innovations on permanent workers were positive and significant. While product innovation increased permanent workers one and two years after the innovation, process innovation increased permanent workers only after two years of the innovation. The effect product innovation on total employment was similar before and after the EPL change. However, the ef-

fect of process innovations on total employment was considerably lower after the change in the EPL. The difference is mainly explained by the reduction in the effect of process innovation on the number of temporary workers.

Although we are focused on the effect of innovation on employment, our results show that the change in the EPL in 1997 was successful in changing the willingness of innovative firms to offer open-ended contracts after their innovations. However, they also show that the restrictions introduced on temporary contracts also affected the willingness of firms of hiring additional workers.

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Table 1: Descriptive Statistics

	SMEs (less than 200 empl.)		**Large firms (more than 200 empl.)**	
	Mean	**Std. Dev**	**Mean**	**Std. Dev**
A. All firms				
Number of firms	1608		765	
Number of observations	14075		7082	
Permanent Workers	35.52	47.94	642.40	1293.03
Temporary Workers	11.09	21.62	90.90	208.82
Age	13.42	15.73	31.24	22.91
Only process innovation	0.20	0.40	0.36	0.48
Product innovation	0.19	0.39	0.40	0.49
B. Firms that do not innovate between 1991 and 2005				
Number of firms	399		62	
Number of observations	2736		362	
Permanent Workers	24.62	34.02	425.95	591.57
Temporary Workers	7.62	12.40	55.44	102.39
Age	12.66	15.77	28.24	20.65
Only process innovation	-		-	
Product innovation	-		-	
C. Firms with at lease one product or process innovation between 1991 and 2005				
Number of firms	1209		703	
Number of observations	11339		6720	
Permanent Workers	38.14	50.37	654.07	1319.32
Temporary Workers	11.92	23.23	92.81	212.88
Age	13.60	15.71	31.40	23.01
Only process innovation	0.26	0.44	0.39	0.49
Product innovation	0.24	0.43	0.42	0.49

Table 2: The effect of innovation on employment

	Total number of employees		**Permanent workers**		**Temporary workers**	
	k=2	**k=3**	**k=2**	**k=3**	**k=2**	**k=2**
Only process innovation (t-1)	0.018***	0.015***	0.009	0.007	0.096***	0.090***
	[0.005]	[0.006]	[0.007]	[0.007]	[0.022]	[0.024]
Only process innovation (t-2)	0.014***	0.009	0.012*	0.010	-0.002	-0.012
	[0.005]	[0.006]	[0.007]	[0.007]	[0.022]	[0.023]
Only process innovation (t-3)	-	0.008	-	0.000	-	-0.007
		[0.006]		[0.007]		[0.023]
Product innovation (t-1)	0.017***	0.016***	0.015**	0.020***	0.069***	0.060**
	[0.006]	[0.006]	[0.007]	[0.007]	[0.023]	[0.023]
Product innovation (t-2)	0.017***	0.016***	0.013**	0.014**	0.002	0.015
	[0.005]	[0.006]	[0.007]	[0.007]	[0.023]	[0.024]
Product innovation (t-3)	-	-0.001	-	-0.003	-	-0.028
		[0.006]		[0.007]		[0.023]
Production (t-1, in logs)	0.463***	0.467***	0.435***	0.442***	0.459***	0.441***
	[0.012]	[0.013]	[0.013]	[0.014]	[0.029]	[0.032]
R-squared	0.37	0.37	0.34	0.34	0.10	0.09
Number of observations	15,913	13,693	15,913	13,693	15,913	13,693
Number of firms	2,350	2,082	2,350	2,082	2,350	2,082

Notes: (1) All dependent variables are in logs. (2) All regressions include log of age, square of the log of age, and the interaction between industry and year dummies. (3) Robust standrd errors in brackets. (4) *** p<0.01, ** p<0.05, * p<0.1.

Table 3: The effect of innovation on employment before and after the policy change

	Total number of employees [1]	**Permanent workers** [2]	**Temporary workers** [3]
A. Sample Period: 1991-1997			
Only process innovation (t-1)	0.026***	0.013	0.137***
	[0.007]	[0.009]	[0.034]
Only process innovation (t-2)	0.0103	0.000	0.014
	[0.007]	[0.009]	[0.032]
Product innovation (t-1)	0.012*	-0.008	0.074**
	[0.007]	[0.009]	[0.037]
Product innovation (t-2)	0.021***	-0.005	0.037
	[0.008]	[0.009]	[0.035]
Production (t-1, in logs)	0.248***	0.184***	0.359***
	[0.0165]	[0.0188]	[0.0583]
R-squared	0.16	0.09	0.07
Number of observations	6,442	6,442	6,442
Number of firms	1,709	1,709	1,709
B. Sample Period: 1998-2005			
Only process innovation (t-1)	0.007	0.008	0.0528*
	[0.006]	[0.008]	[0.027]
Only process innovation (t-2)	0.011	0.017**	-0.005
	[0.006]	[0.007]	[0.026]
Product innovation (t-1)	0.018***	0.023***	0.0534*
	[0.007]	[0.008]	[0.031]
Product innovation (t-2)	0.017**	0.027***	-0.017
	[0.007]	[0.008]	[0.029]
Production (t-1, in logs)	0.404***	0.399***	0.343***
	[0.0196]	[0.0206]	[0.0428]
R-squared	0.29	0.27	0.08
Number of observations	9,471	9,471	9,471
Number of firms	1,768	1,768	1,768

Notes: (1) All dependent variables are in logs. (2) All regressions include log of production, log of age, square of the log of age, and the interaction between industry and year dummies. (3) Robust standrd errors in brackets.
(4) *** p<0.01, ** p<0.05, * p<0.1.