Departament d'Econometria, Estadística i Economia Espanyola
Facultat de Ciències Econòmiques i Empresarials
Universitat de Barcelona

ESSAYS ON TOTAL FACTOR PRODUCTIVITY, INNOVATION, EDUCATION AND TRAINING: THE ROLE OF SIZE IN SPANISH MANUFACTURING FIRMS

Laia Castany Teixidor

Directors: Dr. Enrique López Bazo i Dra. Rosina Moreno Serrano

Tesi Doctoral per a optar al títol de Doctora per la Universitat de Barcelona
Març 2007

Programa de Doctorat en Economia, bienni 2002-2004
Especialitat en Tècniques d'Anàlisi en Economia Aplicada

Chapter 5

THE ROLE OF FIRM SIZE IN TRAINING PROVISION DECISIONS: THE SPANISH CASE

5.1. *Introduction*

As commented in the Introduction of Part III, continuous training is considered to increase workers' and firms' productivity. Small firms are generally believed to face more difficulties in providing training to their employees. In this Chapter we intend to assess the relative contribution of different firms' characteristics in explaining the training provision gap between large and small firms. The hypothesis is that large firms provide more training because they have certain characteristics that require a higher provision of training.

In Section 5.2, we review several theoretical arguments that explain differences in training provision by firm size and different training determinants suggested in the literature. In Section 5.3 we give our empirical model and discuss some methodological issues related to the method of estimation. In Section 5.4 we offer a descriptive analysis showing evidence that small Spanish manufacturing firms spend less on training and that it is associated to certain firm characteristics: the qualification of the labour force, the technological activity, the geographical scope of the market, the participation of foreign capital or the use of temporary workers. In addition, among firms with such characteristics, large firms provide more training, which may suggest differences in the effect of such characteristics in the decision to provide training. In Section 5.5 we offer results of the estimation of our specification. First, we discuss whether it is appropriate to estimate a model that takes sample selection into account and, second, we introduce

firm-specific effects. On the basis of the estimation for the small and large firms' subsamples, in Section 5.6 we apply the Oaxaca-Blinder decomposition to analyse the differential in the provision of training by firm size –the differential in the probability of providing training and the differential in the quantity. Finally, Section 5.7 concludes.

5.2. Determinants of Training

Continuous training of workers is an extension of the process by which the stock of human capital is enhanced by the school system; however, this part of the educational process takes place within firms. Some is formal and occurs in a structured environment, often in a classroom. Other is informal and involves supervision and work associated with the production process. The importance of analysing continuous training at firm level, instead of employees' level, lies in the fact that decisions on the expenditure on training are made at firm level.

The empirical work by Black et al. (1999) addresses the relationship between different training measures and firm size for a sample of US firms and they find that large firms invest more in training. They argue that large firms have scale economies in the provision of both formal and informal training and more opportunities of doing co-worker training (i.e. if more than one person is doing the same task, then one of them can leave his or her job for a while to teach the new worker without interruption of the productive process). Baldwin et al. (1995) argue that large firms might have higher pay-off from their investment in training, and thus they would invest more. Holtmann and Idson (1991) argue that they face lower investment risks because they "pool risks". Barron et al. (1987) argue that there are more possibilities of shirking in large firms, because when employees work cooperatively to produce a common output it is more difficult to disentangle the participation of each one. Then, large firms will have higher monitoring costs and a way of reducing these costs is training their employees. Also, according to Hashimoto (1979), large firms have access to cheaper capital to finance training. For the Spanish case, Rigby (2004) highlights that small firms in Spain usually have access to training plans that "do not reflect the specific needs of employers and are promoted actively by social partners independently of employers".

On the other hand, there is a strand of literature dedicated to explore the reasons why firms decide whether to train workers or the amount of training provided. Some

relevant empirical works are Bartel (1989), Baldwin et al. (1995), Black and Lynch (1998), Blundell et al. (1999). For the Spanish case, see Alba-Ramírez (1994b), Peraita (2005) and Albert et al. (2005a). This literature estimates the impact of certain firm characteristics (determinants) that are supposed to be associated to training decisions.

In this Chapter, we argue that large firms are often associated to some of these characteristics, while small firms are not, or not with the same intensity. If these characteristics are associated to higher training levels and large firms more associated to these characteristics, they can explain in part why small and large firms follow different patterns in their training decisions, and thus the differences observed between them in terms of whether to provide training and on the amount of it. In the following paragraphs, we discuss how these characteristics may have an influence on the firms' training decisions and how they might differ by firm size.

First of all, training will be dedicated to those who have previously shown aptitudes to learn through a formal education process because they are supposed to be capable of taking higher profit from their expenditure on training (see Black and Lynch, 1998; or Alba-Ramírez, 1994). So, firms with more qualified workers are likely to provide more training. Evans and Leighton (1989) find evidence of some sorting on ability characteristics across firm sizes. Zábojník and Bernhardt (2001) propose a model in which workers in larger firms and industries acquire more human capital. We argue that large firms have a more qualified labour force, which could explain why they provide more training than their smaller counterparts.

The use of advanced and specialized technology requires specific knowledge and skills that are not easily found in the labour market and training is a way of acquiring such skills (Baldwin et al., 1995). Technological changes occur at high speed and they require the continuous upgrading of the current labour force. There exists a wide debate on whether technological change leads to deskilling (technology permits separating tasks in other simpler tasks so that high skills are not so necessary) or leads to upskilling (technology makes the most repetitive tasks automatic so that workers are set free to perform tasks that require higher skills). However, the empirical evidence seems to favour more upskilling rather than deskilling. The skill-biased technological change effect has been mainly studied for the case of formal education, but a similar argument could be applied in the case of training (Osterman, 1995). Often, the

innovative activity or the innovative effort of firms has also been included as a measure of its technological complexity. However, we consider that the use of advanced technologies and the innovative activity might both require separate training, as they are quite different processes.[96] When firms obtain an innovation, they will need to incorporate it in their production process. As before, the specific knowledge that the new process or product requires may not be easily found in the labour market. For example, when they launch a new product they may need to train sales workers. Or when they implement a process innovation, they may need to provide technical training to production workers (Alba-Ramírez, 1994). Since Schumpeter (1942), different authors argue that large firms have an advantage over small companies as their financial situation allows them to be the most capable innovators. Huergo and Jaumandreu (2004a) find that innovation is narrowly related to firm size in Spain. We consider that the same argument applies for a more intense use of advanced technologies in large firms. Thus, we expect that large firms innovate more and make a more intense use of advanced technologies and this can partially explain that they provide more training.

Investing in training is a way of increasing firms' competitiveness. Then, firms exposed to more competitive markets may invest more in training as a strategy to make their employees more competitive and to be able to survive (see for example, Bartel, 1989). Small firms will be more vulnerable to highly competitive markets than large firms in the same market, so one would expect them to invest more in training. However, it is possible that large and highly competitive firms will place themselves in competitive markets, where small firms could not survive (i.e. international markets). Then, it is not clear whether small or large firms would provide more training so as to improve their competitiveness.

Other authors argue that foreign-owned firms are more likely to train workers. Very often, these firms are multinational firms, which are more efficient in their management, which employ more qualified workers and have a more positive attitude toward workers' skills than domestic firms (see Görg and Strobl, 2005; Hughes et al., 2004).

[96] Baldwin et al. (1995) comment that the lack of available data on the use of advanced technology led many authors to use proxies such as the innovative activity, the capital-labour ratio or some measure of productivity.

Finally, firms with a high percentage of temporary workers are expected to invest less in training. This effect has an additional importance in the case of the Spanish labour market, as there is a high degree of temporary employment. See the works by Alba-Ramírez (1994) at firm level and Albert et al. (2005b) at employee level. On the one hand, if workers abandon the firm in the short term, the firm will not be interested in training them as it will not be able to capture the returns from such investment. On the other hand, temporary workers do not have incentives to acquire the firm-specific human capital as he or she has a low probability of continuing in the firm. Oi (1983) finds that large firms have less rotation because of internal labour markets, thus we expect that these firms are more likely to provide training.

There are determinants of training for which we cannot control. First, the percentage of unionized workers in the firm: it has been argued that unions bargain with the employer to achieve greater investment in training; also, quit rates tend to be lower in unionized firms, and thus, the costs of training employees are lower in unionized organizations (Wagar, 1997). Large firms tend to be more unionized and so they will be more likely to provide training. Second, due to the fact that we use a firm-level dataset, we cannot take into account the personal characteristics of workers (age, gender, experience, tenure, nationality, civil status or parents' education level; see Oosterbeek, 1996), as well as the workplace and personnel practices (total quality management, benchmarking, job sharing, self-managed teams, number of organizational levels, internal promotion, incentive-based retribution or joint decision-making; see Black and Lynch, 2004).

To summarize, large firms are usually associated to having a more qualified labour force. We argue that large firms provide more training because they have certain characteristics that *allow* them to dedicate more efforts to training workers —having more white collars or less temporary workers—. They may also provide more training because they have certain characteristics that *require* more training —using more advanced technologies or having a higher innovative activity, operating in more competitive markets (i.e. international) and being partially owned by foreign capital—. There are theoretical arguments and some empirical evidence pointing to the fact that these characteristics permit and require providing more training in the case of large

firms and this could explain their training provision differential in relation with small firms. Therefore, we will consider these factors as the main determinants of training.

5.3. Methodological Issues and Empirical Model

The ultimate purpose of this Chapter is analysing whether small and large firms follow different patterns in their decisions of providing continuous training to their employees. We argue that large firms have certain characteristics that may determine a higher provision of training. It is a common practice to estimate a probit model to analyse what determines whether firms provide training to their employees or not. To analyse the determinants of firms' expenditure on training, it is also quite common to estimate a tobit model, which takes into account the fact that the dependent variable is censored at zero as, by nature, it can only take nonnegative values. See for example, Alba-Ramírez (1994), Black and Lynch (1998) or Black et al. (1999). The maximum likelihood estimation (MLE) of the tobit model would provide consistent estimations if the error term is normal and homoskedastic.[97] Estimating the specification by OLS instead, would provide inconsistent estimates, as it assumes that the dependent variable can take both positive and negative values. Moreover, as the logarithm of zero does not exist, a common solution is to add a small positive constant; but this constant is set arbitrarily. The main limitation of the tobit model is that it is quite a particular case, as it does not consider that the decision on the quantity of training may be a double-decision process: first, firms decide whether to invest in training or not, and second, they decide the amount they will spend on it. It is especially the case when the two decisions are motivated by different determinants. For instance, when the decision on whether to provide training involves incurring fixed costs such as designing a training plan or evaluating the necessities on training of the firm. Then, fixed costs determine the decision on whether to spend some money or not, but they do not necessarily affect the decision on the quantity. Even in the case that the two decisions depend on the same factors, the dependent variable may have observations that take value zero with a high frequency and this mass of zeros may respond differently to covariates than the observations with positive values. When this occurs, there are reasons to model the

[97]Although heteroskedasticity can be modeled, the tobit is hypersensitive to extreme values in the distribution.

decision on training as two separate mechanisms, which can be seen as a generalization of the tobit model.[98]

Two-part models permit estimating the determinants of the expenditure on training (quantity equation) supposing that, on a first stage, firms decide whether to provide training to its employees or not (participation equation). These models add flexibility in the sense that they allow that zeros and non-zeros are generated from different densities. There are two approaches to such flexible models: the sample selection model and the two-part model itself. The main difference between them is that the former takes into account a sample selection effect, which may cause biased estimations when it is omitted. In this Chapter, we estimate the two models and discuss which one is preferred in the specific case of firms' training provision, both from a theoretical and applied perspective.

The most popular sample selection model is the bivariate sample selection model studied by Heckman (1979). The so-called *heckit* model comprises a participation equation, which may cause sample selection:

$$dTR_i^* = X_{1i}'\beta_1 + \varepsilon_{1i} \tag{5.1}$$

where dTR_i^* is a censoring latent variable that reflects whether each i-firm would be willing to provide some training and X_{1i} is a vector of variables that determine this decision. The willingness of firms to provide training cannot be observed, but we observe whether the firm spends some money on it. Define dTR_i as the censoring observed variable, which is a binary indicator that takes value 1 if we observe that the firm does some expenditure on training. So, $dTR_i = 1$ if $dTR_i^* > 0$ and $dTR_i = 0$ if $dTR_i^* \leq 0$.

Define TR_i as the firms' expenditure on training and $lnTR_i$ as its logarithm, which is determined by a vector of variables X_{2i}. The quantity equation can be expressed as:

$$\ln TR_i = X_{2i}'\beta_2 + \varepsilon_{2i} \tag{5.2}$$

Assuming that the error terms ε_{1i} and ε_{2i} follow a bivariate normal distribution with zero means, standard deviation σ_1 and σ_2, covariance σ_{12} and correlation ρ:

$$E(\ln TR_i \mid dTR_i = 1) = X'_{2i}\beta_2 + \sigma_{12}\lambda_i\left(X'_{1i}\beta_1\right) \tag{5.3}$$

[98] See Cameron and Trivedi (2005, pp. 544-551) for a thorough explanation.

where $\lambda_i(X'_{1i}\beta_1) = \phi(X'_{1i}\beta_1)/\Phi(X'_{1i}\beta_1)$ is defined as the inverse Mills' ratio, ϕ is the standard normal density function and Φ is the standard normal cumulative distribution function. The coefficients β_1 are obtained by a first-step probit regression of *dTR* on X_1: $P(dTR = 1) = \Phi(X'_{1i}\beta_1)$. The *heckit* model augments the OLS regression on the quantity of training by the inverse Mills' ratio and then uses the positive values of *TR* to estimate the model by OLS. The estimate of β_2 is consistent, as it takes the sample selection bias into account.[99]

By introducing the inverse Mills' ratio, this model corrects for the possible sample selection effects. Sample selection appears when the error terms of the two equations are not independent, and thus the covariance of the error terms, σ_{12}, is different from zero. When σ_{12} equals zero, the *heckit* model simplifies to the two-part model, which simply uses the positive values of *TR* to estimate the model by OLS, obtaining consistent estimates of the β_2 parameters. The two-part model was first proposed by Cragg (1971) and was especially designed for data on expenditure that contains a large number of zeros and a right-skewed distribution. The two-part model also departs from a participation and quantity equation. As before, the participation equation is estimated by a probit model and the quantity equation by a least squares standard regression. The difference with the *heckit* model is that it does not include the inverse Mills' ratio term in the quantity equation to take into account possible sample selection:

$$E(\ln TR_i \mid dTR_i = 1) = X'_{2i}\beta_2 \tag{5.4}$$

Departing from the discussion in Section 5.2 on the determinants of training, we include the following covariates in X_1 and X_2: the firm size, the percentage of white collars, the intensity of use of advanced technologies, the innovative capacity of the firm, the geographical scope of the firm market, the foreign capital participation and the percentage of temporary workers. As control variables, we include the intensity of use of the productive capacity, a variable on whether the firm belongs to a group and finally a set of regional, industrial and year dummies.[100]

[99] The bivariate sample selection model can also be estimated by ML although it imposes stronger assumptions on the distribution of the error terms.
[100] See Appendix 5.1 for a more detailed explanation in the measurement of variables.

All in all, we estimate the following equations as the quantity equations of these models: the former, corresponds to the *heckit* model and the latter to the two-part model. For *dTR=1*:

$$\ln TR_i = X'_{2i}\beta_2 + \sigma_{12}\lambda_i\left(X'_{1i}\beta_1\right) + v_i \tag{5.5}$$

$$\ln TR_i = X'_{2i}\beta_2 + \varepsilon_{2i} \tag{5.6}$$

In the following paragraphs we follow Dow and Norton (2003) in discussing which of the two models could be more appropriate to estimate firms' provision of training. The choice between the two models is a controversial question and has led to an intense debate over the last years. First of all, one should carefully consider what kind of dependent variable has to be modelled. To put it simply: when analysing continuous variables on expenditure on training with a large proportion of zeros, do we observe *potential* training-providers that for some reason did not decide to provide training to their employees? Or otherwise, do we observe firms that do not desire to provide any training to their workers (*actual* outcome)? In other words, is there a latent positive expected training provision which might have been incurred under certain circumstances? These authors argue that when the zeros do not represent zero values for the potential outcome, the potential and observed outcome differ, and then sample selection bias could appear.

Lynch (1993) argues that, in small firms, fixed costs of training are distributed across a smaller number of employees, and then the production losses associated with a worker being away from the workplace can be higher in a small than in a large firm. Other fixed costs may be, for instance, the design of firms' training plans or the evaluation of their necessities of training. We argue that some firms, in the presence of fixed costs, could obtain a low net benefit from their investment in training. And although they would will to provide some training, if the net benefit was too low, we would observe a zero for the variable on the expenditure on training. Otherwise, if the net benefit was high, firms would decide to provide training and we would observe some positive value. According with this argument, a large mass of zeros may include potential training-providers that for some reason did not decide to provide training. In this perspective, our interest is placed in the potential outcome rather than the actual

outcome.[101] By omitting the unobservable effect hidden in the potential outcome, one is only considering those firms that obtain a high net benefit from training, so that the coefficients of the decision on the quantity of training would be biased. In this sense, we consider that fixed costs could be hiding a latent expected training provision and thus causing a sample selection bias in the coefficients. In such case, the *heckit* model would be more appropriate while the two-part model would only be appropriate when sample selection does not exist.

Second, the *heckit* model may have problems of identification when the same regressors are included in the two equations, while in the case of the two-part model this is not a limitation.[102] The *heckit* model with normal errors is theoretically identified without any restriction on the regressors. However, if the same regressors are included in the two equations, this model is close to unidentified because $X_1=X_2$ leads to multicollinearity problems. Cameron and Trivedi (2005, pp 551) explain that sometimes it can be very difficult to make defensible exclusion restrictions. In our case, it seems difficult to find at least one regressor that determines the decision on whether to provide training or not, but does not determine the quantity of training provided.

A test of $\sigma_{12}=0$ in the *heckit* model can be used to test the null hypothesis that the two-part model is correct against the alternative hypothesis that the *heckit* is correct.[103] However, under collinearity between the covariates and the inverse Mills' ratio, the power of the t-test on the inverse Mills' ratio is limited and this test cannot be used as a criterion to select between the two models; with low collinearity, the t-test is reliable. According with Leung and Yu (1996), the main sources of multicollinearity are imposing no exclusion restrictions, having low variability among regressors or a high degree of censoring. These authors recommend using the condition number to check for multicollinearity between the inverse Mills' ratio and the covariates in the quantity equation. The condition number is defined as the square root of the ratio of the largest to

[101] Dow and Norton (2003) argue that labour economists "are generally interested in the *potential* wage. Observations without positive wage outcomes do not imply that an individual worked for zero wages". On the contrary, in health economics, "researchers are interested in the public and private budgetary implications of *actual* expenditures" and "potential expenditures that are never incurred will not affect health care budgets".

[102] Although it is also possible to make exclusions in the case of the two-part model.

[103] Dow and Norton (2003) stress that if the coefficient of the inverse Mills' ratio is zero, the *heckit* reduces exactly to the two-part model, but the two-part model does not require the coefficient to be equal to zero. The two models simply make different implicit distributional assumptions and they are only partially nested.

the smallest eigenvalue of the moment matrix $X'X$. Based on Monte Carlo experiments, Belsley et al. (1980) suggest that a condition number beyond 30 is indicative of collinearity problems.

Finally, using statistical criteria to select between the two models, Dow and Norton (2003) recommend the test proposed by Toro-Vizcarrondo and Wallace (1968), which they name an empirical mean squared error (EMSE) test. The original test statistic was derived for OLS models, but the intuition can be extended to the *heckit* and two-part models. This test consists on calculating the EMSE of both estimators, under the assumption that one model is consistent and correct. Then, the estimator with the lower EMSE is chosen. The EMSE for the supposed correct model will then involve only the variance component, whereas that for the other model will involve its variance and its squared bias relative to the former.

On the other hand, and following with the econometric issues related to our model, it seems sensible to think that using a firm-level dataset will lead to a high degree of heterogeneity among firms with similar observed characteristics. As we argue in Section 3.3, this particularity of the data requires estimating a model that takes unobservable firm-specific effects into account. The random effects model assumes that the individual heterogeneity is part of an error term component and that the error term is uncorrelated with the regressors.[104] In the case of micro-databases, where firms in the sample are selected randomly from a larger population, it is quite common to estimate a random effects model, rather than a fixed effects model (Cameron and Trivedi, 2005).[105]

5.4. The Dataset and Descriptive Analysis

As in Parts I and II, we use data drawn from the ESEE to perform the analysis. This survey collects information of firms' decisions for a sample of Spanish manufacturing firms, being representative by industry and size strata. The variables included in the questionnaire permit taking into account a wide range of firm decisions that may be related with training (further details in Section 2.2.1).

[104] Although this is a quite strong assumption we prefer the random effects model rather than fixed effects because some of our variables do not change over time (for example, sector or regional dummies).

[105] Groot and Maassen van den Brink (2003) estimate a random effects probit model to analyse the frequency of training in Dutch firms. Barrios et al. (2003), Máñez et al. (2004) and Licandro et al. (2004) among others also estimate a random effects model when dealing with firms' heterogeneity in the Spanish industry.

For the analysis in Part III, we use information drawn from this survey that corresponds to years 2001 and 2002,[106] with 1515 and 1505 firms respectively.[107] Out of these, 31.55% and 30.3% are large firms. For these firms, data are available for all the variables required. As commented in Section 2.2.1, the ESEE considers that large firms are those with more than 200 employees, and small firms have between 10 and 200 employees.

Table 5.1 shows a descriptive analysis of training, both for the discrete variable (*dTR*) and for the expenditure per worker (*TR*) for the year 2001 and in relation with the other variables of interest. Table 5.2 shows the same analysis for 2002. First of all, we obtain that around 40% of the firms in the sample provided training in our period of analysis.[108] As we are interested in differences by size, we separate the total sample in the subsamples of small and large firms: we obtain that 24% of small firms provide some training in 2001 and 25% in 2002; in the case of large firms it rises to 72% in 2001 and 78% in 2002.[109] The average real expenditure per worker and year is 39 euros in small firms in 2001 and 44 euros in 2002; in large firms, it rises to 130 euros in 2001 and 151 euros in 2002. We perform tests of equality of proportions and equality of means that permit analysing whether the differences in the provision of training by size are statistically significant. We already commented in Section 2.5.4, we obtain that large firms provide more training and that the differences are significant at 1% for both 2001 and 2002.

Following the discussion in Section 5.2 about firm characteristics that determine the provision of training, in Tables 5.1 and 5.2, we analyse whether it is associated with such characteristics. We split the total sample in two groups: firms with and without the characteristics mentioned in Section 5.2 (or with a level above or below the median). Next, we compare the proportion and the average expenditure on training per worker in the two groups. Firms with a percentage of white collars above the median (labelled

[106] The information on the firms' provision of continuous training in the ESEE is only available for 2001 and 2002.

[107] Notice that the number of observations is larger here than in the descriptive analysis in Section 2.5.4, which relates training and TFP. This is due to the fact that we lose a great number of observations when calculating the TFP index.

[108] Data from the Eurostat (CVTS2) show that, in 1999, the percentage of Spanish firms providing training by size class are the following: 10 to 49 employees: 23%; 50 to 249 employees: 49%; 250 employees or more: 80%. However, notice that these percentages refer to the whole economy, while we only consider manufacturing firms. The sector that provides more training is the service sector, which is quite a large sector in the Spanish case.

[109] Alba-Ramírez (1994) finds that around 60% of large firms provided training in 1988.

"high % white") provide significantly more training. Innovative firms and firms that make a more intense use of advanced technologies provide more training (concretely, firms that make high use of these tecnologies provide more training than firms with medium use, and firms that make medium use of advanced technologies provide more training than firms with low use). Also, firms that operate in international markets and firms that are more participated by foreign capital provide significantly more training. Finally, those firms with a percentage of temporary workers below the median also provide more training. In all the cases, the tests of equality of proportions and equality of means reject the null that the two groups provide the same training at 1%. The only exception is the test of equality of proportions in the comparison between firms with a percentage of temporary workers above and below the median in 2001, which does not show any significant difference between the two groups. All in all, these descriptive measures confirm that training seems to be associated with these characteristics, as our a priori reasoning indicated.

In this Chapter, we argue that small firms' difficulty in accessing training is related with the fact that these firms are not associated with the above-mentioned characteristics or not with the same intensity as large firms. Our objective is analysing whether small and large firms follow different patterns in their training decisions in relation to these characteristics. So, we investigate whether small and large firms are also different after conditioning to these characteristics. Tables 5.1 and 5.2 show that, among those firms that have a percentage of white collars above the median, the large ones provide significantly more training than their smaller counterparts. Also, among those firms that have a percentage of white collars below the median, the large ones provide significantly more training. Similar results are obtained for all the other characteristics. The tests of equality of proportions and means reject the null that small and large firms provide the same training at 1%. The only exception is the test of equality of means in the comparison between small and large firms with a participation of foreign capital above the median in 2001, which does not show any significant difference between the two groups. Thus, we observe a clear picture: firms with certain characteristics provide significantly more training, and among this group, large firms also provide significantly more training than small ones.

Table 5.1. Descriptive of training in 2001 by firms' characteristics and size

	dTR	Eq prop test (•)	Training/worker (euros)	Eq mean test (•)	No of obs
Total sample	39.66		67.9427		1515
Small	24.59	17.6718***	39.0094	6.471***	1037
Large	72.38		130.7122		478
Low % white	24.14	12.3622***	24.5848	7.9201***	758
High % white	55.22		111.3578		757
Low % white - small	13.61	12.9419***	14.5179	5.1208***	595
Low % white - large	62.58		61.3323		163
High % white - small	39.37	10.3892***	71.9787	4.2366***	442
High % white - large	77.46		166.6136		315
Adv tech low	24.73	10.2389***	40.1577	3.5192***	845
Adv tech med	53.08		89.886		454
Adv tech high	69.91	4.1309***	130.5171	1.7606**	216
Adv tech low - small	17.16	11.7554***	25.6008	4.9264***	711
Adv tech low - large	64.93		117.3959		134
Adv tech medium - small	39.16	6.9742***	63.7311	2.2359***	263
Adv tech medium - large	72.25		125.9003		191
Adv tech high - small	47.62	4.5829***	87.1314	1.7752**	63
Adv tech high - large	79.09		148.3819		153
Non innovative	24.31	12.2155***	34.6759	6.0239***	757
Innovative	55.01		101.1656		758
Non innovative - small	16.26	10.7411***	22.1866	5.1567***	615
Non innovative - large	59.15		88.7666		142
Innovative - small	36.73	11.3397***	63.5259	3.9682***	422
Innovative - large	77.98		148.4392		336
National market	29.26	12.1025***	54.5181	4.058***	1032
International market	61.90		96.6263		483
National market - small	19.70	12.967***	33.7689	3.7217***	812
National market - large	64.55		131.1016		220
International market - small	42.22	8.3184***	57.9218	5.2698***	225
International market - large	79.07		130.3802		258
Low % foreign K	29.90	14.7036***	48.0743	7.0823***	1184
High % foreign K	74.62		139.0125		331
Low % foreign K - small	20.02	14.1695***	29.2313	3.9025***	929
Low % foreign K - large	65.88		116.722		255
High % foreign K - small	63.89	3.1229***	123.1185	0.9612	108
High % foreign K - large	79.82		146.7101		223
High % temp workers	38.71	0.7669	51.4381	2.9616***	757
Low % temp workers	40.63		84.4255		758
High % temp workers - small	23.19	13.2218***	31.1772	5.5807***	526
High % temp workers - large	74.03		97.5733		231
Low % temp workers - small	26.03	11.7764***	47.0714	4.5848***	511
Low % temp workers - large	70.85		161.7045		247

Note: (***) (**) and (*) denote significant at 1%, 5% and 10%.

Table 5.2. Descriptive of training in 2002 by firms' characteristics and size

	dTR	Eq prop test (•)	Training/worker (euros)	Eq mean test (•)	No of obs
Total sample	41.26		76.9683		1505
Small	25.26	19.1235***	44.6833	9.4218***	1049
Large	78.07		151.2381		456
Low % white	24.57	13.1639***	31.8816	9.1805***	753
High % white	57.98		122.1151		752
Low % white - small	13.66	13.3871***	18.4951	4.8865***	593
Low % white - large	65		81.4952		160
High % white - small	40.35	12.1556***	78.7395	6.6247***	456
High % white - large	85.14		188.9369		296
Adv tech low	24.94	10.8696***	47.4908	3.8328***	838
Adv tech med	55.31		91.0573		452
Adv tech high	75.35	4.9775***	162.2428	3.2984***	215
Adv tech low - small	16.97	12.7351***	30.8087	6.3557***	713
Adv tech low - large	70.4		142.6452		125
Adv tech medium - small	41.64	7.0894***	65.8023	3.1198***	269
Adv tech medium - large	75.41		128.1807		183
Adv tech high - small	47.76	6.3151***	107.5427	1.7135**	67
Adv tech high - large	87.84		187.0056		148
Non innovative	27.71	12.6221***	40.9176	7.6938***	877
Innovative	60.19		127.313		628
Non innovative - small	16.67	14.3266***	22.3721	7.1306***	696
Non innovative - large	70.17		112.2308		181
Innovative - small	42.21	10.4296***	88.6737	4.2921***	353
Innovative - large	83.27		176.9119		275
National market	30.25	12.4939***	52.7272	6.1329***	1015
International market	64.08		127.1822		490
National market - small	20.3	13.8469***	30.0197	6.7268***	813
National market - large	70.3		144.1191		202
International market - small	42.37	9.6549***	95.1983	2.7784***	236
International market - large	84.25		156.8996		254
Low % foreign K	31.67	14.5138***	52.7326	9.1928***	1184
High % foreign K	76.64		166.3612		321
Low % foreign K - small	21.46	15.0616***	35.4448	5.6428***	946
Low % foreign K - large	72.27		121.4481		238
High % foreign K - small	60.19	4.7851***	129.5345	2.2942***	103
High % foreign K - large	84.4		183.761		218
High % temp workers	37.33	3.0859***	59.8489	3.3923***	750
Low % temp workers	45.17		93.9744		755
High % temp workers - small	22.8	12.977***	40.9062	4.5742***	535
High % temp workers - large	73.49		106.9856		215
Low % temp workers - small	27.82	13.9855***	48.6148	8.5701***	514
Low % temp workers - large	82.16		190.7164		241

Note: (***) (**) and (*) denote significant at 1%, 5% and 10%.

Additionally, the statistics of the tests of equality of proportions and means that compare the provision of training in small and large firms are smaller for the group of

firms with a high level of qualified workers than for the group with a low level. This indicates that differences between small and large firms reduce for firms with more human capital. Thus, having a high percentage of white collars seems to slightly mitigate the differences in training provision decisions between small and large firms. This result is obtained for most of the other characteristics, both in 2001 and 2002. Therefore, it seems that providing a high level of human capital, using advanced technologies with a high intensity, innovating, operating in an international market, having a high percentage of foreign capital or few temporary workers permits small firms being closer to large firms with respect to the provision of training, although differences are still important. Moreover, it suggests the possibility of an indirect effect of this variables on training, which can be associated with firm size.

Tables 5.3 and 5.4 show the mean and standard deviation of the potential determinants of training for the total sample and the small and large firms' subsamples. Large firms have more white collars, innovative more and use advanced technology with an intermediate and high intensity more than small firms do; large firms also operate more in international markets and they are more participated by foreign capital. As for small firms, they use advanced technology with low intensity more than large firms do and they have more temporary workers than large firms. Moreover, the differences in these characteristics between small and large firms are significant at 1% in all the cases.

These results suggest that large firms may provide more training because they are more associated to these characteristics and this constitutes the point of departure for the remaining of our analysis. In the next section, we perform a causal analysis to see if such characteristics are driving the training decisions and if they have different influence in small and large firms. As we explain in Section 5.6.1, the differential in the provision of training could also be associated to a higher impact of these characteristics on the decisions of training.

Table 5.3. Descriptive of firms' characteristics by firm size in 2001

	Total sample		Small firms		Large firms		
	Mean	Std dev	Mean	Std dev	Mean	Std dev	Eq mean test (•)
Size	243.4686	699.7923	46.9967	46.3617	669.7058	1133.0016	12.0116***
% White collars	10.948	12.4904	9.4495	12.189	14.1988	12.5308	6.9146***
Advanced technology low	0.5578	0.4968	0.6856	0.4645	0.2803	0.4496	16.1346***
Advanced technology medium	0.2997	0.4583	0.2536	0.4353	0.3996	0.4903	5.5743***
Advanced technology high	0.1426	0.3498	0.0608	0.239	0.3201	0.467	11.4685***
Innovation	0.5003	0.5002	0.4069	0.4915	0.7029	0.4574	11.4287***
International market	0.3188	0.4662	0.217	0.4124	0.5397	0.4989	12.3346***
% Foreign K	19.3241	38.2651	8.6972	26.9353	42.3787	47.891	14.3646***
% Temporary workers	20.3932	22.7669	22.0143	24.9551	16.8763	16.5684	4.7403***
No of obs	1515		1037		478		

Note: (***) (**) and (*) denote significant at 1%, 5% and 10%.

Table 5.4. Descriptive of firms' characteristics by firm size in 2002

	Total sample		Small firms		Large firms		
	Mean	Std dev	Mean	Std dev	Mean	Std dev	Eq mean test (•)
Size	241.5015	697.9168	47.4211	47.155	687.9714	1148.1854	11.9087***
% White collars	11.6006	13.1976	9.9985	12.9629	15.2864	13.0066	7.2555***
Advanced technology low	0.5568	0.4969	0.6797	0.4668	0.2741	0.4466	15.9687***
Advanced technology medium	0.3003	0.4586	0.2564	0.4369	0.4013	0.4907	5.4373***
Advanced technology high	0.1429	0.35	0.0639	0.2446	0.3246	0.4687	11.2302***
Innovation	0.4173	0.4933	0.3365	0.4727	0.6031	0.4898	9.8046***
International market	0.3256	0.4687	0.225	0.4178	0.557	0.4973	12.4729***
% Foreign K	19.0452	38.1206	8.2364	26.3801	43.9101	48.0792	14.8993***
% Temporary workers	19.3388	22.1853	21.0709	24.416	15.3543	15.1985	5.5139***
No of obs	1505		1049		456		

Note: (***) (**) and (*) denote significant at 1%, 5% and 10%.

5.5. Estimation

The ultimate purpose of this study is to shed some light on the reasons why small firms provide less training than their larger counterparts. Using the Oaxaca-Blinder decomposition we intend to assess the contribution of differences in the characteristics and in their returns to the gap in the probability of providing training, and in the difference in expenditure for those firms providing training, between small and large firms. As already stated in Section 3.6.1, the point of departure of the Oaxaca-Blinder decomposition is the estimation of auxiliary regressions for small and large firms separately. This methodology is applied on the basis of our preferred empirical specification. In the following subsections we select a specification out of different possibilities based on alternative definitions of innovative activity. We also discuss whether it is more appropriate a model that takes sample selection into account or not.

Finally, we introduce firm-specific effects and test whether the panel data estimations are more appropriate than the pooled data estimations.

5.5.1. The two-part model vs. the *heckit* model

As commented in Section 5.4, around 60% of the observations of our dependent variable *TR* take value zero. This percentage indicates the existence of a high degree of censoring, and thus the necessity to consider that the zeros and positive observations may be generated from different processes. Departing from the arguments in Section 5.3, we consider a two-part model. In this Section we discuss whether it is more appropriate to model firms' training decisions as a two-part model with sample selection or not. [110]

Before focusing on this question, and since innovation is one of the determinants to be included in the specification of training, we first discuss whether the training provision is either contemporaneous to the innovation or it takes place some time after the innovation is obtained. The idea is that firms obtain process or product innovations and they try to incorporate them in the production process as soon as possible. We argue that workers may need some training to adapt their skills to the requirements of the innovation. Then, firms will have to provide training at the same time in which they obtain the innovation or some period after that. As firms are interested in recovering the returns of their innovative effort, they will try to incorporate the innovation as soon as possible. If firms provided training after obtaining the innovation, the new technology would be idle for a period of time. Thus, we expect that firms provide training at the same moment in which they obtain the innovation. However, implementing a process innovation or launching a new product may take longer than simply adopting advanced technology, so that training could take place some time after the innovation is obtained. These reasons support the ideas of defining innovation as contemporaneous or lagged with respect to training.

In Table 5.5, we estimate specifications (5.5) and (5.6), defining the innovative activity as contemporaneous to the provision of training. In Table 5.6, we show the

[110] The distribution of expenditure on training per worker is clearly right skewed. The median is 90€ per worker in 2001 and 109€ per worker in 2002, while the average is 171 and 186 respectively. The skewness coefficient is 7 in 2001 and 5.3 in 2002. As commented in Section 5.3, the two-part model is specially designed for variables with a high degree of censoring and a very right skewed distribution as in our case. See the descriptive analysis of expenditures per worker in Section 6.4.2 for further details.

results when it is lagged one period. In columns (a), innovative activity is defined using two dummy variables (named *PRODUCT*, *PROCESS*) that take value one when the firm has obtained a product/process innovation. In columns (b), the innovative activity is defined using one dummy variable that takes value one when the firm has obtained a product or process innovation (*INNOV*). The first and second columns show the marginal effects and coefficients of the participation equation respectively. The participation equation is the same in the *heckit* and the two-part model. The difference between the two models resides in the quantity equation, which, in the case of the *heckit* model, contains an additional term to account for sample selection. The third and fourth columns show the coefficients of the quantity equation in the *heckit* model in the two-part model.[111]

Regarding an appropriate specification of innovation, in the participation equation, this variable is positive and significant irrespective of the definition of innovation. In the quantity equation, results are more diverse: when product and process innovations are contemporaneous, only the coefficient for process innovations is statistically different from zero; when they are lagged, only the coefficient for product innovations is significant; when the innovative activity is defined as a single dummy variable (*INNOV*) its coefficient is significant, both in the contemporaneous and lagged cases. These results seem to point out the different nature of the effects of product and process innovations on training. Actually, process innovations seem to have a contemporaneous effect on the quantity of training per employee, while product innovations seem to have an effect one period after the new product is obtained. This result may be explained by the type of training associated to each type of innovation. Even though analysing the determinants of each kind of training would be a very interesting exercise, for the purposes of the present analysis we will simply consider product and process innovations defined as a single dummy variable that affects firms' training provision contemporaneously.[112]

[111] Notice that the two sets of coefficients of the quantity equation cannot be directly compared: while in the two-part model, the coefficients are equal to the conditional marginal effects, in the heckit, they are only part of the conditional marginal effect. For further details, see Cameron and Trivedi (2005).

[112] In this view, we follow the approach by Alba-Ramírez (1994). Given the particular behaviour of product and process innovations, in Table A5.1 in Appendix 5.2 we repeat the same exercise but for innovative activity, defined in the following way: product innovations are lagged and process innovations are contemporaneous. These variables are considered as two separate dummy variables (*PRODUCT*,

Table 5.5. Estimation of heckit and two-part models. Contemporaneous product and process innovations

	(a) Product (t) // Process (t)				(b) Innov (t)			
	Participation eq		Quantity eq		Participation eq		Quantity eq	
	Mg eff	Coeff	Heckit Coeff	Two-part Coeff	Mg eff	Coeff	Heckit Coeff	Two-part Coeff
Size	0.1279***	0.3395***	0.0606	-0.0193	0.1318***	0.3507***	0.0812	-0.0246
	(0.0108)	(0.0288)	(0.0697)	(0.0396)	(0.0107)	(0.0285)	(0.0752)	(0.0395)
White collars	0.0053***	0.0142***	0.0233***	0.0203***	0.0053***	0.0142***	0.0236***	0.0198***
	(0.0009)	(0.0024)	(0.0039)	(0.0033)	(0.0009)	(0.0024)	(0.004)	(0.0033)
Advanced technology - medium	0.1297***	0.3387***	0.0849	-0.0079	0.1324***	0.3463***	0.1167	-0.0043
	(0.0251)	(0.0652)	(0.1116)	(0.0907)	(0.025)	(0.065)	(0.1158)	(0.0898)
Advanced technology - high	0.1448***	0.3726***	0.1965*	0.114	0.1511***	0.3893***	0.2274*	0.1164
	(0.0368)	(0.0932)	(0.1224)	(0.1101)	(0.0366)	(0.0927)	(0.1271)	(0.1094)
Product innovation	0.1119***	0.2912***	0.0251	-0.0293				
	(0.0274)	(0.0704)	(0.0919)	(0.0799)	0.1668***	0.4411***	0.3209***	0. 1935***
Process innovation	0.1465***	0.3827***	0.2585***	0.1767**	(0.022)	(0.0585)	(0.1104)	(0.0806)
	(0.0244)	(0.0634)	(0.0998)	(0.0774)				
International market	0.1094***	0.2866***	0.1598	0.0865	0.1109***	0.2912***	0.1719*	0.0792
	(0.0245)	(0.0637)	(0.0957)	(0.082)	(0.0244)	(0.0634)	(0.098)	(0.0819)
Foreign capital	0.0011***	0.0028***	0.0027***	0.0022***	0.001***	0.0027***	0.0029***	0.0023***
	(0.0003)	(0.0009)	(0.001)	(0.0009)	(0.0003)	(0.0009)	(0.001)	(0.0009)
Temporary workers	-0.0002	-0.0005	-0.0063***	-0.0059**	-0.0002	-0.0005	-0.0065***	-0.006**
	(0.0006)	(0.0015)	(0.0024)	(0.0031)	(0.0006)	(0.0015)	(0.0025)	(0.0031)
Controls								
Productive capacity	-0.0012	-0.0031	-0.0009	-0.0003	-0.0012	-0.0032	-0.0009	0
	(0.0008)	(0.0021)	(0.003)	(0.0029)	(0.0008	(0.0021)	(0.003)	(0.0029)
Group	0.0377	0.0996	0.1445	0.1121	0.0361	0.0958	0.1624	0.1218
	(0.0301)	(0.0791)	(0.102)	(0.099)	(0.0299	(0.079)	(0.1032)	(0.0991)
Year	-0.0311	-0.0827	-0.2721***	-0.2554***	-0.0307	-0.0816	-0.2731***	-0.2525***
	(0.021)	(0.0557)	(0.0729)	(0.0719)	(0.0208	(0.0555)	(0.0735)	(0.0719)
Sector dummies	yes	yes	yes	Yes	yes	yes	yes	yes
Region dummies	yes	yes	yes	Yes	yes	yes	yes	yes
constant		-1.9872***	3.1591***	3.9768***		-2.0382***	2.8695***	3.9481***
		(0.4104)	(0.8472)	(0.6068)		(0.4101)	(0.8945)	(0.605)
No of obs	3020		1222	1222	3020		1222	1222
Pscudo R	0.3469		-	0.1781	0.3431		-	0.1789
pseudolnL	-1331.1115		-	-	-1338.8303		-	-
rho	-		0.353	-	-		0.4425	-
sigma2	-		1.2649	-	-		1.2888	-
sigma12	-		0.4465	-	-		0.5703	-
			(0.3268)				(0.3484)	
H0: Sector=0	46.37***		55.05***	2.97***	47.80***		56.89***	3.11***
H0: Region 0	65.12***		30.79***	1.87**	67.08***		30.48***	1.83**

Note: standard deviation in parentheses; (***) (**) and (*) denote significant at 1%, 5% and 10%.

PROCESS) and as one single dummy variable (*INNOV*). In this Table, we obtain that the innovative activity is significantly positive both in the participation and in the quantity equation.

Table 5.6. Estimation of the heckit and two-part models. Lagged product and process innovations

	(a) Product (t-1) // Process (t-1)				(b) Innov (t-1)			
	Participation eq		Quantity eq		Participation eq		Quantity eq	
	Mg eff	Coeff	Heckit Coeff	Two-part Coeff	Mg eff	Coeff	Heckit Coeff	Two-part Coeff
Size	0.1275***	0.3389***	0.0575	-0.0212	0.1306***	0.3478***	0.0665	-0.0196
	(0.0108)	(0.0288)	(0.0714)	(0.0393)	(0.0107)	(0.0286)	(0.075)	(0.0388)
White collars	0.0053***	0.0141***	0.0228***	0.0198***	0.0053***	0.0142***	0.0231***	0.0199***
	(0.0009)	(0.0024)	(0.0039)	(0.0033)	(0.0009)	(0.0024)	(0.004)	(0.0033)
Advanced technology - medium	0.1279***	0.3344***	0.0881	-0.0047	0.1307***	0.3422***	0.095	-0.0043
	(0.0251)	(0.0652)	(0.1139)	(0.0909)	(0.025)	(0.065)	(0.116)	(0.0909)
Advanced technology - high	0.1499***	0.386***	0.1961	0.1104	0.1554***	0.4005***	0.209*	0.115
	(0.0368)	(0.0931)	(0.1254)	(0.1099)	(0.0367)	-0.0929	(0.1281)	(0.1103)
Product innovation	0.1028***	0.2687***	0.1954**	0.1414*				
	(0.0262)	(0.0677)	(0.0904)	(0.0814)	0.1702***	0.454***	0.2631**	0.153**
Process innovation	0.1293***	0.3401***	0.0959	0.0255	(0.0216)	(0.0583)	(0.1148)	(0.0785)
	(0.0234)	(0.0613)	(0.0952)	(0.0782)				
International market	0.1171***	0.3072***	0.1595*	0.0852	0.1174***	0.3083***	0.1708*	0.0916
	(0.0244)	(0.0634)	(0.0977)	(0.0826)	(0.0243)	(0.0632)	(0.0993)	(0.0826)
Foreign capital	0.0011***	0.0028***	0.0028***	0.0022***	0.001***	0.0027***	0.0028***	0.0022***
	(0.0003)	(0.0009)	(0.001)	(0.0009)	(0.0003)	(0.0009)	(0.001)	(0.0009)
Temporary workers	-0.0002	-0.0005	-0.0063***	-0.0059**	-0.0002	-0.0005	-0.0065***	-0.006
	(0.0006)	(0.0015)	(0.0025)	(0.003)	(0.0006)	(0.0015)	(0.0025)	(0.0031)
Controls								
Productive capacity	-0.001	-0.0026	-0.0005	0.0001	-0.0011	-0.003	-0.0009	-0.0002
	(0.0008)	(0.0021)	(0.003)	(0.0029)	(0.0008)	(0.0021)	(0.003)	(0.0029)
Group	0.0369)	0.0977	0.146	0.1133	0.0357	0.0947	0.148	0.1143
	(0.03)	(0.079)	(0.1025)	(0.1001)	(0.0299)	(0.079)	(0.1026)	(0.1001)
Year	-0.0428**	-0.1139**	-0.28***	-0.2584***	-0.0421**	-0.1122**	-0.2842***	-0.26***
	(0.021)	(0.0559)	(0.074)	(0.072)	(0.0209)	(0.0558)	(0.0746)	(0.0719)
Sector dummies	yes	yes	yes	yes	yes	yes	yes	yes
Region dummies	yes	yes	yes	yes	yes	yes	yes	yes
constant		-2.0569***	3.1089***	3.937***		-2.0382***	2.8695***	3.9481***
		(0.4117)	(0.8758)	(0.6119)		(0.4101)	(0.8945)	(0.605)
No of obs	3020		1222	1222	3020		1222	1222
Pseudo R	0.3442		-	0.1772	0.344		-	0.1772
pseudolnL	-1336.4628		-	-	-1336.9093		-	-
rho	-		0.3493	-	-		0.37	-
sigma2	-		1.2651	-	-		1.2703	-
sigma12	-		0.4419	-	-		0.47	-
			(0.3403)					(0.3541)
H0: Sector=0	46.20***		57.64***	3.16***	46.60***		56.25***	3.14***
H0: Region=0	64.97***		29.55***	1.84***	66.74***		30.50***	1.88**

Note: standard deviation in parentheses; (***) (**) and (*) denote significant at 1%, 5% and 10%.

Once we have chosen to include innovation contemporaneously, we turn to the issue of whether it is more appropriate to estimate a *heckit* model or a two-part model. According with Section 5.3, we discuss whether the zeros observed in the dependent variable reflect that firms are not interested in providing training (actual outcome) or otherwise they hide some latent expected training provision that only becomes positive under certain circumstances (potential outcome). We argue that, in the presence of fixed costs (Lynch, 1993), some firms cannot afford to provide training and we observe a zero in the variable measuring the expenditures on training. If the fixed costs were smaller, they would decide to provide training and we would observe some positive value. In this view, fixed costs can be hiding a latent expected training provision. From this perspective, we are interested in the potential outcome and the *heckit* model seems to be more appropriate.

Next, we are interested in analysing whether, in practice, sample selection exists for the case of provision of training in the Spanish manufactures. The t-test on the inverse Mills' ratio is used to test the null that the two-part model is correct against the alternative that the *heckit* is correct. When the same regressors are included in the two equations of the *heckit* model, multicollinearity problems arise and the model is close to unidentified. However, in our empirical specification, it seems difficult to find at least one regressor that can be included in the participation equation but not in the quantity equation. When collinearity problems appear, the t-test on the inverse Mills' ratio is not an appropriate tool to select between the two models. Following Leung and Yu (1996) we calculate the condition number to check for multicollinearity. For the total sample, the condition number for the covariates is 26.9, and after including the inverse Mills' ratio it takes a value of 36.9. As suggested in Cameron and Trivedi (2005, pp 554), although the condition number including the inverse Mills' ratio takes a value above 30, the increase when including this regressor is very small, for which we do not consider that multicollinearity problems are severe. Then, the t-test on the inverse Mills' ratio can be considered a useful tool to select between the two models. Table 5.5 columns (b) show that the coefficient of the inverse Mills' ratio takes value 0.57 and it is not statistically significant. Thus, the null that the two-part model is correct cannot be rejected for the total sample.

The application of the selection procedure based on the EMSE suggests that the two-part model seems more appropriate to model firms' decisions to provide training. As explained in Section 5.3, first we consider that the two-part model is the "true" model, and next, the *heckit* model. We select the model with smaller EMSE under the two assumptions. Table A5.3 in Appendix 5.2 offers the results for these tests. For most of the variables of interest in our empirical specification, we obtain that the EMSE for the two-part model is smaller than the EMSE for the *heckit* model, indicating that the former seems more appropriate. The only exception is the variable on the percentage of temporary workers, for which the model that accounts for sample selection seems more appropriate. As for the control variables, the same result is obtained and the two-part model is preferred with the exception of some regional dummies. Under the two assumptions, the results are similar, indicating the robustness of the results. Thus, as obtained through the test on the inverse Mills' ratio, the two-part model seems to be more appropriate to model the firms' decision on the provision of training.

Therefore, although from a theoretical point of view it can be argued that sample selection could exist, a reliable significance test on the inverse Mills' ratio and application of the EMSE criteria suggest that in practice it seems more appropriate to estimate a two-part model to model firms' training provision. In the case of the subsample of small and large firms, we obtain similar results.[113]

The results for the estimation of the two-part model are shown on columns (b) of Table 5.5. The first and second columns show the marginal effects and coefficients of the probit corresponding to the participation equation. The fourth column shows the coefficients of the OLS estimation of the quantity equation. In the participation equation for the total sample, almost all the variables of interest are significant, except the percentage of temporary workers, and have the expected sign. In the quantity equation, the percentage of white collars, the innovative activity, the participation of foreign capital and the percentage of temporary workers are clearly significant. The results for the subsample of small and large firms are shown on Table A5.2 in Appendix 5.2. Results show the existence of certain differences in the behaviour of small and large firms in their decisions on the quantity of training.

[113] Detailed results for the EMSE tests for large and small firms are in Table A5.3.

5.5.2. The two-part model with random effects

The empirical evidence highlights the existence of high heterogeneity among firms with similar characteristics. The random effects model permits taking unobservable characteristics of the firms into account. In this Section we estimate the participation and quantity equations introducing a firm-specific effect to control for this heterogeneity. This model assumes that the individual heterogeneity is part of an error term component and this error term is uncorrelated with the regressors.

We estimate the participation equation by means of a random effects probit model, which assumes a normal distribution for the random effects. The model is estimated by maximum likelihood (see Guilkey and Murphy, 1993). The integral in the likelihood function is approximated with the non-adaptive Gauss-Hermite quadrature. The quadrature formula requires that the integrated formula is well approximated by a polynomial. As the panel size increases, the quadrature approximation becomes less accurate.[114] If the results of the estimation change when the number of quadrature points changes, the results should be dismissed. We check the magnitude of these changes and obtain that, for most variables, the relative difference between the coefficients using different quadrature points is smaller than 0.01%. So, the results of the probit random effects model estimated in this Section can be trusted. As for the quantity equation, we estimate a standard regression model including random effects by GLS (dependent and independent variables are transformed using the idiosyncratic and the individual components of the error term).

Table 5.7 shows the results of the two-part model including firm-specific effects, for the total sample and for the subsamples of small and large firms. As for the total sample (first set if columns in Table 5.7), the results for both the participation and the quantity equation are similar to those in Table 5.5 columns (b). The same variables are significant and with the same sign. Although the results are similar to the model without the inclusion of random effects, the tests reject the null hypothesis that the firm-specific effects are zero. For the participation equation, the likelihood-ratio test compares the pool estimator (probit) with the panel estimator. When the panel-level variance component is unimportant, the panel estimator is not significantly different from the pooled estimator. The test rejects the null that the panel-level variance component is

[114] We have observations for only two years, so panel size is small and should not present severe quadrature problems.

equal to zero at 1%. As for the quantity equation, the Breusch and Pagan Lagrange-multiplier test rejects the null hypothesis at 1%. Similar conclusions on the tests are obtained for the subsamples of small and large firms. According to all we have said until now, we have chosen the two-part model with random effects to carry on the remaining of our analysis.

In general terms, the results obtained here confirm the general findings of the previous empirical studies. See for instance, Bartel (1989), Alba-Ramírez (1994), Baldwin et al. (1995), Black and Lynch (1998) and Hughes et al. (2004). More concretely, for the total sample, the effect of the variable on firms' size is positive and significant in the participation equation indicating the presence of effects associated to large firms even after controlling for the set of possible training determinants. Concretely, increasing the firm size by one point increases the probability of firms providing training by 0.2. However, it is not significant in the quantity equation.[115]

The effects associated to the percentage of white collars are positive and significant: firms with more educated workers are more likely to provide training because these workers can take more profit of it; and these firms will spend more on training per worker.[116] Notice however, that the two effects are very small in magnitude.

In relation to technical requirements that may motivate firms' training, those that use advanced technologies with a medium or high intensity are more likely to provide training: changing from using advanced technology with low to a medium intensity increases the probability of providing training by 0.24; and changing to using advanced technology with high intensity, 0.28. Also, changing from being a non-innovative firm to an innovative one increases the probability of providing training by 0.19. The reason is that using more complex technology requires more specialized knowledge and, as very specialized skills are not easily found in the labour market, firms may need to provide training. Contrary to what we expected, the use of advanced technologies variable does not have a significant effect in the quantity equation, while becoming an innovative firm increases the expenditure on training per worker by 14%. The two variables are considered to have an effect contemporaneous to the provision of training:

[115] The results are in line with Baldwin et al. (1995) and Black and Lynch (1998) and with Alba-Ramírez (1994) for the Spanish case. However, Black et al (1999) find positive and significant effects when estimating a tobit model.

[116] The percentage of white collars has been lagged in order to capture the effect the effect that training is directed to those who have previously shown aptitudes to acquire knowledge.

we argue that, if firms provided training before adopting the new technology, workers could leave the firm before it captured the returns from training; if firms provided training after that, the new technology would be idle for a period of time. See Section 5.5.1, where we discuss the case of innovation.

The effects of the variable on the geographic scope of the market are positive and significant: firms operating in international markets increase the probability of training their workers by 0.18, in relation to operating at national, regional or local markets. However this variable does not seem to have a significant impact on the quantity of training.[117] Being participated by foreign capital also increases both the probability of providing training and the firms' expenditure on training per worker. However, the two effects are quite small in magnitude.

Finally, firms that have a high degree of temporary employment are expected to be less interested in providing training as they will not be able to capture the returns from this investment if workers leave their jobs. The percentage of temporary workers does not seem to have any significant effect in the participation equation, whereas in the quantity equation, the effects are significantly negative although very small in magnitude.

As for the control variables, the percentage of use of the productive capacity and belonging to a group does not increase the probability to provide more training. Finally, the sets of regional and industrial dummies are jointly significant.

The fact that firm size is significantly positive in the participation equation, even after controlling for other variables and firm-specific effects, suggests the existence of scale economies in the provision of training as well as other effects associated with firm size. Apart from this direct effect of firms' size, the other covariates may have different effects in small and large firms' subsamples, as suggested by the descriptive on Tables 5.1 and 5.2. For example, does the increase in the ratio of skilled workers lead to higher probability of training (or more expenditure) in both small and large firms? Is this effect higher in magnitude in one of the groups? To further analyse this question we estimate the same equations for the subsamples of small and large firms. Given that small firms are acknowledged to have more difficulties in accessing training, we are interested in

[117] Bartel (1989) estimates a logit model and finds a positive and significant effect of the degree of competition faced by firms.

analysing the impact of these variables in the training decisions and whether they play different roles in firms with different sizes.

The second and third sets of Columns in Table 5.7 show the results for the estimation of the empirical specification for the subsamples of small and large firms. Results suggest the existence of certain differences between small and large firms in their training provision decisions. Concretely, the firm size has a negative effect on the expenditure on training per worker in small firms, which is not the case of large firms. This suggests the existence of heterogeneity in the training expenditure by size and the necessity for further analysis, as done in Section 5.6.

Regarding the qualification of the labour force, it does not determine that large firms decide to provide training, but it does have an impact on the amount of it. While in small firms, the level of qualification of the labour force motivates the two decisions. This result could be explained by the fact that large firms employ a wide range of employees, and so, *ceteris paribus*, they have a higher probability of providing training to at least one employee.

The variables related with technology seem to be important determinants of the firms' decision to provide training for both small and large firms. However, in the case of large firms, the effects seem to be slightly smaller in magnitude than in the case of small firms. Moreover, changing from being a non-innovative large firm to an innovative one increases the expenditure on training per worker almost 22%, whereas in the case of small firms, this variable does not have a significant effect. These results suggest a relationship between size, technological activities and the quantity of training per worker. As we analyse later, technological activities could explain that large firms provide more training per worker.

In the case of small firms, competing in an international market and being participated by foreign capital affects the two training decisions. This may be explained by the fact that small firms that operate in international markets or have more participation of foreign capital may decide to provide training as a way to deal with the necessities of their competitive environment. However, the effect of the geographical scope of the market on the decision of whether to provide training is much larger in large than in small firms.

Table 5.7. Estimation the two-part random effects model for the total sample and the small and large firms' subsamples

	Total sample			**Small firms**			**Large firms**		
	Participation eq		Quantity eq	Participation eq		Quantity eq	Participation eq		Quantity eq
	Mg Eff	Coeff	Coeff	Mg Eff	Coeff	Coeff	Mg Eff	Coeff	Coeff
Size	0.2024***	0.6273***	-0.0341	0.0662***	0.6955***	-0.2347**	0.0681	0.379***	0.0299
	(0.0212)	(0.0683)	(0.0484)	(0.0149)	(0.1161)	(0.1075)	(0.1897)	(0.154)	(0.082)
White collars	0.0089***	0.0276***	0.0195***	0.0036***	0.0375***	0.0197***	0.0011	0.0062	0.0177***
	(0.0017)	(0.0053)	(0.0038)	(0.0009)	(0.0069)	(0.0048)	(0.0034)	(0.0082)	(0.0058)
Advanced technology	0.2420***	0.7019***	0.0436	0.109***	0.8085***	-0.0142	0.0784	0.4604**	0.1931
-medium	(0.0518)	(0.1471)	(0.1123)	(0.0352)	(0.1924)	(0.1536)	(0.2235)	(0.2367)	(0.1727)
Advanced technology	0.2801***	0.7696***	0.1576	0.136*	0.8152***	0.1408	0.0979	0.6219**	0.2403
-high	(0.0794)	(0.2073)	(0.1395)	(0.0805)	(0.3249)	(0.2488)	(0.2868)	(0.2709)	(0.183)
Innovation	0.1928***	0.5832***	0.1414*	0.0738***	0.6272***	0.0567	0.1026	0.529***	0.2244**
	(0.0365)	(0.1078)	(0.0795)	(0.0239)	(0.1406)	(0.1285)	(0.2662)	(0.1701)	(0.0968)
International market	0.1835***	0.5413***	0.096	0.0458*	0.397**	0.2674*	0.1205	0.6401***	0.051
	(0.0449)	(0.1282)	(0.0904)	(0.0254)	(0.1773)	(0.1543)	(0.3155)	(0.1889)	(0.1121)
Foreign capital	0.0014**	0.0043***	0.0022**	0.0007**	0.0075**	0.0047**	0.0005	0.0028	0.0013
	(0.0006)	(0.0018)	(0.0011)	(0.0003)	(0.0032)	(0.0022)	(0.0014)	(0.0021)	(0.0013)
Temporary workers	-0.0001	-0.0002	-0.0066*	0.0000	0.0005	-0.002	-0.0005	-0.0029	-0.0156***
	(0.0010)	(0.003)	(0.0034)	(0.0003)	(0.0036)	(0.0042)	(0.0018)	(0.0062)	(0.0053)
Controls									
Productive capacity	-0.0013	-0.004	-0.002	-0.0002	-0.0024	-0.0016	-0.0010	-0.0056	-0.0036
	(0.0013)	(0.0041)	(0.0031)	(0.0005)	(0.0051)	(0.0043)	(0.0031)	(0.0075)	(0.0042)
Group	0.0682	0.2078	0.113	0.0137	0.1339	0.0297	0.0114	0.0621	0.1983
	(0.0572)	(0.1717)	(0.1234)	(0.0268)	(0.2435)	(0.193)	(0.0555)	(0.2455)	(0.1674)
Year	-0.0462*	-0.1431*	-0.2154***	-0.0062	-0.0656	-0.2004**	-0.0541	-0.3019***	-0.2147***
	(0.0245)	(0.0761)	(0.0507)	(0.0093)	(0.0973)	(0.0937)	(0.1502)	(0.1267)	(0.0587)
Sector dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes
Region dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes
Random effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
constant		-4.0818	4.2892***		-5.0014***	4.3705***		5.7329	4.7874***
		(0.9042)	(0.709)		(1.1196)	(0.9879)		(5.09)	(0.9618)
No of obs	3020		1222	2086		520	934		702
No of firms	1538		734	1068		335	493		409
pseudolnL	-1223.5902			-777.5287			-421.5722		
H0:Sector=0	30.81**		39.15**	25.84		40.77***	15.08		47.09***
H0:Region=0	41.52***		20.31	36.91***		16.77	13.46		30.35***
H0:RE=0	230.48***		68.17***	164.98***		15.72***	48.31***		42.65***

Note: standard deviation in parentheses; (***) (**) and (*) denote significant at 1%, 5% and 10%.

Finally, the coefficient of the variable on the percentage of temporary workers is only significant and with negative sign in the decision on the quantity of training for large firms. As before, given large firms employ a wide range of workers, it does not affect their probability of providing training but its quantity. In relation with the control variables on the group and use of the productive capacity, small and large firms do not

show differences in behaviour. As for the sets of dummy variables on the region and sector, there are differences between small and large firms.

In conclusion, the technological activities and the geographical scope of the market seem to be important determinants of firms' training decisions. In addition, there are certain differences between small and large firms that may explain why small firms provide less training per employee than their larger counterparts. In Section 5.6 we use the Oaxaca-Blinder decomposition to further investigate the contribution of these variables in explaining the training provision gap between small and large firms.

5.6. Decomposition of the Training gap between small and large firms

5.6.1. The Oaxaca-Blinder decomposition in the two-part model

We apply the Oaxaca-Blinder methodology to decompose the training provision differential between large and small firms. It permits decomposing the differences in the yes/no training decision and in the amount of training in two components: differences in the *levels* of the determinants of training and differences in the *impact* of these determinants. The first component reflects that small and large firms have different characteristics, which are associated to different training levels. The second component reflects the differences in the impact of such characteristics on the training provision by firm size. For example, supposing that small and large firms had the same percentage of qualified workers, would they show a similar propensity to invest in training? This component shows that the origin of the differences in training may arise because of the fact that firms' characteristics may have different impact on their training decisions in small and large firms (i.e. a different coefficient as opposed to different levels in characteristics).

As in Chapter 3, we depart from two auxiliary regressions for small and large firms:

$$\begin{aligned} \hat{T}_S &= F(X'_S \hat{\beta}_S) \\ \hat{T}_L &= F(X'_L \hat{\beta}_L) \end{aligned} \tag{5.7}$$

where T denotes training, both as a discrete (TR) and continuous variable ($lnTR$), X is the matrix of determinants of training, $\hat{\beta}$ is the conforming vector of estimated coefficients and subscripts L and S refer to large firms and small firms respectively.

Notice that these auxiliary regressions are more general than in Chapter 3 as $F(\cdot)$ can be both a linear and a non-linear function. A complete decomposition of the two-part model requires decomposing the gap of the variable of interest in the quantity equation, which is a linear model, and the gap of the variable of interest in the participation equations, which is a probit model and so, non-linear. The traditional detailed Oaxaca-Blinder decomposition can be applied in linear models, but it is not suitable for a non-linear specification. Thus, the standard decomposition can be applied for the quantity equation of the two-part model, but not for the participation equation. Instead, for this latter case we apply a recent proposal (Yun, 2004) to compute detailed decompositions for non-linear models that are linear in their arguments, such as our participation probit equation.[118]

Yun's methodology consists of finding the contribution of every *n*-variable to the total difference. The Yun-Oaxaca-Blinder detailed decomposition for non-linear equations is expressed as follows:

$$\hat{T}_L - \hat{T}_S = \sum_{n=1}^{N} W_{\Delta X}^{n}\left[\overline{\Phi(X_L\hat{\beta}_L)} - \overline{\Phi(X_S\hat{\beta}_L)}\right] + \sum_{n=1}^{N} W_{\Delta\beta}^{n}\left[\overline{\Phi(X_S\hat{\beta}_L)} - \overline{\Phi(X_S\hat{\beta}_S)}\right] \qquad (5.8)$$

where, in the case of the probit model, Φ is a standard normal cumulative distribution function and $W_{\Delta X}^{n}$ and $W_{\Delta\beta}^{n}$ are the weights for each *n*-variable.

The key question is finding proper weights for the variables. Yun (2004) suggests evaluating the value of the function using mean characteristics and then using a first order Taylor expansion to linearize Φ around $X_L\hat{\beta}_L$ and $X_S\hat{\beta}_S$. In this way, he derives the expression for the weights:

$$W_{\Delta X}^{n} = \frac{(\bar{X}_L^n - \bar{X}_S^n)\hat{\beta}_L^n}{(\bar{X}_L - \bar{X}_S)\hat{\beta}_L}; \; W_{\Delta\beta}^{n} = \frac{(\hat{\beta}_L^n - \hat{\beta}_S^n)\bar{X}_S^n}{(\hat{\beta}_L - \hat{\beta}_S)\bar{X}_S}; \qquad (5.9)$$

As we use a variation of the Oaxaca-Blinder decomposition suggested by Oaxaca and Ransom (1994) which does not make any assumption on which is the natural model (see Section 3.6.1), the decomposition for the participation equation in the two-part model is calculated as follows:

[118] As far as we know Yun's detailed decomposition have been only applied so far in a reduced number of labor market studies (Motellón and López-Bazo, 2005; Hernanz and Toharia, 2006).

$$\hat{T}_L - \hat{T}_S = \sum_{n=1}^{N} W_{\Delta X}^{n}\left[\overline{\Phi(X_L\hat{\beta}^*)} - \overline{\Phi(X_S\hat{\beta}^*)}\right] + \sum_{n=1}^{N} W_{\Delta\beta ADV}^{n}\left[\overline{\Phi(X_L\hat{\beta}_L)} - \overline{\Phi(X_L\hat{\beta}^*)}\right] + \sum_{n=1}^{N} W_{\Delta\beta DIS}^{n}\left[\overline{\Phi(X_S\hat{\beta}^*)} - \overline{\Phi(X_S\hat{\beta}_S)}\right] \quad (5.10)$$

Linearizing the characteristics and coefficients around $\bar{X}_L\hat{\beta}_L$, $\bar{X}_S\hat{\beta}_S$ and $\bar{X}_S\hat{\beta}^*$, the weights are calculated as:

$$W_{\Delta X}^{n} = \frac{(\bar{X}_L^n - \bar{X}_S^n)\hat{\beta}^{*n}}{(\bar{X}_L - \bar{X}_S)\hat{\beta}^*};\ W_{\Delta\beta ADV}^{n} = \frac{(\hat{\beta}_L^n - \hat{\beta}^{*n})\bar{X}_L^n}{(\hat{\beta}_L - \hat{\beta}^*)\bar{X}_L};\ W_{\Delta\beta DIS}^{n} = \frac{(\hat{\beta}^{*n} - \hat{\beta}_S^n)\bar{X}_S^n}{(\hat{\beta}^* - \hat{\beta}_S)\bar{X}_S} \quad (5.11)$$

where $\hat{\beta}^*$ is the estimated nondiscriminatory coefficients structure, calculated as a weighted average of the small and large coefficients structure: $\hat{\beta}^* = \Omega\hat{\beta}_L + (I-\Omega)\hat{\beta}_S$, where Ω is obtained as: $\Omega = (X'X)^{-1}(X'_L X'_L)$. The subscripts $\Delta\beta ADV$ and $\Delta\beta DIS$ indicate that the weights correspond to the effect of large firms' advantage and small firms' disadvantage in relation with the non-discriminatory coefficients structure.

The first term at the right hand-side of equation (5.10) reflects training differences due to differences in characteristics. This term is an estimate of the differential in the probability of providing training between small and large firms in the absence of differences in the impact of these characteristics. The second and third terms are estimates of the differential in probability of providing training due to differences in the *impact* of firms' characteristics. Together, they collect the effect of large firms' advantage and small firms' disadvantage in relation with the non-discriminatory coefficients structure. Since we are not particularly interested in distinguishing the advantage and disadvantage effects, but in evaluating the differences in the coefficients as a whole, we will consider these two terms together.

5.6.2. Results of the decomposition of the training gaps

The results in Section 5.5.2 show evidence of certain firm characteristics that determine the probability of providing training and the quantity of resources devoted to this activity. There, we have also shown that the effect of these determinants differs across firms with different size. In this Section, we try to assess the individual contribution of these determinants in explaining the training provision gap between small and large firms in two ways: differences in the level of the determinants of the training provision

in small and large firms and differences in the impact of such characteristics on the training provision decisions. To perform such analysis, we apply the detailed decomposition described in expression (5.10).

Tables 5.8 and 5.9 show the results of the Oaxaca-Blinder decomposition, as suggested by Oaxaca and Ransom (1994), for years 2001 and 2002. The former shows the results for the estimation without firm-specific effects and the latter includes firm-specific effects to control for possible heterogeneity among firms. As commented in Section 3.6.2, in interpreting the results we should keep in mind that the Oaxaca-Blinder decomposition is not exact when it is based on coefficients from models with random effects. It should also be mentioned that, as some of the determinants of the provision of training are defined as dummy variables, the Gardeazábal and Ugidos (2004) identification constraints have been used in the estimation of equations (5.7) to guarantee robustness of the results regardless of the omitted category in the dummy variables (see Section 3.6.2 for further details).

Table 5.8 shows the main results of the decomposition based on the estimation of the two-part model without firm-specific effects.[119] The differential in the probability of providing training between small and large firms is 0.40 in 2001 and 0.45 in 2002. The decomposition for all the variables together shows that in 2001, most part of the gap is due to differences in characteristics, while differences in the impact of characteristics explain only a 10% of the gap. In 2002 the whole differential can be explained by differences in firms' characteristics, while differences in the impact of characteristics show a small effect in favour small firms. That is, under equal impact of characteristics (i.e. coefficients), the gap in the probability of providing training would be larger favouring large firms. However, we are especially interested in the individual decomposition to analyse the contribution of each variable.

The fact that large firms employ more white collars explains a very small part of the differential in the probability of providing training between small and large firms. Although differences in characteristics favour large firms in both years, this variable shows a different behaviour in 2001 and 2002: in the first case, the differences in characteristics, which favour large firms, are compensated by differences in the impact of characteristics, which favour small firms; in the second case, it favours of large firms.

[119] Table 5.8 shows the most relevant results of the decomposition. For more detailed and complete results, see Table A5.4 at the Appendix 5.3.

As for the variables related to technological activities, the differences in the intensity of use of advanced technologies explain around 20% of the gap, while the global impact of this variable has a very small effect in favour of small firms. The differences in innovative activity between small and large firms explain about than 10% of the differential in the probability of providing training for both years, while the global impact of this variable is also very small in magnitude and favours small firms. The differences in the variable on the geographical scope of the firms' market contribute around 8% to explain the probability gap in both years, while differences in the global impact of this variable is quite small and favours large firms. The differences in the participation of foreign capital and the percentage of temporary workers show a small contribution to the differences in the probability of providing training.

Table 5.8. Decomposition for the two-part model. Estimation without firm-specific effects

	2001				2002			
	Participation eq		Quantity eq		Participation eq		Quantity eq	
Training differential	**0.4014**		**0.1812**		**0.4501**		**0.2899**	
	Charact	Impact	Charact	Impact	Charact	Impact	Charact	Impact
Total	0.466	0.066	0.252	0.208	0.461	-0.015	0.333	0.084
	87.62%	12.38%	54.71%	45.29%	103.47%	-3.47%	79.82%	20.18%
White collars	0.015	-0.021	-0.004	-0.004	0.015	0.032	0.013	-0.004
	2.75%	-3.86%	-0.95%	-0.77%	3.47%	7.24%	3.17%	-0.91%
Advanced Technology	0.098	-0.002	0.053	0.016	0.093	-0.017	0.052	0.02
	18.36%	-0.32%	11.41%	3.55%	20.79%	-3.83%	12.50%	4.90%
Innovation	0.053	-0.001	0.05	0.024	0.056	-0.011	0.054	0.017
	9.99%	-0.25%	10.96%	5.27%	12.52%	-2.54%	13.03%	4.06%
International Market	0.041	0.001	0.034	0.037	0.04	0.026	0.035	0.034
	7.68%	0.19%	7.47%	7.94%	8.93%	5.87%	8.51%	8.09%
Foreign capital	0.02	-0.004	0.054	-0.109	0.02	0.01	0.064	-0.101
	3.72%	-0.72%	11.72%	-23.76%	4.45%	2.30%	15.47%	-24.13%
Temporary workers	0.001	-0.005	0.008	-0.186	0.001	0.011	0.022	-0.164
	0.12%	-0.88%	1.76%	-40.40%	0.13%	2.42%	5.34%	-39.28%

The differential in the logarithm of the expenditure on training per worker between small and large firms is 0.18 in 2001 and 0.28 in 2002. The decomposition for all the variables together shows that differences in firms' characteristics explain around 55% of the differential in 2001 and almost 80% in 2002, while differences in the impact of characteristics explain 45% and 20% respectively.

Again, the percentage of white collars has an almost negligible contribution in explaining the gap of the quantity of training.[120] Regarding the variables related to technological activities, the use of advanced technologies explains more than 15% of the differential in the quantity of training: around 12% of the effect is due to differences in characteristics and the remaining portion is due to differences in the impact of characteristics, both in favour of large firms. The innovative activity also explains more than 15% of the gap —more than 10% is due to differences in characteristics and the remaining portion is due to differences in the impact—. Differences in the geographical scope of firms' market explain more than 16% of the training gap and both differences in characteristics and differences in the impact of these characteristics have a similar contribution, both in favour of large firms. The participation of foreign capital explains a quite important part of the differential: around 15% is due to the fact that large firms are more participated by foreign capital. However, the effect due to the impact of this variable is also quite large and favours small firms, taking values above 23%. This effect in favour of small firms is due to the fact that the coefficient of this variable in the case of small firms is larger than in the case of large firms. Finally, the percentage of temporary workers has an important contribution in explaining the differential in the quantity of training and it is mainly due to differences in the impact of characteristics in favour of small firms, taking values of almost 40%. Having temporary workers has a negative effect on the quantity of training and the coefficients for small firms are larger than for large firms, then, the resulting effect favours small firms. In other words, if small and large firms had the same impact of the variable on temporary workers, *ceteris paribus*, the gap in the probability of providing training between small and large firms would be even wider.

Table 5.9 offers the main results of the decomposition based on the estimation of the two-part model including firm-specific effects.[121] The effects of the individual decomposition based on pooled and panel data show the same signs. Moreover, the importance of the contribution of the different variables is generally maintained. That is,

[120] The differences in the levels of the variable on the percentage of while collars are negative because the sample of small firms that make a positive expenditure on training, have a higher percentage of white collars than their larger counterparts.

[121] Table 5.9 shows the most relevant results of the decomposition. For more detailed and complete results, see Table A5.5 at the Appendix 5.3.

the most relevant effects explaining the gap in the decomposition based on pooled data are the same as those in the decomposition based on panel data.

In addition, regarding the participation equation, the magnitudes of the individual effects are very similar under the two models for both 2001 and 2002. However, in the decomposition based on random effects, the individual contribution of each variable is slightly higher and the most important difference corresponds to the variable on the use of advanced technologies. So, as in Table 5.8, the variables that have a more important role in explaining the gap between small and large firms in their probability of providing training are: the use of advanced technology, the innovative activity and the international scope of the market where firms operate and their effect is mainly due to differences in characteristics.

Table 5.9. Decomposition for the two-part model. Estimation including firm-specific effects

	2001				2002			
	Participation eq		Quantity eq		Participation eq		Quantity eq	
Training differential	**0.4014**		**0.1812**		**0.4501**		**0.2899**	
	Charact	Impact	Charact	Impact	Charact	Impact	Charact	Impact
Total	0.527	0.044	0.21	0.17	0.519	-0.035	0.308	0.119
	131.29%	10.96%	115.89%	93.82%	115.31%	-7.78%	106.24%	41.05%
White collars	0.018	-0.018	-0.004	-0.029	0.019	0.031	0.013	-0.031
	4.48%	-4.48%	-2.21%	-16.00%	4.22%	6.89%	4.48%	-10.69%
Advanced Technology	0.122	-0.004	0.082	0.02	0.114	-0.01	0.079	0.023
	30.39%	-1.00%	45.25%	11.04%	25.33%	-2.22%	27.25%	7.93%
Innovation	0.044	-0.001	0.037	0.034	0.046	-0.002	0.04	0.025
	10.96%	-0.25%	20.42%	18.76%	10.22%	-0.44%	13.80%	8.62%
International Market	0.047	0.003	0.042	0.036	0.046	0.012	0.043	0.033
	11.71%	0.75%	23.18%	19.87%	10.22%	2.67%	14.83%	11.38%
Foreign capital	0.02	-0.004	0.052	-0.1	0.019	0.007	0.063	-0.092
	4.98%	-1.00%	28.70%	-55.19%	4.22%	1.56%	21.73%	-31.74%
Temporary workers	0	-0.002	0.009	-0.211	0	0.004	0.025	-0.186
	0%	-0.50%	4.97%	-116.45%	0%	0.89%	8.62%	-64.16%

Note: given that the decomposition is not exact in the case of using the RE estimates, the sum of the shares of the components does not equal 100%.

Although the effects have the same signs and a similar importance under the two models, the results of the quantity equation shows some differences in magnitude: the contribution of the different variables is much larger here than for the decomposition based on the standard regression, both as differences in characteristics and the differences in the impact of these characteristics. As before, the variables that have a

more important contribution in explaining the gap in the quantity of training are: the use of advanced technology, the innovative activity and the international scope of the market where firms operate and their effect is due to both differences in characteristics and differences in the impact of these characteristics. Additionally, the participation of foreign capital in the firms and the percentage of temporary workers seem to explain a large part of the effect, which is especially due to differences in the impact of these characteristics on the quantity of training in favour of small firms.

5.7. Conclusions

In this Chapter we try to assess the reasons why small firms provide less training than their larger counterparts. The hypothesis is that large firms are associated to certain characteristics that permit them to dedicate more efforts to training workers or that require more training.

First, we presented theoretical arguments and previous empirical evidence supporting the hypothesis that training is associated to certain characteristics such as the previous qualification of the labour force, the technological complexity of the productive process, the innovative capacity of the firm, the fact that firms operate in an international market, the participation of foreign capital in the firm and the percentage of temporary workers. Using the ESEE, we showed evidence that large Spanish manufacturing firms invest more on training and they are more associated to these characteristics than their smaller counterparts.

Next, we estimated a *heckit* model, which encompasses the two-part model, to analyse if these characteristics explain the decision on whether to provide training or not and how much to spend on it. We discussed which of the two models could be more appropriate to model firms' decisions on training, both from a theoretical and applied perspective. Although the *heckit* model seems to be more appropriate from a theoretical point of view, we do not find evidence of strong sample selection in the case of the Spanish manufacturing firms in 2001 and 2002. Thus, we consider that the two-part model could be more appropriate to model their decisions on training and we perform the remaining of our analysis on the basis of this model. Departing from previous evidence that small and large firms follow different patterns in their training decisions, we estimate the two subsamples separately.

Results from these estimations suggest that technological activities and the geographical scope of the market are important determinants of firms' training decisions. The effects of the technological variables on the yes/no decision are larger in magnitude in the case of small firms. As for the market scope, it determines the two decisions in the case of small firms, whereas in the case of large firms, it has a large effect on the probability of providing training.

Finally, the Oaxaca-Blinder decomposition assesses the relative contribution of these determinants to explain the differential in the patterns of training between small and large firms. As for the decision on whether to provide training, the most important contributions are related with the firms' technological activity and the geographical scope of the market where they operate and these effects are mainly due to differences in characteristics in favour of large firms. With regards to the decision on the quantity of training per worker, the variables related with the technological activity and the market scope explain a relevant part of the gap, both as differences in characteristics and differences in the impact of characteristics in favour of large firms. In addition, the participation of foreign capital and temporary workers explain a large part of the gap, basically as differences in the impact of characteristics in favour of small firms.

All in all, we confirm the general result that small firms have a limited access to a tool that permits adapting the skills of their employees for becoming more competitive. Our results suggest that in general, the differences in training between small and large firms are related to differences in firms' *requirements* to update the skills of their employees so that they acquire specific knowledge to use the new technologies and to make the firms more competitive in an international environment. And these differences favour large firms. In other words, the differences between small and large firms do not seem to be related with characteristics that allow firms to provide more training (i.e. having more qualified workers or non-temporary workers).

Appendix 5.1. Description of the variables

- Training is measured as a discrete variable (*dTR*), according to whether the firm provides continuous training, and as a continuous variable, that is, the log of the real expenditure on continuous training per worker (*lnTR*). Continuous training is measured as the external expenses on training per worker, including fives different types of training: computation and information technologies, foreign languages, sales and marketing, engineering and technical training and other issues (and expressed in 2001 real euros).
- The firm size is defined as the total number of employees and measured as the number of full time employees plus the number of part time employees divided by two (both on December 31st) plus the number of temporary employees.
- The percentage of white collars in the firm includes engineers, graduates, middle level engineers, experts and qualified assistants. Data on white collars are not available in 2000 and 2001 as they are not assumed to change substantially on every year. We interpolate the percentage of white collars, making the assumption that they increase or decrease linearly. For the firms that entered the survey in 2000 and 2001, we use data on this year. For the firms that entered the survey in previous years, we interpolate the percentage of white collars in 2000 and 2001, using the corresponding values for every firm in 1998 and 2002 and making the assumption that they increase or decrease linearly.
- The intensity of use of advanced technologies is measured by a set of three dummy variables labelled as low, medium and high, when firms use 0-1, 2-3 or 4-5 advanced technologies respectively. The survey has questions on whether the following technologies are used by the firm: Computer Numerically Controlled (CNC) machines and tools, Robots, Computer-aided design (CAD), Combination of the previous systems by central computer (CAM, flexible manufacturing systems, etc) and Local Area Network (LAN) for factory use. In the dataset, these data are only available every four years, as it is not supposed to change yearly, and so, we assumed to be constant between 2001 and 2002.
- Innovation is defined as a dummy variable that takes value one if the firm has introduced a product or a process innovation (*PRODUCT, PROCESS*).

- The geographical scope of the market where the firm operates is defined by a dummy that takes values 1 when the firm operates in an international market. And it takes values zero, when it is local, province, regional or national.
- The participation of foreign capital is defined as the percentage of foreign-owned capital of the firm.
- The percentage of temporary workers over the total employees in the firm is measured at the end of 2001 and 2002. When the firm reports that the number of temporary employees has changed considerably, it is computed as the average of temporary employees at the end of every quarter.
- As for the control variables, we include the percentage of the productive capacity used by the firm is a question directly asked in the survey. We control for the fact that the firm is part of a group by means of a dummy that takes value 1 when the firm belongs to a group of firms. We also control for sector by means of a set of 20 dummy variables according to the National Classification of Economic Activities (NACE-93). The excluded category is "Office machines, computer equipments, process equipments, optics and similar". The regional dummies are a set of 17 dummy variables by CCAA. The omitted category is "La Rioja". Due to lack of variability, we consider all the firms situated in the "Balearic Islands" and "Canary Islands" as a single category. Finally, we include year dummies.

Appendix 5.2. Estimation of the two-part and *heckit* models. Complementary results

Table A5.1. Estimation of the heckit and two-part models. Lagged product innovations and contemporaneous process innovations

	(a) Product (t-1) // Process (t)				(b) Innov (t-1 // t)			
	Participation eq		Quantity eq		Participation eq		Quantity eq	
	Mg eff	Coeff	Heckit Coeff	Two-part Coeff	Mg eff	Coeff	Heckit Coeff	Two-part Coeff
Size	0.1265***	0.3357***	0.0409	-0.0285	0.1302***	0.3464***	0.0648	-0.0318
	(0.0108)	(0.0289)	(0.0696)	(0.0396)	(0.0107)	(0.0286)	(0.0747)	(0.0394)
White collars	0.0053***	0.014***	0.0223***	0.0197***	0.0052***	0.0139***	0.0227***	0.0193***
	(0.0009)	(0.0024)	(0.0038)	(0.0033)	(0.0009)	(0.0024)	(0.0039)	(0.0033)
Advanced technology -medium	0.1302***	0.3402***	0.0664	-0.0155	0.1336***	0.3495***	0.1036	-0.0096
	(0.0251)	(0.0652)	(0.1122)	(0.09)	(0.025)	(0.0649)	(0.1163)	(0.0896)
Advanced technology -high	0.1457***	0.375***	0.1761	0.1029	0.1504***	0.3874***	0.2104*	0.1085
	(0.0368)	(0.0932)	(0.1227)	(0.1094)	(0.0367)	(0.0929)	(0.1266)	(0.1094)
Product innovation	0.1099***	0.2869***	0.1698*	0.1189				
	(0.0259)	(0.0668)	(0.0894)	(0.0787)	0.1694***	0.4501***	0.3855***	0.2614***
Process innovation	0.1553***	0.4057***	0.2186**	0.1438*	(0.0219)	(0.0586)	(0.1149)	(0.0821)
	(0.0239)	(0.0621)	(0.0993)	(0.0783)				
International market	0.1116***	0.2924***	0.1456	0.0811	0.1128***	0.2961***	0.1661*	0.0788
	(0.0245)	(0.0636)	(0.0958)	(0.0819)	(0.0244)	(0.0634)	(0.0985)	(0.0819)
Foreign capital	0.0011***	0.0029***	0.0028***	0.0023**	0.001***	0.0028***	0.003***	0.0024***
	(0.0003)	(0.0009)	(0.001)	(0.0009)	(0.0003)	(0.0009)	(0.001)	(0.0009)
Temporary workers	-0.0002	-0.0004	-0.0061***	-0.0057*	-0.0002	-0.0005	-0.0065***	-0.0059**
	(0.0006)	(0.0015)	(0.0024)	(0.003)	(0.0006)	(0.0015)	(0.0025)	(0.003)
Controls								
Productive capacity	-0.001	-0.0028	-0.0005	0.0001	-0.0011	-0.0028	-0.0007	0
	(0.0008)	(0.0021)	(0.003)	(0.0029)	(0.0008)	(0.0021)	(0.003)	(0.0029)
Group	0.0385	0.1017	0.1501	0.1214	0.0366	0.0969	0.1674*	0.1292
	(0.0301)	(0.0791)	(0.1017)	(0.099)	(0.0299)	(0.079)	(0.1028)	(0.099)
Year	-0.0403**	-0.1071**	-0.2791***	-0.2622***	-0.0416**	-0.1108**	-0.295***	-0.2699***
	(0.021)	(0.0559)	(0.0732)	(0.0723)	(0.0209)	(0.0558)	(0.0743)	(0.0719)
Sector dummies	yes	yes	yes	yes	yes	yes	yes	yes
Region dummies	yes	yes	yes	yes	yes	yes	yes	yes
constant		-2.033***	3.2284***	3.955***		-2.0382***	2.8695***	3.9481***
		(0.4114)	(0.856)	(0.6089)		(0.4101)	(0.8945)	(0.605)
No of obs	3020		1222	1222	3020		1222	1222
Pseudo R	0.3472		-	0.1796	0.3436		-	0.1821
pseudolnL	-1330.4748		-	-	-1337.7413		-	-
rho	-		0.3115	-	-		0.4126	-
sigma2	-		1.2549	-	-		1.2775	-
sigma12	-		0.3909	-	-		0.5271	-
			(0.3301)					(0.3506)
H0:Sector=0	46.68***		55.84***	3.05***	47.63***		56.86***	3.16***
H0:Region=0	65.00***		29.66***	1.84**	67.33***		30.35***	1.83**

Note: standard deviation in parentheses; (***) (**) and (*) denote significant at 1%, 5% and 10%.

Table A5.2. Estimation the heckit and two-part models for the small and large firms' subsamples

	Small firms				Large firms			
	Participation eq		Quantity eq		Participation eq		Quantity eq	
	Mg eff	Coeff	Heckit Coeff	Two-part Coeff	Mg eff	Coeff	Heckit Coeff	Two-part Coeff
Size	0.0982***	0.3657***	0.0225	-0.2112**	0.0704***	0.2439***	-0.1194	0.009
	(0.0127)	(0.0479)	(0.2222)	(0.098)	(0.0242)	(0.0845)	(0.1233)	(0.064)
White collars	0.0051***	0.019***	0.0307***	0.0199***	0.0003	0.001	0.019***	0.0197***
	(0.0008)	(0.0029)	(0.0106)	(0.0045)	(0.0013)	(0.0046)	(0.0051)	(0.005)
Advanced technology -medium	0.1136***	0.3911***	0.1817	-0.0648	0.0687**	0.2431**	0.0317	0.1277
	(0.0248)	(0.0799)	(0.2546)	(0.1353)	(0.0346)	(0.1251)	(0.1806)	(0.1283)
Advanced technology -high	0.1239***	0.4019***	0.3258	0.0932	0.1013***	0.3715***	-0.0089	0.216
	(0.0476)	(0.1382)	(0.2956)	(0.2077)	(0.0368)	(0.1439)	(0.2197)	(0.1374)
Innovation	0.14***	0.4855***	0.4065	0.115	0.1171***	0.3934***	0.0076	0.2484***
	(0.0225)	(0.0738)	(0.2837)	(0.1287)	(0.0315)	(0.1035)	(0.2047)	(0.1031)
International market	0.0613***	0.217***	0.3851**	0.2569*	0.1055***	0.3612***	-0.2017	0.0306
	(0.0251)	(0.0846)	(0.1796)	(0.1443)	(0.0307)	(0.1048)	(0.1987)	(0.1044)
Foreign capital	0.0012***	0.0046***	0.0073***	0.0051***	0.0005	0.0019	0.0001	0.0013
	(0.0004)	(0.0014)	(0.0028)	(0.0019)	(0.0003)	(0.0012)	(0.0015)	(0.001)
Temporary workers	0.0001	0.0003	-0.0025	-0.0022	-0.001	-0.0033	-0.0118***	-0.0143***
	(0.0005)	(0.0017)	(0.0035)	(0.0039)	(0.001)	(0.0035)	(0.0046)	(0.0047)
Controls								
Productive capacity	-0.0008	-0.0029	-0.0027	-0.0008	-0.0011	-0.0039	0.0009	-0.001
	(0.0007)	(0.0025)	(0.0047)	(0.004)	(0.0013)	(0.0044)	(0.005)	(0.0041)
Group	0.0144	0.053	0.0285	-0.0023	0.01	0.0343	0.2012	0.2172*
	(0.0295)	(0.1067)	(0.1736)	(0.1666)	(0.0388)	(0.1324)	(0.1509)	(0.1305)
Year	-0.0077	-0.0286	-0.2305**	-0.2122	-0.056**	-0.1945**	-0.1525	-0.2626***
	(0.0185)	(0.0691)	(0.1201)	(0.115)	(0.0278)	(0.097)	(0.131)	(0.09)
Sector dummies	yes	yes	yes	yes	yes	yes	yes	yes
Region dummies	yes	yes	yes	yes	yes	yes	yes	yes
constant		-2.0382***	2.8695***	3.9481***		4.4786	5.3329***	4.5951***
		(0.4101)	(0.8945)	(0.605)		(4.567)	(1.2953)	(0.7253)
No of obs	2086		520	520	934		702	702
Pscudo R	0.2658		-	0.1902	0.1487		-	0.2674
pseudolnL	-860.0167		-	-	-445.7285		-	-
Rho	-		0.6575	-	-		-1.0000	-
sigma2	-		1.4597	-	-		1.4874	-
sigma12	-		0.9597	-	-		-1.4874	-
			(0.8239)				(1.0214)	
H0:Sector=0	39.54***		31.80**	2.33***	24.26		39.99***	4.95***
H0:Region=0	64.91***		18.82	1.55*	58.81***		20.15	2.93***

Note: standard deviation in parentheses; (***) (**) and (*) denote significant at 1%, 5% and 10%.

Table A5.3. Empirical mean squared error test to choose between the heckit and the two-part model

	Total sample						Small firms						Large firms					
	Two-part is "true" model			Heckit is "true" model			Two-part is "true" model			Heckit is "true" model			Two-part is "true" model			Heckit is "true" model		
	emse Two-part	emse Heckit	choice	emse Two-part	emse Heckit	choice	emse Two-part	emse Heckit	choice	emse Two-part	emse Heckit	choice	emse Two-part	emse Heckit	choice	emse Two-part	emse Heckit	choice
Size	1.56E-03	1.68E-02	2pm	1.79E-03	5.65E-03	2pm	9.61E-03	1.04E-01	2pm	1.85E-02	4.94E-02	2pm	4.10E-03	3.17E-02	2pm	4.86E-03	1.52E-02	2pm
White collars	1.09E-05	3.04E-05	2pm	1.09E-05	1.58E-05	2pm	1.98E-05	2.29E-04	2pm	1.99E-05	1.13E-04	2pm	2.50E-05	2.61E-05	2pm	2.50E-05	2.56E-05	2pm
Advanced technology -medium	8.06E-03	2.80E-02	2pm	8.46E-03	1.34E-02	2pm	1.83E-02	1.26E-01	2pm	2.98E-02	6.48E-02	2pm	1.65E-02	5.80E-02	2pm	1.82E-02	3.26E-02	2pm
Advanced technology – high	1.20E-02	2.85E-02	2pm	1.22E-02	1.62E-02	2pm	4.31E-02	1.41E-01	2pm	5.28E-02	8.74E-02	2pm	1.89E-02	9.89E-02	2pm	2.53E-02	4.83E-02	2pm
Innovation	6.49E-03	2.84E-02	2pm	6.97E-03	1.22E-02	2pm	1.66E-02	1.65E-01	2pm	3.87E-02	8.05E-02	2pm	1.06E-02	9.98E-02	2pm	1.86E-02	4.19E-02	2pm
International market	6.71E-03	1.82E-02	2pm	6.84E-03	9.61E-03	2pm	2.08E-02	4.87E-02	2pm	2.16E-02	3.23E-02	2pm	1.09E-02	9.34E-02	2pm	1.77E-02	3.95E-02	2pm
Foreign capital	8.46E-07	1.53E-06	2pm	8.46E-07	1.08E-06	2pm	3.63E-06	1.28E-05	2pm	3.63E-06	7.86E-06	2pm	1.09E-06	3.68E-06	2pm	1.09E-06	2.31E-06	2pm
Temporary workers	9.31E-06	6.42E-06	h	9.31E-06	6.06E-06	h	1.52E-05	1.25E-05	h	1.52E-05	1.24E-05	h	2.25E-05	2.75E-05	2pm	2.25E-05	2.15E-05	h
Controls																		
Productive capacity	8.43E-06	9.81E-06	2pm	8.43E-06	9.02E-06	2pm	1.58E-05	2.56E-05	2pm	1.58E-05	2.21E-05	2pm	1.65E-05	2.93E-05	2pm	1.65E-05	2.54E-05	2pm
Group	9.82E-03	1.23E-02	2pm	9.82E-03	1.06E-02	2pm	2.78E-02	3.11E-02	2pm	2.78E-02	3.01E-02	2pm	1.70E-02	2.30E-02	2pm	1.71E-02	2.28E-02	2pm
Sector 1	1.44E-01	2.13E-01	2pm	1.49E-01	1.83E-01	2pm	3.31E-01	6.68E-01	2pm	4.44E-01	5.18E-01	2pm	2.65E-01	4.51E-01	2pm	3.00E-01	4.49E-01	2pm
Sector 2	9.71E-02	1.37E-01	2pm	9.87E-02	1.36E-01	2pm	2.17E-01	3.36E-01	2pm	2.31E-01	3.30E-01	2pm	1.44E-01	4.13E-01	2pm	2.16E-01	3.76E-01	2pm
Sector 3	1.44E-01	2.27E-01	2pm	1.51E-01	2.00E-01	2pm	4.44E-01	9.26E-01	2pm	6.77E-01	7.07E-01	2pm	1.66E-01	4.69E-01	2pm	2.58E-01	4.69E-01	2pm
Sector 4	9.88E-02	1.38E-01	2pm	1.00E-01	1.38E-01	2pm	2.22E-01	3.04E-01	2pm	2.29E-01	3.04E-01	2pm	1.63E-01	5.39E-01	2pm	3.04E-01	4.35E-01	2pm
Sector 5	1.35E-01	3.01E-01	2pm	1.62E-01	2.95E-01	2pm	2.38E-01	5.09E-01	2pm	3.11E-01	5.08E-01	2pm	1.59E-01	1.33E+00	2pm	1.53E+00	1.24E+00	h
Sector 6	1.59E-01	1.98E-01	2pm	1.61E-01	1.98E-01	2pm	2.86E-01	4.30E-01	2pm	3.07E-01	4.28E-01	2pm	2.36E-01	7.48E-01	2pm	4.98E-01	5.88E-01	2pm
Sector 7	1.05E-01	1.57E-01	2pm	1.08E-01	1.53E-01	2pm	2.71E-01	3.86E-01	2pm	2.84E-01	3.73E-01	2pm	1.46E-01	4.19E-01	2pm	2.21E-01	3.98E-01	2pm
Sector 8	1.04E-01	1.52E-01	2pm	1.06E-01	1.46E-01	2pm	2.58E-01	3.46E-01	2pm	2.66E-01	3.45E-01	2pm	1.43E-01	4.01E-01	2pm	2.09E-01	3.83E-01	2pm
Sector 9	8.32E-02	1.50E-01	2pm	8.76E-02	1.29E-01	2pm	2.03E-01	4.04E-01	2pm	2.43E-01	3.31E-01	2pm	1.23E-01	3.69E-01	2pm	1.83E-01	3.43E-01	2pm
Sector 10	9.31E-02	1.66E-01	2pm	9.84E-02	1.43E-01	2pm	2.01E-01	3.98E-01	2pm	2.40E-01	3.41E-01	2pm	1.46E-01	4.26E-01	2pm	2.25E-01	3.92E-01	2pm
Sector 11	1.25E-01	1.48E-01	2pm	1.25E-01	1.48E-01	2pm	4.72E-01	3.85E-01	h	4.79E-01	3.82E-01	h	1.71E-01	4.62E-01	2pm	2.56E-01	4.04E-01	2pm
Sector 12	1.01E-01	1.84E-01	2pm	1.08E-01	1.53E-01	2pm	2.81E-01	5.85E-01	2pm	3.73E-01	4.52E-01	2pm	1.50E-01	3.84E-01	2pm	2.05E-01	3.76E-01	2pm
Sector 13	9.17E-02	1.59E-01	2pm	9.63E-02	1.36E-01	2pm	2.02E-01	4.36E-01	2pm	2.57E-01	3.45E-01	2pm	1.50E-01	3.68E-01	2pm	1.98E-01	3.64E-01	2pm
Sector 14	8.61E-02	1.40E-01	2pm	8.90E-02	1.32E-01	2pm	1.90E-01	3.30E-01	2pm	2.09E-01	3.05E-01	2pm	1.33E-01	3.67E-01	2pm	1.88E-01	3.62E-01	2pm
Sector 16	9.06E-02	1.43E-01	2pm	9.33E-02	1.34E-01	2pm	1.97E-01	3.99E-01	2pm	2.38E-01	3.41E-01	2pm	1.54E-01	3.72E-01	2pm	2.02E-01	3.64E-01	2pm
Sector 17	9.42E-02	1.37E-01	2pm	9.60E-02	1.34E-01	2pm	2.35E-01	4.38E-01	2pm	2.76E-01	3.79E-01	2pm	1.43E-01	3.90E-01	2pm	2.04E-01	3.67E-01	2pm

Sector 18	1.29E-01	1.82E-01	2pm	1.32E-01	1.66E-01	2pm	2.90E-01	6.17E-01	2pm	3.97E-01	4.75E-01	2pm	1.90E-01	4.30E-01	2pm	2.47E-01	4.26E-01	2pm
Sector 19	1.12E-01	1.62E-01	2pm	1.15E-01	1.60E-01	2pm	3.34E-01	3.78E-01	2pm	3.36E-01	3.77E-01	2pm	1.50E-01	5.14E-01	2pm	2.82E-01	4.55E-01	2pm
Sector 20	1.86E-01	2.22E-01	2pm	1.87E-01	2.22E-01	2pm	2.94E-01	5.31E-01	2pm	3.50E-01	5.30E-01	2pm	2.51E-01	5.51E-01	2pm	3.41E-01	5.50E-01	2pm
Region 1	2.24E-01	2.85E-01	2pm	2.28E-01	2.08E-01	h	5.30E-01	6.48E-01	2pm	5.44E-01	4.62E-01	h	1.51E-01	2.57E+00	2pm	5.99E+00	1.32E+00	h
Region 2	2.00E-01	1.82E-01	h	2.00E-01	1.78E-01	h	4.64E-01	3.97E-01	h	4.69E-01	3.86E-01	h	1.08E-01	1.21E+00	2pm	1.32E+00	8.43E-01	h
Region 3	2.47E-01	2.26E-01	h	2.47E-01	1.99E-01	h	8.27E-01	7.28E-01	h	8.37E-01	5.63E-01	h	1.47E-01	1.46E+00	2pm	1.86E+00	9.41E-01	h
Region 45	2.75E-01	2.78E-01	2pm	2.75E-01	2.43E-01	h	4.47E-01	8.16E-01	2pm	5.83E-01	6.27E-01	2pm	2.98E-01	1.61E+00	2pm	2.01E+00	1.04E+00	h
Region 6	2.42E-01	2.89E-01	2pm	2.44E-01	2.36E-01	h	6.96E-01	5.71E-01	h	7.12E-01	5.65E-01	h	1.54E-01	2.86E+00	2pm	7.50E+00	1.42E+00	h
Region 7	2.22E-01	2.75E-01	2pm	2.25E-01	2.14E-01	h	5.43E-01	6.82E-01	2pm	5.63E-01	5.14E-01	h	1.17E-01	2.51E+00	2pm	5.86E+00	1.29E+00	h
Region 8	2.09E-01	1.70E-01	h	2.11E-01	1.66E-01	h	4.64E-01	3.10E-01	h	4.87E-01	3.10E-01	h	1.33E-01	1.52E+00	2pm	2.06E+00	9.36E-01	h
Region 9	1.84E-01	1.53E-01	h	1.84E-01	1.48E-01	h	3.88E-01	2.59E-01	h	4.04E-01	2.59E-01	h	8.40E-02	1.49E+00	2pm	2.05E+00	8.97E-01	h
Region 10	1.92E-01	2.15E-01	2pm	1.92E-01	1.74E-01	h	3.94E-01	5.05E-01	2pm	4.06E-01	3.78E-01	h	1.14E-01	1.76E+00	2pm	2.81E+00	1.01E+00	h
Region 11	3.12E-01	4.66E-01	2pm	3.36E-01	3.76E-01	2pm	8.18E-01	3.21E+00	2pm	6.52E+00	2.63E+00	h	2.65E-01	2.19E+00	2pm	3.96E+00	1.31E+00	h
Region 12	2.37E-01	2.06E-01	h	2.38E-01	1.79E-01	h	4.88E-01	3.37E-01	h	5.11E-01	3.27E-01	h	1.68E-01	2.49E+00	2pm	5.57E+00	1.25E+00	h
Region 13	1.88E-01	2.00E-01	2pm	1.89E-01	1.65E-01	h	4.00E-01	4.94E-01	2pm	4.09E-01	3.66E-01	h	1.01E-01	1.61E+00	2pm	2.39E+00	9.51E-01	h
Region 14	2.82E-01	2.95E-01	2pm	2.82E-01	2.33E-01	h	7.69E-01	1.17E+00	2pm	9.28E-01	8.05E-01	h	1.71E-01	2.08E+00	2pm	3.81E+00	1.15E+00	h
Region 15	1.99E-01	2.03E-01	2pm	1.99E-01	1.94E-01	h	5.21E-01	5.11E-01	h	5.21E-01	4.86E-01	h	1.02E-01	1.22E+00	2pm	1.35E+00	8.64E-01	h
Region 16	1.92E-01	1.81E-01	h	1.92E-01	1.65E-01	h	4.26E-01	3.64E-01	h	4.30E-01	3.29E-01	h	9.97E-02	1.70E+00	2pm	2.65E+00	9.84E-01	h
Year	5.17E-03	5.83E-03	2pm	5.17E-03	5.41E-03	2pm	1.32E-02	1.48E-02	2pm	1.32E-02	1.44E-02	2pm	8.10E-03	2.93E-02	2pm	8.55E-03	1.72E-02	2pm
constant	3.66E-01	1.96E+00	2pm	2.92E+00	8.00E-01	h	7.66E-01	9.30E+00	2pm	7.36E+01	4.42E+00	h	5.26E-01	2.22E+00	2pm	3.40E+00	1.68E+00	h

Note: 2pm indicates that the two-part model is preferred over the *heckit* as it has smaller mean squared error; h indicates that the *heckit* is preferred over the two-part.

Appendix 5.3. Decomposition for the two-part model. Detailed results

Table A5.4. Decomposition for the two-part model. Estimation without firm-specific effects. Detailed results (corresponds to Table 5.8)

	2001						2002					
	Participation eq			Quantity eq			Participation eq			Quantity eq		
Training differential	**0.4014**			**0.1812**			**0.4501**			**0.2899**		
	Charact	Adv	Disadv	Charact	Adv	Disadv	Charact	Adv	Disadv	Charact	Adv	Disadv
Total	0.466	0.067	-0.001	0.252	-0.019	0.227	0.461	-0.003	-0.012	0.333	0	0.084
	87.62%	12.59%	-0.21%	54.71%	-4.13%	49.41%	103.47%	-0.66%	-2.81%	79.82%	0%	20.18%
White collars	0.015	-0.021	0	-0.004	-0.002	-0.002	0.015	0.002	0.031	0.013	-0.002	-0.002
	2.75%	-3.94%	0.08%	-0.95%	-0.35%	-0.43%	3.47%	0.38%	6.87%	3.17%	-0.42%	-0.49%
Advanced Technology	0.098	-0.001	0	0.053	0.029	-0.013	0.093	0	-0.017	0.052	0.03	-0.01
	18.36%	-0.27%	-0.05%	11.41%	6.35%	-2.80%	20.79%	0.03%	-3.85%	12.50%	7.26%	-2.37%
Innovation	0.053	-0.001	0	0.05	0.018	0.006	0.056	0	-0.011%	0.054	0.016	0.001
	9.99%	-0.22%	-0.03%	10.96%	4.00%	1.27%	12.52%	0.02%	-2.56%	13.03%	3.85%	0.21%
International Market	0.041	0.001	0	0.034	-0.009	0.045	0.04	0	0.026	0.035	-0.01	0.044
	7.68%	0.12%	0.07%	7.47%	-1.89%	9.84%	8.93%	-0.02%	5.88%	8.51%	-2.36%	10.45%
Foreign capital	0.02	-0.004	0	0.054	-0.044	-0.065	0.02	0	0.01	0.064	-0.046	-0.055
	3.72%	-0.75%	0.03%	11.72%	-9.66%	-14.09%	4.45%	0.07%	2.23%	15.47%	-10.93%	-13.20%
Temporary workers	0.001	-0.005	0	0.008	-0.125	-0.061	0.001	0	0.01	0.022	-0.103	-0.061
	0.12%	-0.91%	0.03%	1.76%	-27.07%	-13.33%	0.13%	0.07%	2.34%	5.34%	-24.75%	-14.53%
Size	0.207	-0.074	0	-0.055	0.208	0.739	0.196	0.006	0.033	-0.055	0.21	0.747
	38.84%	-13.82%	0.09%	-11.90%	45.23%	160.62%	44.08%	1.24%	7.41%	-13.15%	50.27%	179.13%
Productive capacity	-0.001	-0.006	0	0	-0.084	0.061	-0.001	0	0.017	0	-0.083	0.059
	-0.20%	-1.13%	0.05%	0%	-18.22%	13.29%	-0.29%	0.10%	3.88%	-0.02%	-20.02%	14.21%
Group	0.025	-0.004	0	0.111	0.058	-0.037	0.024	0	0.018	0.111	0.059	-0.036
	4.66%	-0.71%	0.05%	24.06%	12.57%	-8.14%	5.35%	0.07%	3.97%	26.72%	14.26%	-8.65%
Sector	0.012	-0.031	0	0.056	0.19	-0.11	0.019	0.003	0.015	0.059	0.211	-0.106
	2.30%	-5.85%	0.04%	12.07%	41.29%	-23.92%	4.19%	0.57%	3.34%	14.11%	50.65%	-25.53%
Region	-0.003	-0.53	0.001	-0.055	-0.917	-0.296	-0.001	0.04	0.056	-0.024	-0.92	-0.376
	-0.59%	-99.55%	0.15%	-11.87%	-199.12%	-64.33%	-0.15%	8.88%	12.52%	-5.85%	-220.59%	-90.28%
Year	0	0.013	0	0	0.01	0.04	0	0.001	0.034	0	-0.01	-0.04
	0%	2.38%	-0.09%	0%	2.20%	8.75%	0%	0.21%	7.64%	0%	-2.43%	-9.66%

Table A5.5. Decomposition for the two-part model. Estimation including firm-specific effects. Detailed results (corresponds to Table 5.9)

	2001						2002					
	Participation eq			Quantity eq			Participation eq			Quantity eq		
Training differential	**0.4014**			**0.1812**			**0.4501**			**0.2899**		
	Charact	Adv	Disadv	Charact	Adv	Disadv	Charact	Adv	Disadv	Charact	Adv	Disadv
Total	0.527	0.051	-0.007	0.21	-0.039	0.209	0.519	-0.019	-0.017	0.308	0.002	0.118
	131.29%	12.71%	-1.74%	115.89%	-21.52%	115.34%	115.31%	-4.22%	-3.78%	106.24%	0.69%	40.70%
White collars	0.018	-0.02	0.002	-0.004	-0.027	-0.002	0.019	0.015	0.015	0.013	-0.03	-0.002
	4.48%	-4.98%	0.50%	-2.21%	-14.90%	-1.10%	4.22%	3.33%	3.33%	4.48%	-10.35%	-0.69%
Advanced Technology	0.122	-0.002	-0.002	0.082	0.03	-0.01	0.114	0.002	-0.011	0.079	0.031	-0.008
	30.39%	-0.50%	-0.50%	45.25%	16.56%	-5.52%	25.33%	0.44%	-2.44%	27.25%	10.69%	-2.76%
Innovation	0.044	-0.001	0	0.037	0.028	0.006	0.046	0.001	-0.003	0.04	0.024	0.001
	10.96%	-0.25%	0%	20.42%	15.45%	3.31%	10.22%	0.22%	-0.67%	13.80%	8.28%	0.34%
International Market	0.047	0.001	0.002	0.042	-0.008	0.044	0.046	-0.001	0.012	0.043	-0.009	0.042
	11.71%	0.25%	0.50%	23.18%	-4.42%	24.28%	10.22%	-0.22%	2.67%	14.83%	-3.10%	14.49%
Foreign capital	0.02	-0.004	0.001	0.052	-0.043	-0.057	0.019	0.003	0.004	0.063	-0.044	-0.048
	4.98%	-1.00%	0.25%	28.70%	-23.73%	-31.46%	4.22%	0.67%	0.89%	21.73%	-15.18%	-16.56%
Temporary workers	0	-0.003	0	0.009	-0.136	-0.075	0	0.002	0.002	0.025	-0.112	-0.074
	0%	-0.75%	0%	4.97%	-75.06%	-41.39%	0.00%	0.44%	0.44%	8.62%	-38.63%	-25.53%
Size	0.23	-0.103	0.006	-0.076	0.396	0.795	0.217	0.071	0.037	-0.076	0.399	0.803
	57.30%	-25.66%	1.49%	-41.94%	218.54%	438.74%	48.21%	15.77%	8.22%	-26.22%	137.63%	276.99%
Productive capacity	-0.001	-0.009	0.003	-0.001	-0.134	-0.031	-0.001	0.006	0.02	-0.006	-0.133	-0.03
	-0.25%	-2.24%	0.75%	-0.55%	-73.95%	-17.11%	-0.22%	1.33%	4.44%	-2.07%	-45.88%	-10.35%
Group	0.033	-0.005	0.001	0.103	0.052	-0.025	0.032	0.004	0.007	0.103	0.053	-0.024
	8.22%	-1.25%	0.25%	56.84%	28.70%	-13.80%	7.11%	0.89%	1.56%	35.53%	18.28%	-8.28%
Sector	0.016	-0.022	0	0.056	0.194	-0.084	0.026	0.016	0.002	0.06	0.216	-0.079
	3.99%	-5.48%	0%	30.91%	107.06%	-46.36%	5.78%	3.55%	0.44%	20.70%	74.51%	-27.25%
Region	-0.002	-0.451	0.005	-0.09	-0.889	-0.286	0.001	0.312	0.03	-0.036	-0.891	-0.368
	-0.50%	-112.36%	1.25%	-49.67%	-49.62%	-157.84%	0.22%	69.32%	6.67%	-12.42%	-307.35%	-126.94%
Year	0	0.01	0	0	0	0.02	0	0.01	0.01	0	0	-0.015
	0%	2.74%	-0.50%	0%	-0.55%	8.28%	0%	1.56%	2.67%	0%	0.34%	-5.17%

Note: given that the decomposition is not exact in the case of using the RE estimates, the sum of the shares of the components does not equal 100%.

Chapter 6

DO SUBSIDIES STIMULATE FIRMS' PROVISION OF TRAINING? EVIDENCE FOR SPAIN

6.1. Introduction

The purpose of this Chapter is estimating the impact of subsidies on the provision of in-company training for Spanish manufacturing firms in 2001 and 2002, when subsidies were regulated by the III National Agreement on Continuous Training (ANFC). We follow the same approach, specification and model as in Chapter 5, but considering also the subsidies on training.

This Chapter is structured as follows: in the next Section, we briefly explain the Spanish system of subsidies to continuous training. In Section 6.3, we discuss the empirical approach. Basically, the effect of subsidies can be seen as the sum of a direct effect of the public expenditure and an indirect effect, which takes place through the reaction of the privately financed training that can be either positive or negative. We offer a description of the variables of interest and the sources used to construct them in Section 6.4. An important finding in the descriptive analysis is that large firms receive more hours of subsidized training per hour worked. Section 6.5 presents and discusses the main results of the estimation of the probability of firms providing training and on the expenditure for the total sample. Given the observed differences in the hours of subsidised training by firm size, we estimate our model for the subsample of small and large firms. The final Section summarizes and concludes.

6.2. The third National Agreement on Continuous Training

In this Section, we succinctly explain the main characteristics of the third National Agreement on Continuous Training (III ANFC), signed on December 2000, which regulated the subsidies on training during the period January 2001 until December 2003. A more extensive and detailed description is provided in Appendix 6.1.

The III ANFC comprised a system of subsidies for different continuous training modalities: firm training plans, grouped training plans, specific training plans for non-profit and voluntary organizations, inter-sector training plans, complementary activities related to training and individual training plans. In this study we focus on the first two modalities, which are named *in-company training*; firm training plans are adopted by firms with at least 100 employees and with their own training plan; and *grouped training plans* when they are adopted by at least two firms in the same sector with common training necessities.

Firms and employees pay an accident and health insurance contribution to the social security system calculated on the basis of payroll. In 2001 and 2002, the amount of resources dedicated to vocational training was 0.35% of their payroll and it is called the vocational training levy. Firms could be awarded subsidies for their continuous training actions provided to those workers that paid the vocational training levy to the social security system. Workers who did not have the obligation to pay had access to training in the terms described in Appendix 6.1.

Firms could apply for a subsidy by describing in detail the training actions they planned to undertake. The proposals were evaluated by the so-called sector or regional "joint commissions" (*comisiones paritarias*),[122] which produced a report. If the report was positive, the application was submitted to the Tripartite Foundation. This institution decided whether to award an advanced payment of the subsidy and the INEM transferred the total amount awarded to the firm. At the end of the training activities, the firm had to certify that the training had been provided. According to the degree of fulfilment of the plan, the actual subsidy was determined and, if it was lower than the advanced payment, firms had to make a refund for the difference. Thus, the subsidy was designed as a credit to the firms. Given this design, the subsidy awards and the training

[122] The collective bargaining agreements indicated the joint commission that evaluated the report on firms' training plan. In the absence of a joint commission, the report was evaluated by the National Joint Commission.

provision can be considered contemporaneous: first the advanced payment was awarded; then, firms had to perform the training activities; and finally, the ultimate settlement was unknown until the training activities were finished. Although the advanced payment was awarded before the end of December on every year, firms had time to carry on the training actions until the end of April of the following year. Given that the maximum delay is of only four months, we assume that the two decisions are contemporaneous.

The total amount of the subsidy awarded depended on the following factors: the technical evaluation, the estimated cost (with a ceiling), the private co-financing, the quantity demanded and the available resources. There was a maximum of 100 hours of subsidized training per worker. In the case of firm training plans, the maximum subsidy was the continuous training levy paid by the firm and workers to the social security system or the total cost of the training plan (so that firms were encouraged to co-finance their own training plans).

6.3. Empirical Approach

Training provided by firms to their employees is generally assumed to have a positive impact on firms' performance, as more qualified workers become more productive and so do their corresponding firms. See for example the empirical studies by Bartel (1994), Alba-Ramírez (1994), Black and Lynch (1996), Barrett and O'Connell (2001), Almeida and Carneiro (2005) or Dearden et al. (2006). Blundell et al. (1999) argue that private returns to training constitute an incentive for firms to invest in it. However, the benefits of training are not only restricted to the firms providing training, but also could spill over to other firms, so that the gains to the economy as a whole (social returns) could exceed the returns obtained by the investing parties (private returns). These spillovers include positive production externalities and social effects, such as a more equal distribution of income. See for example, Dearden et al. (2000, 2006) who find evidence in favour of positive externalities from training for the case of the UK. The existence of these positive economy-wide training spillovers indicate that there is an alleged underinvestment in training, as the actual expenditure on training is lower than the optimal expenditure. Leuven and Oosterbeek (2004) argue that such underinvestment in work-related training can origin in the poaching-externality in the case of general

training and in the hold-up problem in the case of specific training.[123] The existence of this market failure is an important economic justification for the public support of training and governments try to compensate it by means of public policies.

The continuous training system in Spain has raised the interest of economists, sociologists and pedagogues, with studies that describe the evolution of subsidized continuous training and the main characteristics of firms applying for subsidies. See for example, Parellada et al. (1999), Crespo and Sanz (2000), Planas and Rifà (2003), Rigby (2004) and Planas (2005). Other studies analyse the determinants of firms' decision to invest in training, for example Bartel (1989), Alba-Ramírez (1994) and Black and Lynch (1998). In Chapter 5, we showed evidence that there are some factors influencing the decision on whether to provide training and the decision on the amount of training. Concretely, we find a significant impact on firms' training provision of the previous education of the employees, the use of advanced technology in the firm, its innovative activity, the degree of competition faced by the firm, the participation of foreign capital in the firm and the percentage of temporary workers. Although some studies for the Spanish case highlight the increasing expenditure, firms and participants in continuous training, the impact of training subsidies on in-company training provision has still to be empirically examined for the Spanish case.

Given the alleged positive effects of training for the whole economy and the efforts dedicated to increase firms' investment in training made by public institutions, we intend to analyse whether subsidies have an impact on the training provided by Spanish manufacturing firms. Only a few studies have analysed this question. Görg and Strobl (2005) study the effect of government subsidies on firms' training expenditure for Irish firms. They find that subsidies stimulate training in domestic-owned firms, but not in foreign-owned firms based in Ireland. Leuven and Oosterbeek (2004) study the effect of an additional tax deduction for firms that train employees older than 40-years-old in the Netherlands. They estimate a difference-in-differences model that compares the participation in training of workers above and below age 40. They find that this extra deduction does not lead to higher training participation by employees above age

[123] Firms will not finance general training because of the poaching of trained workers by other firms. The hold-up problem decreases workers' incentives to invest in specific training as it will increase firms' productivity and generates a surplus that, under bargaining, will have to be shared between firms and workers.

40, as firms mainly postpone the training of their employees until they reach this age. Barry et al. (2004) find no evidence that plants that receive subsidies are more likely to provide privately financed training in the Irish case. They also find that firms that receive training subsidies provide less training per employee. They argue that this result might reflect that training subsidies are targeted to firms that otherwise are unlikely to provide much training. Holzer et al. (1993) use a survey of US firms that applied for training subsidies and estimate the effects of subsidies on total hours of training. The authors recognize that their estimations may suffer from sample selection biases. They find large and significant, though one-time, increase in training hours due to the awarded grants.

In the following paragraphs, we specify the empirical model used to assess the effect of subsidies on firms' training provision. Although there are differences with their approach, we use Leuven and Oosterbeek (2004) as a starting point for our specification. We define T_i as the firm's provision of training to their employees and S_i as the level of the subsidy. Then our specification can be written as:

$$T_i = \alpha + \beta S_i + X_i'\delta + u_i \tag{6.1}$$

where T_i can be defined both as a continuous or binary variable, X_i is a set of control variables, u_i is the error term and β is the effect of the change in the subsidy on the training provision. As explained in Section 6.2, the subsidy awards and the training provision can be considered contemporaneous. We intend to reflect it in our specification, where these two variables refer to the same period.

Subsidies may have a direct and an indirect effect on training expenditures and on the probability of providing training –defining training as the company-financed training plus the subsidy–. The direct effect increases the total expenditure while holding the company-financed training constant. The direct effect also increases the probability of providing training. The indirect effect operates through the response of the company-financed training to the subsidy and it is a sum of two opposite effects, so it can be positive or negative: the "spillover" or "complementary effect" is positive and magnifies the direct effect of subsidies. The "substitution" or "crowding-out effect" is negative and reduces the direct effect of subsidies. Thus, the final effect of the subsidy can be higher or lower than predicted by direct effect alone.

When $\beta>0$, the subsidy has a positive direct effect and an indirect effect that can be positive, null or negative (although smaller in magnitude than the positive direct effect). For example, when the subsidy reduces the fixed costs of other current or future training plans or there is knowledge transfer and know-how that stimulates other training actions; also, when the subsidy lowers the private cost of the current plan, turning an unprofitable project to a profitable one, or increasing its probability of being undertaken. When $\beta=0$, the crowding-out effect of the subsidies compensates the direct effects. Finally, when $\beta<0$, the final effect of the subsidies is negative because the crowding-out effect is larger than the direct effect. The last two cases take place when firms dedicate resources that they would have dedicated to training to other areas in the firm, so that the privately financed training is displaced. Notice that even in the first case it is possible that privately financed training is displaced and subsidies are not having the expected positive indirect effect. Thus, the subsidies can only be considered to be effective when the positive indirect effect appears. This interpretation is quite common among the literature on R&D subsidies —see for example Lach (2002), Busom (2000) and David et al. (2000).

Departing from the reasoning and specification in Chapter 5, the empirical specification estimated in this Chapter is expression (6.1). The dependent variable is defined both as a continuous variable (expenditure on training per worker in logs) and a binary indicator (that takes value 1 for positive expenditure). Our variable of interest is the subsidies, which is considered contemporaneous to the provision of training (as discussed in Section 6.2). Finally, a set of control variables and firm-specific effects have been included. The control variables of the model are included as specified in Section 5.3 (based on the reasoning in Section 5.2 and defined as in Appendix 5.1). Namely: the percentage of white collars, the intensity of use of advanced technologies, the innovative capacity of the firm, the geographical scope of the firms' market, the foreign capital participation and the percentage of temporary workers, the firm size, the intensity of use of the productive capacity, a variable on whether the firm belongs to a group and a set of regional, industrial and year dummies.

6.4. Data and Descriptive Analysis

6.4.1. Definition of the variables and sources of data

Our variables of interest are the provision of training by the firm and the level of the subsidy. As in Chapter 5, data on training are drawn from the ESEE. The provision of training is measured by a discrete and a continuous variable: the dummy variable (dTR_i), which takes value 1 when the firm has positive training expenses and 0 otherwise; and the log expenditure on training ($lnTR_i$), defined as the sum of expenses per worker for training in computing and information technologies; foreign languages; sales and marketing; engineering and technical training; and diverse issues (expressed in euros of 2001). As commented in the previous Chapter, data on training are available in 2001 and 2002.

Information on the amount of the subsidy (S_i) is not available at the level of individual firms. Moreover, even if this variable was available, it may suffer endogeneity problems because unobservable factors determining the expenditure on training may be common to those factors determining whether the firm obtains a subsidy. For example, the effect of trade unions, for which we cannot control, is considered a factor determining training expenses. Trade unions also determine in part whether firms obtain a subsidy: when firms apply for a subsidy, a joint commission has to produce a report on the appropriateness of awarding the subsidy. As firms are assigned to different joint commissions according to their collective bargaining agreement, the subsidies are strongly influenced by trade unions. Therefore, trade unions may constitute an unobservable factor determining both the expenditure on training and whether the firm obtains the subsidy. In such case, the variable on the subsidy will be correlated with the error term, which may produce biased coefficients for this variable. A way of dealing with the two limitations at the same time is finding a proxy of the variable S_i. An adequate proxy of S_i would be a variable that has a strong correlation with the firm receiving a subsidy: we assume that a variable that measures the percentage of subsidized hours of training over the hours worked for firms in a given region and size strata ($SUBS_i$) will be highly correlated with S_i. Given that S_i is unknown, we cannot perform the first-stage estimation in instrumental variables and analyse whether $SUBS_i$ is an appropriate instrument for S_i. However, $SUBS_i$ is assumed to have effect on firms' training provision other than through its effect on the subsidy

received by the firm. If this assumption is correct, the endogeneity problem between subsidies and the firm provision of training would be solved. In this view, the coefficients obtained from the regression of dTR_i or $lnTR_i$ on $SUBS_i$ can be seen analogously as the reduced form estimates in an instrumental variables setting.

The variable $SUBS_i$ for each i-firm is defined according with its r-region and f-firm size strata, so that we obtain the percentage of hours of subsidized training over worked hours by size and region ($SUBS_{rf}$) as follows:

$$SUBS_{rf} = \frac{HTR_{rf}}{HWK_{rf}} \tag{6.2}$$

where HTR is the number of hours of subsidized training and HWK is the number of hours worked. Subscripts r and f correspond to firms in a certain region and firm size strata respectively. The regions are defined as the Autonomous Communities[124] where the firm is located. We consider five different size strata according to the number of employees in the firm: 1 to 10; 11 to 50; 51 to 250; 251 to 500; more than 500.[125]

The variable HTR is calculated as the number of participants in subsidized training multiplied by average subsidized hours per subsidized participant.[126] The available data exclude informal and on-the-job training as well as the so-called "supply training plans" (continuous training carried on by workers independently of their employers). This way $lnTR$ and HTR are measuring company-provided training. To construct this variable we use data provided by the Tripartite Foundation for Employment Training.[127]

The variable HWK is calculated as the number of workers affiliated to the Social Security System multiplied by the average yearly effective hours of work. We consider only the workers that contribute to the Social Security System because otherwise their employers are not eligible for a training subsidy dedicated to such employees, and so

[124] Spain is divided in 17 NUTS II regions called Autonomous Communities (*Comunidades Autónomas*).
[125] Although the ESEE contains information of firms with 10 or more employees, those firms that after some periods report having less than 10 employees are maintained in the survey. This is the case of 108 firms in 2001 and 109 in 2002, which represent around 6.8% of the observations.
[126] "Participants" are defined as workers that take part in training actions. When the same person participates in more than one training action, she/he is counted as more than one participant.
[127] Further details http://www.fundaciontripartita.org/index.asp?MP=6&MS=25&MN=2&TR=C&IDR=21 (last time visited on 1st of January 2007).

they cannot receive subsidized training.[128] These data are collected by the General Treasury of the Social Security.[129] The average yearly effective hours of work is calculated as the hours worked according to the collective agreement plus overtime hours minus lost hours. The workers considered to compute hours worked are those who have a labour contract with the firm on the last day of the corresponding quarter. The hours per worker are obtained as a weighted average of the effective hours of part time and full time workers. These data are drawn from the *Encuesta de Coyuntura Laboral*,[130] elaborated by the *Subdirección General de Estadísticas Sociales y Laborales*, from the Ministry of Labour and Social Affaires. This dataset collects information on a sample of about 12000 establishments on every quarter.

The data used to construct *HTR* and *HWK* correspond to firms in the industrial sector, which is defined according to the NACE-93 classification (groups 15 to 37, excluding group 23) in 2001 and 2002. They are also restricted to the population of workers that contribute to the Social Security System under the General Regime and the Regime of the Mining of Coal[131], including both part-time and full-time workers. These restrictions are necessary to guarantee comparability with the ESEE, from where we obtain the remaining variables in the analysis.

Finally, a set of control variables drawn from the ESEE has been included: the percentage of white collars, the intensity of use of advanced technologies, firms' product or process innovations, the geographical scope of the firm main market, the foreign capital participation, the percentage of temporary workers, the firm size, the intensity of use of the productive capacity, a variable on whether the firm belongs to a group, a set of industry and region dummies; and finally the year dummies. We follow

[128] Workers affiliated to the Social Security System do not necessarily correspond to the number of workers, but to the number of situations that generate the obligation to contribute to this system (i.e. a worker may have labour activities under different regimes, and thus, more than one obligation to contribute to it).

[129] For further details see http://www.mtas.es/estadisticas/anuario2002/AFI/afifn.htm (last time visited on 1st of January 2007).

[130] For further details see http://www.mtas.es/estadisticas/anuario2001/HTML/ECL/eclfn.html (last time visited on 1st of January 2007).

[131] Data on the hours of training include also workers that contribute to the Social Security System under the Autonomous Regime and the Agriculture Regime. However, these groups represent a small proportion over the total participants in training (around 2-4% in most regions). So, we have weighted the hours of training by the percentage of workers that contribute to the Social Security System under the General Regime and the Regime of the Mining of Coal.

the reasoning in Section 5.2 to include these variables. For further details, see the description of the variables in Appendix 5.1.

6.4.2. Descriptive analysis

In this Section we present the main characteristics of the variables introduced in the previous Section. Figures in Table 6.1 complement the major characteristics of data on firms' expenditure on training already described in Section 5.4. Our sample consists of a cross-section for 2001 and 2002, with 1515 and 1505 firms, respectively. Considering the total sample, the average expenditure on training per worker is around 68 euros in 2001 and 77 in 2002. In our sample, around 40% of the firms spend money on training: 601 firms in 2001 and 621 in 2002. A main characteristic of this variable is that it contains an important percentage of observations that take value zero (around 60% firms do not spend anything on formal training). Among firms with positive expenditure, the average is around 171 euros per worker in 2001 and 186 in 2002. As Table 6.1 shows, the positive values of the expenditure on training per worker have a very right skewed distribution: the median expenditure is around 90 euros in 2001 and 109 euros in 2002, while the average is much higher. After taking logarithms, the skewness reduces from 7 to -0.86 in 2001 and from 5.3 to -0.51 in 2002. In the following Sections, we present a model that takes into account the high proportion of "zeros" and the skewness of the positive values. Finally, it should be said that the expenditure on training per worker increases between 2001 and 2002 and shows a considerable dispersion.

Table 6.1. Expenditure on training per worker in the Spanish manufacturing firms

	2001		2002	
	Total sample	Positive expenditure	Total sample	Positive expenditure
No obs	1515	601	1505	621
%		39.66%		41.26%
Expenditure on training per worker				
average	67.943	171.27	76.968	186.534
std dev	217.407	318.654	195.81	269.33
median	0	89.703	0	109.144
min	0	0.025	0	0.771
max	3992.948	3992.948	3292.718	3292.718
skewness	10.092	7.099	7.100	5.366
skewness (logs)		-0.865		-0.512

Note: quantities on expenditure on training per worker are expressed in constant euros of 2001.

Regarding the data on subsidized training for all the firms in the industrial sector, in 2001 and 2002, 18323 and 18052 firms obtained public funds for providing training to their employees, more than 330000 and 315000 workers, respectively. The public funds awarded to in-company training actions are equal to 104 million euros in 2001 and 113 million euros in 2002.

Table 6.2 shows a descriptive of the variables used to construct the percentage of subsidized training hours over working hours (*SUBS*) by region. The first set of columns shows the number of subsidized participants in training actions, the number of workers affiliated to the social security system, the percentage of participants over affiliated workers, the hours of subsidized training per subsidized participant and the average annual effective hours of work for 2001. The second set of columns show the same for 2002. The last row in this table shows the values for all regions in Spain. Recall that this Chapter is restricted to manufacturing firms and workers affiliated to the social security system under the regimes explained in Section 6.4.1. Catalunya is the region with more participants in training actions (more than 72000), while La Rioja in 2001 and Baleares in 2002 are the regions with less participants (around 1800 and 1700 respectively). However, these figures have to be considered in relation with the number of workers in every region. Catalunya is also the region with more affiliated workers in the industrial sector (more than half million workers) and Extremadura is the region with fewer affiliated workers (below than 25000), followed at short distance by La Rioja and Baleares. The columns on the percentage of participants offer an idea of how is training distributed across regions in terms of participants relative to the affiliated workers to the social security system. As for this variable, we observe considerable variation across regions. Less than 7% of workers participated in training in La Rioja in 2001 and in Baleares and Castilla-y-León in 2002. While Madrid and Murcia in 2001 and Castilla-La Mancha in 2002 reach values above 20%.[132] These percentages are quite similar in 2001 and 2002. However it is possible that in some regions the hours of subsidized training are concentrated in few participants, while other regions distribute them. Again we observe a considerable variation in the hours of subsidized training per

[132] Firms in regions considered "Objective 1" and "Objective 3" were awarded an additional 10% and 5% respectively on the maximum quantity of subsidy they could receive. In 2001 and 2002, regions "Objective 1" comprised Andalucía, Asturias, Canarias, Castilla-La Mancha, Castilla-y-León, Extremadura, Galicia, Murcia and Comunidad Valenciana and regions "Objective 3", Aragon, Baleares, Catalunya, Madrid, La Rioja, Navarra and País Vasco.

participant across regions: ranging from less than 23.5 hours per participant in Murcia to around 40 in País Vasco, Castilla-La Mancha in 2001 and Andalucía in 2002. The last column in the two sets of columns shows the average hours worked per affiliated worker in the social security system. The average number of effective hours worked in the Spanish manufacturing firms is more than 1722 hours per worker and year.

Table 6.2. Hours of subsidized training and worked hours by region in the manufacturing sector

	2001					2002				
	Participants in subsidized TR	Affiliated workers	% Particip	Subsidized hours TR per participant	Hours worked	Participants in subsidized TR	Affiliated workers	% Particip	Subsidized hours TR per participant	Hours worked
Andalucía	39113.50	213128	18.35	34.20	1697.66	32638.60	215196	15.17	39.61	1705.13
Aragón	12312.24	96921	12.70	31.13	1729.58	12324.56	96796	12.73	32.15	1723.80
Asturias	8343.99	57747	14.45	32.39	1642.07	9803.77	57227	17.13	30.37	1638.75
Baleares	2412.32	25235	9.56	29.10	1730.79	1694.76	24992	6.78	27.81	1706.10
Canarias	5345.45	37859	14.12	24.68	1752.24	4572.51	38116	12.00	27.95	1742.01
Cantabria	3777.46	31453	12.01	38.55	1732.06	4802.99	31576	15.21	33.00	1717.93
Castilla-LaMancha	19536.77	98412	19.85	40.84	1751.08	20765.49	99118	20.95	36.80	1754.58
Castilla-y-León	10035.99	129384	7.76	33.02	1723.10	8420.56	131509	6.40	33.97	1730.08
Catalunya	72079.47	582586	12.37	32.73	1726.19	73620.10	575475	12.79	32.75	1715.67
Com. Valenciana	31099.61	309352	10.05	27.52	1742.26	28194.86	309602	9.11	26.95	1738.18
Extremadura	2482.15	24949	9.95	34.78	1726.13	2648.99	24532	10.80	34.17	1701.63
Galicia	13130.96	140674	9.33	33.56	1740.69	13985.29	143390	9.75	30.77	1727.91
Madrid	58690.50	260025	22.57	34.24	1740.54	52288.42	258159	20.25	32.69	1734.61
Murcia	14717.79	67156	21.92	21.76	1716.88	12454.32	68736	18.12	23.45	1719.64
Navarra	11108.19	61296	18.12	34.44	1715.66	8682.15	62233	13.95	32.10	1698.02
País Vasco	15621.45	194197	8.04	39.59	1668.63	13921.83	194542	7.16	39.69	1652.42
La Rioja	1837.43	26950	6.82	38.79	1722.99	2489.84	27297	9.12	34.91	1717.75
All regions	321645.27	2357324	13.64	32.99	1722.34	303309.04	2358496	12.86	32.91	1716.05

Table 6.3 describes the same variables as in Table 6.2 by firm size. First of all we observe that as firm size increases, the number of participants also increases. However, these figures should be considered in relation to the number of affiliated workers by size strata. The percentage of participants over affiliated workers across different size strata shows a very clear pattern: workers in smaller firms participate less in subsidized training. Actually, only 4% of workers in firms with up to 10 employees participate in subsidized training. Around 7% of employees do in firms with 11 to 50 employees and 12%, in firms with 51 to 250 employees. These percentages increase slightly for large firms between 250 and 500 employees. Finally, 40% of the workers in firms above 500 employees participate in training, which is considerably higher than for firms below this threshold. As for the hours of subsidized training per participant, another interesting result is that the participants in smaller firms receive more hours of

training than in large firms: ranging from between 36 to 46 hours in firms with less than 50 employees to around 30 hours in firms above this threshold. Actually SMEs are considered a priority for training policies as they face more difficulties of access to training. For this reason, SMEs[133] are awarded an additional 10% on the maximum amount of the subsidy.

Table 6.3. Hours of subsidized training and worked hours by size strata in the manufacturing sector

	2001					2002				
	Participants in subsidized TR	Affiliated workers	% Particip	Subsidized hours TR per participant	Hours worked	Participants in subsidized TR	Affiliated workers	% Particip	Subsidized hours TR per participant	Hours worked
1 to 10	19619.47	448701	4.37	39.46	1697.24	17622.83	444035	3.97	46.85	1696.93
11 to 50	57284.73	740902	7.73	36.40	1743.01	53453.50	740845	7.22	38.73	1733.99
51 to 250	79513.04	633323	12.55	31.65	1738.28	74934.54	641656	11.68	30.54	1730.64
251 to 500	37568.90	234233	16.04	31.04	1710.83	39613.35	229442	17.27	29.70	1708.00
More than 500	127659.13	300165	42.53	31.88	1684.21	117684.82	302518	38.90	30.76	1675.34
All size strata	321645.27	2357324	13.64	32.99	1722.34	303309.04	2358496	12.86	32.91	1716.05

Table A6.1 in Appendix 6.2 shows the percentage of hours of subsidized training over worked hours (*SUBS*) by region and size strata calculated as explained in expression (6.2) and using data summarized in Tables 6.2 and 6.3. Basically, the hours of subsidized training (*HTR*) is the subsidized hours of training per participant multiplied by the number of participants in subsidized training; the worked hours (*HWK*) is the hours worked per worker multiplied by the number of affiliated workers. Figure 6.1 shows graphically the values in Table A6.1. The variable *SUBS* is represented on the vertical axis and the regions, on the horizontal axis. Each colour represents a different size stratum.

Castilla-La Mancha[134] shows the highest percentages of hours of subsidized training over worked hours (11.6% in 2001 and 9% in 2002) and it is mainly due to firms above 500 employees. The second region with high *SUBS* is Extremadura, although at far distance from Castilla-La Mancha (2.6% and 4.3% respectively). Again this is mainly due to the subsidized training provided by large firms. Firms in Andalucía

[133] According to the recommendation of the European Commission 96/280/CE on the 3rd of April 1996, SMEs are those that fulfil these criteria: having less than 250 employees, having a General Balance sheet of less than 40 million euros or a turnover of less than 27 million euros and fulfilling the independence criteria (having less than 25% of their capital owed by another company).

[134] The region Castilla-La Mancha is not represented in these graphics as it shows large values for the firms above 500 employees (between 8% and 10.7%, see Table A6.1), and it does not permit appreciating the effect in the other regions. In 2001, these values correspond to the subsidized training of only 6 large firms.

and Madrid receive training subsidies equivalent to more than 2% hours of subsidized training over worked hours, and the same happens with Navarra in 2001 and La Rioja in 2002. For the remaining regions the percentage of hours of subsidized training takes values between 0.6% and 2%. Canarias and Castilla-León show the lowest percentages, with values of around 0.6-0.7%.

Distinguishing by size strata, we obtain that in every region, firms with more than 500 employees show the highest percentages of hours of subsidized training over worked hours. This result is obtained for all the regions.[135] On average, firms with more than 500 employees receive subsidies equivalent to more than 1.16% of training hours over worked hours. Interestingly, this percentage dramatically decreases as we move to firms with 250 to 500 employees (around 0.3%), reaching values close to 0.1% for firms with 1 to 10 employees. The general picture is that the percentage of hours of subsidized training over worked hours increases with firm size for almost all regions and size strata in 2001 and 2002. Notice that a considerable dispersion among firms with more than 500 employees across regions is observed, maybe due to the fact that there are a few observations and they are very heterogeneous.

[135] The only exception is Canarias, which did not have any manufacturing firm with more than 500 employees in 2001 and 2002.

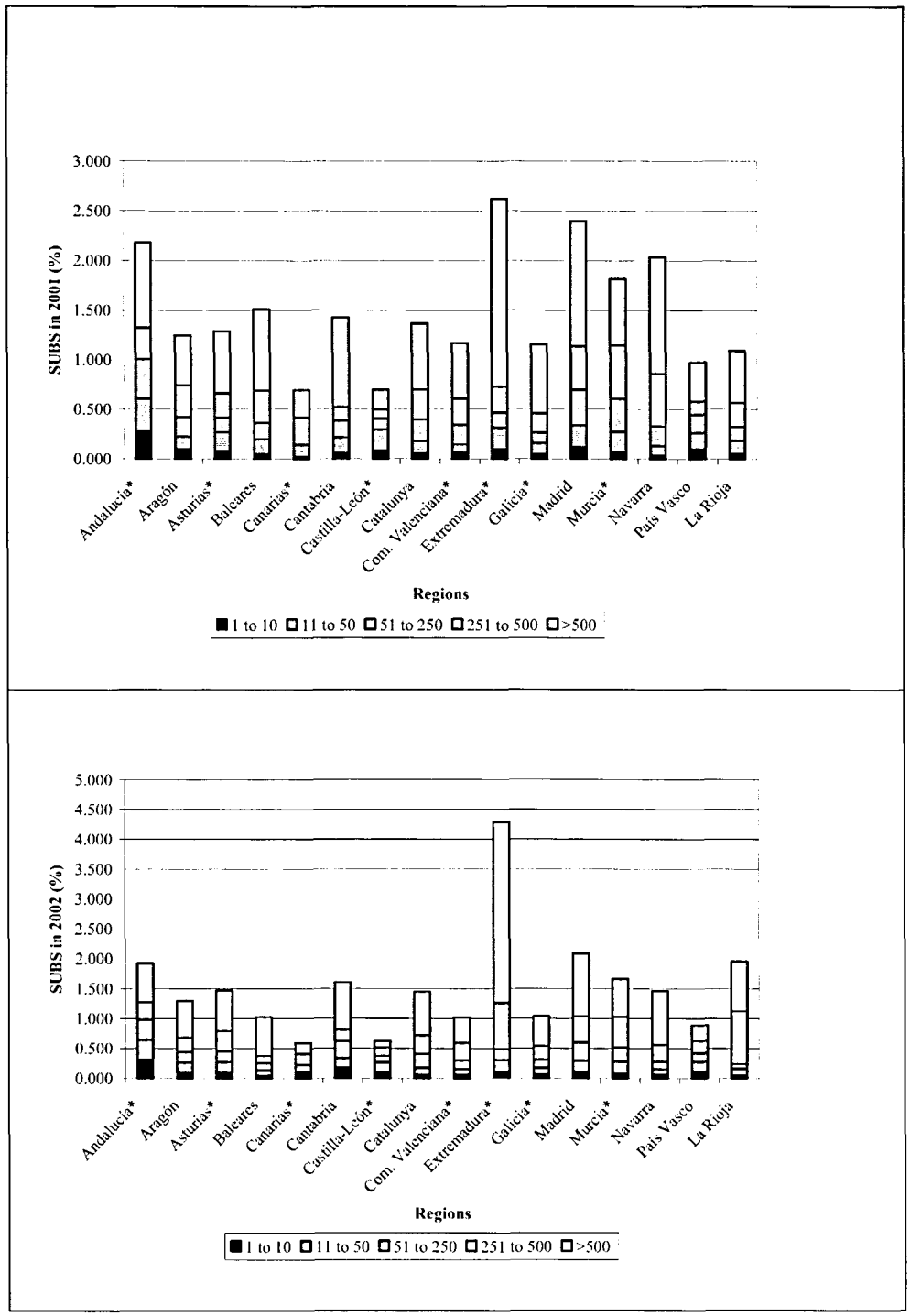

Figure 6.1. Percentage of hours of subsidized training over worked hours by region and size strata

Note: (*) reflects regions Objective 1, the remaining are regions Objective 3

6.5. Results

6.5.1. The effects of subsidies in Spanish manufacturing firms

In this Section we offer the results of the estimation of the effect of subsidies on the provision of training. Using the same strategy as in Chapter 5, we depart from the estimation of the more general heckit model, which encompasses the two-part model, and consider which of them could be more appropriate to estimate the impact of subsidies on training. As explained in Section 5.3, fixed costs of training could hide a latent training provision, causing a sample selection bias in the coefficients of the quantity equation. However, if sample selection does not exist, the two-part model can be considered more appropriate. Given our specification without exclusion restrictions in the quantity equation, the coefficient of the inverse Mills' ratio is not statistically different from zero.[136] For most variables in our empirical specification, we obtain that the EMSE for the two-part model is smaller than the EMSE for the heckit model, suggesting that the former is more appropriate.[137] Therefore, as in Section 5.5.1, the two-part model seems to be preferred over the *heckit* model to estimate the impact of the subsidy on firms' training provision.[138]

Additionally, it is possible that the presence of unobserved firm-specific effects could be biasing the results of the estimation. Using the same strategy as in Chapter 5, we estimate a two-part model including random effects to control for this heterogeneity: the participation equation is estimated by means of a random effects probit model; as for the quantity equation, we estimate a standard regression model including random effects by GLS. The firm random effects appear to be clearly significant: the tests show

[136] The condition number for the covariates is 27.4 and after including the inverse Mills' ratio it takes a value of 37.4. Although the condition number including the inverse Mills' ratio takes a value above 30, the increase when including this regressor is very small, for which we do not consider that multicollinearity problems are severe and we on the t-test on the inverse Mills' ratio.

[137] Table A6.3 in Appendix 6.3 shows the results for the EMSE test to compare heckit and the two-part models. The exceptions to the general result that the two-part model is preferred are the variables on the percentage of temporary workers and most of the regional dummies, for which the heckit obtains lower EMSE. Results are similar under the assumptions that the two-part model and the "*heckit*" are the "true models". Similar results are obtained when applying the empirical EMSE test for the small and large firms' subsamples.

[138] Table A6.2 in Appendix 6.3 shows the results of estimation of the heckit and two-part models and they are close to the results in Table 5.5 columns (b), where a similar specification was estimated although without including the effect of subsidies. Under the two models, subsidies do not show a significant effect on firms' decision to provide training and on the quantity of it.

that the panel estimator is preferred over the pooled data estimator.[139] Therefore, here we estimate the same specification as in Section 5.5.2 but expanded to include subsidies.

Table 6.4 shows the results of the estimation of the two-part model with firm random effects. The first column in this Table offers the marginal effects of the random effects probit model used to estimate the participation equation. Increasing the percentage of hours of subsidized training one point, increases the probability of firms providing training by 0.024, however this effect is not statistically different from zero. The second column in this Table shows the coefficients of the random effects estimation of the quantity equation. A one point increase in the percentage of hours of subsidized training increases firms' expenditure on training by 5.6%, even though this coefficient associated is not statistically different from zero. Therefore, after taking firm-specific effects into account, the effects of the variable on subsidies remains non significant for both firms' probability of providing training and the expenditure on it. From these results, we cannot exclude that the effect of subsidies is null, positive or negative as the three possibilities are within the 95% confidence interval of the estimated parameter, given its high standard error. According with the framework suggested in Section 6.3, it is not possible to state whether the subsidies stimulated the privately financed training (spillover effect) or there was a displacement of private resources to other areas of the firm (crowding-out effect). Our main result is that we do not observe a clear positive effect of publicly financed training on firms' provision of training for the total sample of Spanish manufacturing firms in 2001 and 2002.

As for the other determinants of training in the participation equation, almost all the variables have the expected sign and a significant impact. The exceptions are the percentage of temporary workers, the use of the productive capacity and being part of a group of firms. With respect to the quantity equation, having more white collars, innovating, being participated by foreign capital and having less temporary workers' significantly increase firms' expenditure on training. The industry and regional dummies are also jointly significant in the two equations. These results are similar to

[139] As for the participation equation, the likelihood-ratio test rejects the null that the panel-level variance component is equal to zero at 1%; regarding the quantity equation, the Breusch and Pagan Lagrange-multiplier test also rejects the null hypothesis at 1%.

those in Table 5.7, where we estimated a similar specification but without including the variable on subsidies.

Table 6.4. Estimation of the two-part model with firm-specific effects

	Participation Eq		Quantity Eq
	Mg eff	Coeff	Coeff
Subsidy	0.0243	0.0752	0.0566
	(0.0361)	(0.1118)	(0.051)
Controls:			
Size	0.1991***	0.6169***	-0.0432
	(0.0217)	(0.0697)	(0.0494)
White collars	0.0088***	0.0275***	0.0196***
	(0.0017)	(0.0052)	(0.0038)
Adv technology -medium	0.2431***	0.7047***	0.048
	(0.0518)	(0.1469)	(0.1122)
Adv technology -high	0.2772***	0.7619***	0.1548
	(0.0793)	(0.2071)	(0.1395)
Innovation	0.1935***	0.585***	0.1437*
	(0.0365)	(0.1077)	(0.0797)
International market	0.1846***	0.544***	0.0986
	(0.0449)	(0.1282)	(0.0904)
Foreign capital	0.0014**	0.0043**	0.0023**
	(0.0006)	(0.0018)	(0.0011)
Temporary workers	-0.0001	-0.0002	-0.0065*
	(0.0010)	(0.003)	(0.0034)
Productive capacity	-0.0013	-0.004	-0.002
	(0.0013)	(0.0041)	(0.0031)
Group	0.0676	0.2059	0.1105
	(0.0571)	(0.1715)	(0.1234)
Year	-0.0467*	-0.1447*	-0.2167***
	(0.0246)	(0.0761)	(0.0508)
Sector dummies	Yes	Yes	Yes
Regional dummies	Yes	Yes	Yes
Random effects	Yes	Yes	Yes
constant		-4.0583***	2.9495***
		(0.9034)	(0.8889)
No obs	3020		1222
No firms	1538		734
pseudolnL	-1223.35		-
H0: Sector=0	31.10**		39.29***
H0: Region=0	41.95***		21.02
H0: RE=0	229.13***		68.16***

Note: standard deviation in parentheses; (***) (**) and (*) denote significant at 1%, 5% and 10%.

6.5.2. The effect of subsidies in small and large manufacturing firms

The purpose of this Section is analysing whether the effect of subsidies is different in small and large firms. This question intends to shed light on whether the policies

focused on improving small firms' access to training had a positive impact for the case of Spanish manufacturing firms. In Appendix 6.1, we summarize the specific design of subsidies under the III ANFC, which placed special interest in improving training in SMEs. Following the strategy in the previous Section, we estimate a two-part model including firm-specific effects for the small and large firms' subsamples.

Table 6.5. Estimation of the two-part model with firm-specific effects by firm size

	Small firms			Large firms		
	Participation Eq		**Quantity Eq**	**Participation Eq**		**Quantity Eq**
	Mg Eff	Coeff	Coeff	Mg Eff	Coeff	Coeff
Subsidy	-0.0948	-1.0028	-0.1927	0.0250	0.1373	0.0404
	(0.1745)	(1.8513	(1.6612)	(0.0772)	(0.1157)	(0.0521)
Controls:						
Size	0.0694***	0.7338***	-0.2285*	0.0589	0.3238**	0.0171
	(0.0165)	(0.137)	(0.1217)	(0.1773)	(0.1574)	(0.0843)
White collars	0.0036***	0.0376***	0.0196***	0.0011	0.0062	0.0178***
	(0.0009)	(0.0069)	(0.0048)	(0.0037)	(0.0082)	(0.0059)
Adv technology -medium	0.1093***	0.8139***	-0.0134	0.0815	0.4734**	0.1965
	(0.0353)	(0.1933)	(0.1537)	(0.2499)	(0.2351)	(0.1723)
Adv technology -high	0.1359*	0.8178***	0.1413	0.0967	0.6045**	0.238
	(0.0806)	(0.326)	(0.249)	(0.3053)	(0.2681)	(0.1831)
Innovation	0.0733***	0.6269***	0.0564	0.1056	0.538***	0.2268**
	(0.0238)	(0.1409)	(0.1285)	(0.2946)	(0.1692)	(0.0972)
International market	0.0456*	0.3979**	0.2679*	0.1220	0.6406***	0.0525
	(0.0254)	(0.1778)	(0.155)	(0.3439)	(0.1875)	(0.1123)
Foreign capital	0.0007**	0.0075**	0.0047**	0.0005	0.0028	0.0014
	(0.0003)	(0.0032)	(0.0022)	(0.0016)	(0.0021)	(0.0013)
Temporary workers	0.0001	0.0006	-0.002	-0.0005	-0.0027	-0.0155***
	(0.0003)	(0.0036)	(0.0042)	(0.0019)	(0.0062)	(0.0053)
Productive capacity	-0.0002	-0.0023	-0.0016	-0.0010	-0.0054	-0.0035
	(0.0005)	(0.0051)	(0.0043)	(0.0032)	(0.0075)	(0.0042)
Group	0.0143	0.1404	0.0316	0.0052	0.0281	0.1895
	(0.0269)	(0.2446)	(0.1923)	(0.0479)	(0.2449)	(0.1682)
Year	-0.0051	-0.0544	-0.1982**	-0.0555	-0.306**	-0.2161***
	(0.1658)	(0.0996)	(0.0995)	(0.0246)	(0.1265)	(0.0588)
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes
Random effects	Yes	Yes	Yes	Yes	Yes	Yes
constant		-5.0407***	4.367***		5.966	4.8168***
		(1.1263)	(0.99)		(5.7461)	(0.9637
No obs	2086		520	934		702
No firms	1068		335	493		409
pseudolnL	-777.3809		-	-420.8297		-
H0: Sector=0	25.71		40.56***	15.3		46.86***
H0: Region=0	30.12***		16.81	14.67		30.26***
H0: RE=0	165.26***		15.69***	46.77***		42.27***

Note: standard deviation in parentheses; (***) (**) and (*) denote significant at 1%, 5% and 10%.

Table 6.5 displays the results of the estimation for the two-part model with random effects for small and large firms' subsamples. The first set of columns shows the results of the estimation of the participation and quantity equations for small firms and the second set of columns, for large firms.

As in case of the total sample, the panel-level variance component is not unimportant and the panel estimator is preferred over the pooled estimator. Regarding small firms, the effect of the percentage of hours of subsidized training over worked hours on firms' provision of training is negative and quite large in magnitude, although it is not significant. Increasing the percentage of hours of subsidized training one point, decreases the probability of small firms providing training by 0.095 and the expenditure on training by almost 20%. As in the case of the total sample, the standard errors are very high and so it is not possible to assess whether the effect of subsidies has been positive, null or negative. As regards to large firms, the subsidies seem to have a positive impact on firms' provision of training although the effects are not statistically different from zero: increasing the percentage of hours of subsidized training one point, increases the probability of large firms providing training 0.025 and the expenditure on training by 4%. Again, notice that the standard errors are quite large and it's not possible to exclude that the effect of subsidies in large firms is null, positive or negative. As in the case of the total sample, our main result is that there is not a clear positive significant effect of subsidies on training neither for small nor for large firms.

With respect to the remaining variables, results are similar to those in Table 5.7, where we estimated similar specifications for the two subsamples but without including the variable on the subsidies.

6.6. Conclusions

The III ANFC established a system of subsidies to impulse in-company continuous training in Spain. This agreement regulated the financial aid from the Spanish government to stimulate firms' training provision during our period of analysis, 2001 and 2002. In this Chapter, we estimate the impact that these subsidies had on the provision of training for a sample of Spanish manufacturing firms. Only a few studies have analysed this question for other countries and the evidence is not compelling that subsidies increase the firm provided training.

Using data from the ESEE as well as official data on training subsidies, we estimate a two-part model, which permits considering the decision on the provision of training as a double-decision process: firms first decide whether to invest in training or not, and second, the quantity they will spend, if they do. Following the strategy in Chapter 5, for the first decision, we estimate a random effects probit model and, for the second one, a standard regression model including random effects. We use the percentage of subsidized hours of training over the hours worked by region and size strata as a proxy of the variable on subsidies received by the firm. Subsidies may have a direct and an indirect effect on training: the direct effect increases the total training provision, while holding the company-financed training constant; the indirect effect can stimulate or displace the privately financed training, originating a spillover or crowding-out effect, respectively.

We find a positive although non-significant effect of subsidies on training for Spanish manufacturing firms in 2001 and 2002 for both the participation and the quantity equation. Therefore, we cannot state that publicly financed training has had the *a priori* expected positive effect on firms' provision of training. Thus it is not possible to state whether the subsidies stimulated the privately financed training (spillover effect) or there was a displacement of private resources to other areas of the firm (crowding-out effect).

A previous descriptive analysis shows that larger firms receive more hours of subsidized training over worked hours and this result is obtained across all the regions. Given that the III ANFC placed special interest in improving training in SMEs, we estimate our empirical model for the small and large firms' subsamples. For both the participation and the quantity equations, we obtain a negative effect of subsidies on training in the case of small firms and a positive effect in the case of large firms, although these effects are not statistically different from zero.

We argue that the absence of a clear positive effect of subsidies on training might be related to the design of the system of subsidies.[140] During our period of analysis, firms received a provisional subsidy when they started the training programs,

[140] Rigby (2004) comments possible failures associated with the Spanish continuous training system. For instance, the lack of accreditation of continuous training in Spain, the management of the continuous training subsidies system by the social partners and the irregularities found in the financial management. Crespo and Sanz (2000) discuss different modalities of government interventions suggested in the literature to increase firms' effort on training.

but they did not know whether they would get a subsidy and the exact amount of it until they finished training. Thus, it is possible that firms decided to provide training regardless of the subsidy as they were uncertain about whether they were going to receive it or not and the exact amount. Although the III ANFC contemplated a system of private co-financing of training, the subsidy does not seem to have had a clear effective impact on firms' providing training. Since 2004, a new design of subsidies based on a credit proportional to their vocational training levy in the previous year was implemented. The new system was designed in order to reduce bureaucracy and make training aid more accessible to firms, especially SMEs. With the new system firms know beforehand the quantity of subsidy that they will receive and they are able to plan their training activities. Further research should focus on whether the new design of the subsidies has a positive impact on training.

Appendix 6.1. Particularities of the third National Agreement on Continuous Training

The National Subsystem of Continuous Training is part of the National System of Vocational Training, and in the period 1/1/2001-31/12/2003 it was regulated by the III ANFC, signed on December 2000. Although in the present study we consider only subsidies provided by the National Subsystem of Continuous Training, firms can choose whether to develop training actions through subsidies from other institutions.

The Tripartite Foundation for Employment Training depends on the Ministry of Labour and Social Affaires and is the national entity responsible for management, execution, support and coordination of public policies aimed at improving continuous training in Spain. This entity is integrated by firms' organizations (CEOE and CEPYME), trade unions (CC.OO. and UGT, CYG) and the Spanish administration.

The III ANFC comprised a system of subsidies for different continuous training measures: firm training plans, grouped training plans, specific training plans for the social economy, inter-sector training plans, complementary activities related to training and individual training permits. In this study we have only considered the two first measures, defined as explained below.

Firms could be awarded subsidies for their continuous training actions provided to those workers that paid the vocational training levy (0.7% of their payroll). Workers that did not have the obligation to pay for it could also have access to training in the terms described below.

Procedure to apply for a subsidy under the III ANFC:

1) The subsidies can awarded for training actions that take place since the 1st of January on every year.
2) Firms elaborate a training plan and apply for a subsidy on the basis of the estimated costs (with a maximum intensity) at the Tripartite Foundation before 31/07/2001 (call 2001) and 31/07/2002 (call 2002).
3) The sector and territory joint commission (or in case they do not exist, the national joint commission), evaluate the training plan and produce a report.
4) The Tripartite Foundation decides whether to award the subsidy and the quantity.

5) If the subsidy is awarded, the INEM (National Institute of Employment) sends an advanced payment for the total subsidy awarded, at least within 6 months since the call was closed or before 31/12/01 (call 2001) and 31/12/02 (call 2002).
6) Before training starts, firms have to communicate it to the Tripartite Foundation so that they can supervise it. In any case, they have to execute the training plan before 31/04/02 (call 2001) and 31/04/2003 (call 2002)
7) After the training actions for which they got an advanced payment take place, firms have to justify it.
8) Finally, the Tripartite Foundation determines the final subsidy settlement according to the firm justification of the effective costs and hours of training. When the final subsidy settlement is smaller than the advanced payment, the firm has to make a refund for the difference.

Firms elaborated a training plan and applied for a subsidy according to the following continuous training measures:

- Firm Training Plans (FTP):
  - Firms or groups of firms ('group' defined as those firms with common balance sheet or common effective management or filial companies under a common first firm) with at least 100 workers (12 months before the current call took effect) and their own training plan (maximum one FTP per firm).
  - Firms that justify that they cannot train in a GTP because of geographical reasons or specificity of their TR activity, can also apply for a FTP (with a minimum duration of 300 hours or a minimum participation of 50% of the workers).
  - Workers from other commercially related firms can also participate in a FTP by other firm (maximum 15% of participants).
- Grouped Training Plans (GTP):
  - At least two firms in the same sector with similar training necessities (firm organizations or trade unions at industry or territorial level, firms representative of other firms in the same sector could apply to a GTP) with at least 40 workers in total and a maximum of three GTP per firm (counting also other plans, not only GTP).

Origin of funds for continuous training:

- National: firms and employees pay together an accident and health insurance contribution to the social security system calculated on the basis of their payroll. Some collectives of workers have the obligation to pay the vocational training levy, which is calculated as the 0.7% of their payroll (workers pay 0.1 and firms 0.6). This is a fixed percentage to be divided between two types of training: 0.35% for occupational and 0.35% for continuing training (the government can vary the percentages from year to year). Since 2001, some collectives of workers that do not have the obligation to pay the vocational training levy (including those that contribute to the social security system under the agriculture regime, autonomous regime, permanent discontinuous workers, part time workers with a permanent contract for discontinuous periods during their periods of non-occupation, workers that get unemployed during their training activities or workers under a dismissal) may have access to subsidized training as well and this is funded by the vocational training allocation and an allocation from the INEM budget.
- European: the European Social Fund will co-finance training plans that involve collectives of workers that have greater difficulty in accessing training. The quantity of economic resources will depend on the region where the firm is established ("Objective 1" and "Objective 3" regions in 2001 and 2002): Workers in SMEs, women, disabled, older than 45 years-old, low qualified workers an workers that contribute to the social security system under the autonomous and agriculture regimes.

Summary of determinants of the quantity of the subsidy awarded:

- Technical evaluation
- Estimated cost (with a maximum intensity of aid)
- Private co-financing
- Quantity demanded
- Resources available
- Maximum hours of subsidized training 100 hours per worker.
- Maximum subsidy in FTP is 0.35% of the continuous training levy paid by the firm or the total cost of the training plan (so that firms co-finance).

	Normal Procedure 2001	Simplified Procedure 2001	2002
Technical evaluation	- General priority criteria (30%): *workers in SMEs, women, disabled, >46 years, low qualified, actions related to TIC & Environment.*		- Regarding the plan & its training actions (60%): *Objectives; content (TIC); facilities & materials; mechanisms of evaluation of the learning process; certification of training actions;*
	- Coherence & quality criteria (30%)		
	- Priority criteria according to the industrial & territorial joint commissions (40%)		
	- Reductions according to the degree of fulfilment of the training plans by the firm in the last call (-10%)		
Estimated cost (euros/hour/ trainee)	- In-classroom setting: basic level/general training (GT): 7.20; medium level/specific training (ST): 8.40; high level/specific training (ST): 15.00 *(With incremental percentages: Specialized facilities OR technical equipment/material: +10%; Specialized facilities & technical equipment/material: +20%; Difficulty in hiring trainers: +5%).*		
	- On-line: 4.80. *(With incremental percentages: Specialized didactic material +10%; Tutors +10%; Information technologies +40%)*		
Maximum intensity on (A)	- SMEs: GT (70%); ST (35%) - Non-SMEs (or mix): GT (50%); ST (25%); *(with incremental percentages: "Objective 3" regions: +5%; "Objective 1" regions: +10%; Workers with difficult access to training +10%)*	No maximum	
Private co-financing on (A) (simplified)	No minimum required	- SMEs GT (30%); ST (65%); - Non-SMEs (or mix): GT (50%); ST (75%);	- "Objective 1" regions: SMEs: GT (20%); ST (55%); non-SMEs: GT (40%); ST (65%). - "Objective 3" regions: SMEs: GT (30%); ST (65%); non-SMEs: GT (60%); ST (75%);

Source: Own elaboration

(A) Costs that can be included for calculating maximum intensity and private co-financing:

- Direct costs of the training activity: rewarding of trainers, amortization of didactic equipments, didactic materials, rent, participants accident insurance, transport, maintenance and accommodation.
- Costs associated to the training activity (max 25% costs): assistance staff, publicity expenditure in GTP, electricity, water and heating expenses.
- Personnel costs of the participants in the training plan: these costs are computed as the hours of training, excluding productive hours.

Laws regulating the continuous training subsidy in 2001 and 2002:

- Resolución de 1 de febrero de 2001, de la Subsecretaría de Trabajo y Asuntos Sociales, por la que se da publicidad al III Acuerdo Tripartito sobre Formación Continua.
- Resolución de 2 de febrero de 2001, de la Dirección General de Trabajo, por la que se dispone la inscripción en el Registro y publicación del III Acuerdo Nacional de Formación Continua suscrito el día 19 de diciembre de 2000.
- Orden de 26 de junio de 2001 por el que se establecen las bases reguladoras para la concesión de ayudas de formación continua con cargo a la financiación prevista en el III Acuerdo Tripartito de Formación Continua.
- Resolución de 2 de julio de 2001, de la Dirección General del Instituto Nacional de Empleo, por la que se aprueba la convocatoria de ayudas para planes de formación continúa de demanda correspondiente al ejercicio 2001.
- Resolución de 13 de junio de 2002, de la Dirección General del Instituto Nacional de Empleo, por la que se aprueba la convocatoria de ayudas para planes de formación continua de demanda correspondiente al ejercicio 2002.
- Reglamento (CE) no 68/2001 de la Comisión de 12 de enero de 2001 relativo a la aplicación de los artículos 87 y 88 del Tratado CE a las ayudas a la formación.

Appendix 6.2. Construction of the percentage of hours of subsidized training

Table A6.1. Percentage of hours of subsidized training over total worked hours by region and firm size

	2001						2002					
	1 to 10	>10 to 50	>50 to 250	>250 to 500	>500	All size strata	1 to 10	>10 to 50	>50 to 250	>250 to 500	>500	All size strata
Andalucía	0.282	0.326	0.401	0.312	0.861	2.182	0.307	0.336	0.335	0.292	0.652	1.922
Aragón	0.096	0.129	0.197	0.322	0.501	1.245	0.094	0.165	0.18	0.243	0.612	1.294
Asturias	0.08	0.188	0.15	0.243	0.628	1.289	0.094	0.177	0.187	0.335	0.674	1.467
Baleares	0.049	0.152	0.163	0.329	0.817	1.51	0.039	0.095	0.121	0.12	0.647	1.022
Canarias	0.022	0.12	0.273	0.278	0	0.693	0.099	0.13	0.18	0.184	0	0.593
Cantabria	0.058	0.159	0.166	0.136	0.907	1.426	0.177	0.159	0.284	0.191	0.795	1.606
Cast-LaMancha	0.123	0.187	0.238	0.297	10.739	11.584	0.128	0.202	0.235	0.28	7.96	8.805
Castilla-León	0.078	0.216	0.11	0.092	0.201	0.697	0.093	0.173	0.111	0.14	0.103	0.62
Catalunya	0.057	0.122	0.222	0.299	0.667	1.367	0.053	0.124	0.234	0.31	0.723	1.444
Com. Valenciana	0.06	0.088	0.196	0.266	0.559	1.169	0.062	0.089	0.151	0.29	0.422	1.014
Extremadura	0.095	0.221	0.151	0.263	1.894	2.624	0.112	0.193	0.188	0.764	3.028	4.285
Galicia	0.049	0.11	0.105	0.193	0.701	1.158	0.061	0.118	0.132	0.231	0.499	1.041
Madrid	0.118	0.219	0.36	0.439	1.264	2.4	0.101	0.19	0.308	0.437	1.052	2.088
Murcia	0.07	0.202	0.335	0.539	0.667	1.813	0.079	0.198	0.24	0.511	0.634	1.662
Navarra	0.041	0.092	0.197	0.532	1.178	2.04	0.061	0.092	0.125	0.284	0.897	1.459
País Vasco	0.101	0.159	0.188	0.132	0.396	0.976	0.105	0.176	0.14	0.205	0.265	0.891
La Rioja	0.053	0.131	0.138	0.244	0.525	1.091	0.043	0.113	0.089	0.879	0.825	1.949
All regions	0.084	0.166	0.211	0.289	1.324		0.100	0.161	0.191	0.335	1.164	

Appendix 6.3. Estimation of the two-part and heckit models. Complementary results

Table A6.2. Estimation of the two-part and heckit models without firm-specific effects

	Participation Eq		Quantity Eq	
			Heckit	Two-part
	Mg eff	Coeff	Coeff	Coeff
Subsidy	0.0291	0.0774	0.0728	0.0583
	(0.0224)	(0.0596)	(0.0591)	(0.0438)
Controls:				
Size	0.1282***	0.3412***	0.0632	-0.034
	(0.011)	(0.0294)	(0.0742)	(0.0404)
White collars	0.0053***	0.0142***	0.0234*	0.0198***
	(0.0009)	(0.0024)	(0.004)	(0.0033)
Adv technologies -medium	0.1339***	0.3501***	0.1138	0.0004
	(0.0251)	(0.0651)	(0.1155)	(0.0898)
Adv technologies -high	0.1488***	0.3833***	0.2166*	0.1139
	(0.0367)	(0.0929)	(0.1261)	(0.1095)
Innovation	0.1677***	0.4436***	0.3161***	0.1964***
	(0.0221)	(0.0585)	(0.1101)	(0.0807)
International market	0.1124***	0.2951***	0.1688*	0.0815
	(0.0244)	(0.0634)	(0.0978)	(0.0819)
Foreign capital	0.001***	0.0027***	0.0029***	0.0023***
	(0.0003)	(0.0009)	(0.001)	(0.0009)
Temporary workers	-0.0002	-0.0005	-0.0064***	-0.0058*
	(0.0006)	(0.0015)	(0.0025)	(0.0031)
Productive capacity	-0.0012	-0.0032	-0.0009	-0.0001
	(0.0008)	(0.0021)	(0.003)	(0.0029)
Group	0.0356	0.0944	0.1568	0.119
	(0.0299)	(0.079)	(0.1028)	(0.0992)
Year	-0.0313	-0.0834	-0.2739***	-0.254***
	(0.0209)	(0.0555)	(0.0734)	(0.072)
Sector dummies	Yes	Yes	Yes	Yes
Regional dummies	Yes	Yes	Yes	Yes
constant		-2.023***	2.9494***	-4.0583***
		(0.4104)	(0.8889)	(0.9034)
No of obs	3020		1222	1222
No of firms	-		-	-
PseudoR	0.3435		-	0.1796
pseudolnL	-1337.92		-	-
rho	-		0.4172	-
sigma2	-		1.2807	-
sigma12	-		0.5343	-
			(0.3464)	
H0: Sector=0	48.58***		56.55***	3.11***
H0: Region=0	68.75***		30.67***	1.88**

Note: standard deviation in parentheses; (***) (**) and (*) denote significant at 1%, 5% and 10%.

Table A6.3. Empirical mean squared error test to choose between the heckit and the two-part model

	Total sample						**Small firms**						**Large firms**					
	Two-part is "true" model			***Heckit* is "true" model**			**Two-part is "true" model**						**Two-part is "true" model**			***Heckit* is "true" model**		
	emse Two-part	emse *Heckit*	choice	emse Two-part	emse *Heckit*	choice	emse Two-part	emse *Heckit*	choice	emse Two-part	emse *Heckit*	choice	emse Two-part	emse *Heckit*	choice	emse Two-part	emse *Heckit*	choice
Subsidy	1.92E-03	3.70E-03	2pm	1.92E-03	3.49E-03	2pm	2.70E+00	2.77E+00	2pm	2.70E+00	2.76E+00	2pm	2.40E-03	1.83E-02	2pm	2.65E-03	1.06E-02	2pm
Controls																		
Size	1.63E-03	1.50E-02	2pm	1.81E-03	5.51E-03	2pm	1.29E-02	1.04E-01	2pm	2.13E-02	5.13E-02	2pm	4.50E-03	3.03E-02	2pm	5.17E-03	1.65E-02	2pm
White collars	1.09E-05	2.85E-05	2pm	1.09E-05	1.56E-05	2pm	2.01E-05	2.29E-04	2pm	2.01E-05	1.13E-04	2pm	2.53E-05	3.42E-05	2pm	2.53E-05	3.34E-05	2pm
Advanced technology -medium	8.06E-03	2.62E-02	2pm	8.39E-03	1.33E-02	2pm	1.83E-02	1.25E-01	2pm	2.98E-02	6.48E-02	2pm	1.63E-02	7.80E-02	2pm	2.01E-02	4.31E-02	2pm
Advanced technology -high	1.20E-02	2.64E-02	2pm	1.22E-02	1.59E-02	2pm	4.32E-02	1.41E-01	2pm	5.29E-02	8.74E-02	2pm	1.89E-02	1.22E-01	2pm	2.95E-02	6.01E-02	2pm
Innovation	6.51E-03	2.65E-02	2pm	6.91E-03	1.21E-02	2pm	1.66E-02	1.66E-01	2pm	3.88E-02	8.06E-02	2pm	1.07E-02	1.35E-01	2pm	2.61E-02	5.55E-02	2pm
International market	6.71E-03	1.72E-02	2pm	6.82E-03	9.57E-03	2pm	2.11E-02	4.87E-02	2pm	2.18E-02	3.23E-02	2pm	1.09E-02	1.22E-01	2pm	2.32E-02	5.10E-02	2pm
Foreign capital	8.50E-07	1.47E-06	2pm	8.50E-07	1.08E-06	2pm	3.66E-06	1.28E-05	2pm	3.66E-06	7.85E-06	2pm	1.12E-06	5.08E-06	2pm	1.12E-06	3.09E-06	2pm
Temporary workers	9.42E-06	6.34E-06	h	9.42E-06	6.05E-06	h	1.52E-05	1.27E-05	h	1.52E-05	1.26E-05	h	2.29E-05	3.35E-05	2pm	2.29E-05	2.73E-05	2pm
Productive capacity	8.42E-06	9.66E-06	2pm	8.42E-06	8.96E-06	2pm	1.58E-05	2.56E-05	2pm	1.58E-05	2.21E-05	2pm	1.65E-05	3.73E-05	2pm	1.65E-05	3.28E-05	2pm
Group	9.84E-03	1.20E-02	2pm	9.84E-03	1.06E-02	2pm	2.78E-02	3.14E-02	2pm	2.79E-02	3.04E-02	2pm	1.74E-02	2.99E-02	2pm	1.75E-02	2.99E-02	2pm
Sector 1	1.45E-01	2.10E-01	2pm	1.49E-01	1.83E-01	2pm	3.36E-01	6.69E-01	2pm	4.47E-01	5.20E-01	2pm	2.73E-01	6.02E-01	2pm	3.81E-01	5.92E-01	2pm
Sector 2	9.69E-02	1.36E-01	2pm	9.84E-02	1.35E-01	2pm	2.20E-01	3.37E-01	2pm	2.34E-01	3.32E-01	2pm	1.45E-01	5.34E-01	2pm	2.96E-01	4.88E-01	2pm
Sector 3	1.45E-01	2.24E-01	2pm	1.51E-01	1.99E-01	2pm	4.45E-01	9.27E-01	2pm	6.77E-01	7.07E-01	2pm	1.71E-01	6.12E-01	2pm	3.65E-01	6.11E-01	2pm
Sector 4	9.85E-02	1.38E-01	2pm	1.00E-01	1.37E-01	2pm	2.24E-01	3.05E-01	2pm	2.30E-01	3.05E-01	2pm	1.63E-01	6.94E-01	2pm	4.44E-01	5.62E-01	2pm
Sector 5	1.35E-01	2.99E-01	2pm	1.62E-01	2.94E-01	2pm	2.40E-01	5.09E-01	2pm	3.12E-01	5.08E-01	2pm	1.62E-01	1.67E+00	2pm	2.43E+00	1.60E+00	h
Sector 6	1.60E-01	1.98E-01	2pm	1.61E-01	1.98E-01	2pm	2.91E-01	4.30E-01	2pm	3.10E-01	4.29E-01	2pm	2.40E-01	8.80E-01	2pm	6.50E-01	7.40E-01	2pm
Sector 7	1.05E-01	1.56E-01	2pm	1.07E-01	1.52E-01	2pm	2.80E-01	3.88E-01	2pm	2.92E-01	3.75E-01	2pm	1.47E-01	5.46E-01	2pm	3.06E-01	5.19E-01	2pm
Sector 8	1.04E-01	1.50E-01	2pm	1.06E-01	1.45E-01	2pm	2.59E-01	3.47E-01	2pm	2.67E-01	3.45E-01	2pm	1.44E-01	5.23E-01	2pm	2.88E-01	5.00E-01	2pm
Sector 9	8.29E-02	1.46E-01	2pm	8.69E-02	1.28E-01	2pm	2.08E-01	4.05E-01	2pm	2.46E-01	3.32E-01	2pm	1.24E-01	4.75E-01	2pm	2.47E-01	4.44E-01	2pm
Sector 10	9.28E-02	1.62E-01	2pm	9.76E-02	1.42E-01	2pm	2.02E-01	3.98E-01	2pm	2.41E-01	3.41E-01	2pm	1.47E-01	5.58E-01	2pm	3.16E-01	5.11E-01	2pm
Sector 11	1.24E-01	1.47E-01	2pm	1.25E-01	1.47E-01	2pm	4.81E-01	3.86E-01	h	4.90E-01	3.83E-01	h	1.72E-01	6.15E-01	2pm	3.68E-01	5.30E-01	2pm
Sector 12	1.00E-01	1.80E-01	2pm	1.07E-01	1.52E-01	2pm	2.84E-01	5.85E-01	2pm	3.74E-01	4.53E-01	2pm	1.51E-01	5.02E-01	2pm	2.74E-01	4.90E-01	2pm
Sector 13	9.15E-02	1.56E-01	2pm	9.57E-02	1.36E-01	2pm	2.06E-01	4.37E-01	2pm	2.60E-01	3.46E-01	2pm	1.52E-01	4.85E-01	2pm	2.63E-01	4.76E-01	2pm
Sector 14	8.58E-02	1.38E-01	2pm	8.85E-02	1.31E-01	2pm	1.92E-01	3.30E-01	2pm	2.11E-01	3.05E-01	2pm	1.34E-01	4.76E-01	2pm	2.51E-01	4.71E-01	2pm
Sector 16	9.04E-02	1.41E-01	2pm	9.29E-02	1.33E-01	2pm	1.98E-01	3.99E-01	2pm	2.39E-01	3.41E-01	2pm	1.55E-01	4.89E-01	2pm	2.66E-01	4.75E-01	2pm
Sector 17	9.42E-02	1.36E-01	2pm	9.59E-02	1.33E-01	2pm	2.36E-01	4.39E-01	2pm	2.77E-01	3.79E-01	2pm	1.44E-01	5.02E-01	2pm	2.72E-01	4.76E-01	2pm

Sector 18	1.29E-01	1.79E-01	2pm	1.32E-01	1.65E-01	2pm	2.93E-01	6.17E-01	2pm	3.98E-01	4.75E-01	2pm	1.91E-01	5.56E-01	2pm	3.24E-01	5.54E-01	2pm
Sector 19	1.12E-01	1.61E-01	2pm	1.15E-01	1.59E-01	2pm	3.41E-01	3.80E-01	2pm	3.42E-01	3.79E-01	2pm	1.51E-01	6.64E-01	2pm	4.15E-01	5.91E-01	2pm
Sector 20	1.85E-01	2.21E-01	2pm	1.86E-01	2.20E-01	2pm	2.95E-01	5.31E-01	2pm	3.51E-01	5.30E-01	2pm	2.50E-01	7.17E-01	2pm	4.68E-01	7.15E-01	2pm
Region 1	2.22E-01	2.76E-01	h	2.25E-01	2.07E-01	h	6.29E-01	7.89E-01	2pm	6.55E-01	5.87E-01	h	1.57E-01	3.21E+00	2pm	9.49E+00	1.67E+00	h
Region 2	1.98E-01	1.81E-01	h	1.99E-01	1.77E-01	h	4.63E-01	4.02E-01	h	4.67E-01	3.91E-01	h	1.16E-01	1.45E+00	2pm	1.90E+00	1.06E+00	h
Region 3	2.46E-01	2.22E-01	h	2.46E-01	1.98E-01	h	8.31E-01	7.32E-01	h	8.40E-01	5.66E-01	h	1.53E-01	1.78E+00	2pm	2.80E+00	1.18E+00	h
Region 45	2.73E-01	2.72E-01	h	2.73E-01	2.42E-01	h	4.46E-01	8.19E-01	2pm	5.85E-01	6.28E-01	2pm	3.01E-01	1.96E+00	2pm	3.04E+00	1.31E+00	h
Region 6	2.40E-01	2.81E-01	h	2.42E-01	2.35E-01	h	6.92E-01	5.79E-01	h	7.04E-01	5.71E-01	h	1.59E-01	3.55E+00	2pm	1.17E+01	1.78E+00	h
Region 7	2.39E-01	2.86E-01	h	2.41E-01	2.26E-01	h	5.47E-01	7.02E-01	2pm	5.71E-01	5.28E-01	h	1.58E-01	4.02E+00	2pm	1.51E+01	1.93E+00	h
Region 8	2.08E-01	1.69E-01	h	2.10E-01	1.66E-01	h	4.66E-01	3.11E-01	h	4.91E-01	3.11E-01	h	1.43E-01	1.81E+00	2pm	2.94E+00	1.16E+00	h
Region 9	1.82E-01	1.52E-01	h	1.83E-01	1.48E-01	h	3.88E-01	2.61E-01	h	4.04E-01	2.61E-01	h	8.92E-02	1.82E+00	2pm	3.10E+00	1.13E+00	h
Region 10	1.90E-01	2.08E-01	h	1.91E-01	1.73E-01	h	3.96E-01	5.04E-01	2pm	4.08E-01	3.78E-01	h	1.20E-01	2.13E+00	2pm	4.17E+00	1.26E+00	h
Region 11	3.09E-01	4.58E-01	2pm	3.31E-01	3.77E-01	2pm	8.31E-01	3.24E+00	2pm	6.65E+00	2.66E+00	h	2.64E-01	2.93E+00	2pm	7.36E+00	1.72E+00	h
Region 12	2.35E-01	2.01E-01	h	2.36E-01	1.79E-01	h	4.90E-01	3.39E-01	h	5.13E-01	3.30E-01	h	1.74E-01	3.06E+00	2pm	8.51E+00	1.56E+00	h
Region 13	1.87E-01	1.96E-01	h	1.87E-01	1.64E-01	h	4.38E-01	5.59E-01	2pm	4.53E-01	4.24E-01	h	1.05E-01	2.03E+00	2pm	3.80E+00	1.21E+00	h
Region 14	2.81E-01	2.86E-01	h	2.81E-01	2.31E-01	h	7.81E-01	1.20E+00	2pm	9.56E-01	8.27E-01	h	1.77E-01	2.63E+00	2pm	6.18E+00	1.46E+00	h
Region 15	1.97E-01	2.01E-01	h	1.97E-01	1.93E-01	h	5.24E-01	5.11E-01	h	5.24E-01	4.87E-01	h	1.07E-01	1.53E+00	2pm	2.13E+00	1.10E+00	h
Region 16	1.90E-01	1.78E-01	h	1.91E-01	1.65E-01	h	4.26E-01	3.65E-01	h	4.29E-01	3.30E-01	h	1.08E-01	2.04E+00	2pm	3.84E+00	1.22E+00	h
Year	5.18E-03	5.78E-03	2pm	5.18E-03	5.38E-03	2pm	1.45E-02	1.52E-02	2pm	1.45E-02	1.48E-02	2pm	8.12E-03	3.95E-02	2pm	9.11E-03	2.27E-02	2pm
constant	3.64E-01	1.80E+00	h	2.44E+00	7.90E-01	h	7.70E-01	9.29E+00	2pm	7.33E+01	4.42E+00	h	5.29E-01	2.68E+00	2pm	5.15E+00	2.11E+00	h

CONCLUSIONS

In Part III, we addressed two different questions related with firm-provided training. In Chapter 5, we intended to analyse the contribution of different firm characteristics in explaining the lower provision of training in small Spanish manufacturing firms. In Chapter 6, we analysed the impact of subsidies dedicated to impulse firms' provision of training, with special emphasis in the role of firm size.

The hypothesis in Chapter 5 is that large firms provide more training because they are generally associated to certain firm characteristics that require providing more training or allow them to invest more in it: the qualification of their labour force, the use of advanced technology, the innovative activity, the geographical scope of the market, the participation of foreign capital and the percentage of temporary workers. Specifically, we found that small and large firms seem to behave differently in relation to these variables, considering both the decision on whether to provide training and the decision on the quantity spent on it. The Oaxaca-Blinder decomposition permits analysing the individual contribution of these variables in explaining the training gap between small and large firms. Results suggest that the technological activity and the degree of competition of the markets where firms operate are the main reasons explaining the fact that small firms provide less training than their larger counterparts, both in the participation and quantity equations and in favour of large firms.

In the last Chapter of the thesis, we used the same empirical framework as in Chapter 5, but with the objective of measuring the effect of subsidies on firm provided training. Concretely, we studied the impact of subsidies in 2001 and 2002, under the current regulation. Contrary to what we expected, we did not find a clear positive effect of subsidies awarded to manufacturing firms in 2001 and 2002. In relation to the role of firm size, an interesting result of the descriptive analysis is that the larger the firms, the more hours of subsidized training per worked hours they receive. However, results of our estimations show no significant effect of subsidies on training neither for small nor large firms.

All in all, our analysis in Part III confirms the previous evidence that small firms have more difficulties in accessing training. This can be seen as a limitation, not only for

them, but also for the Spanish economy as a whole, given the predominance of small firms in this economy. Moreover, although the institutions are concerned with the limitations of small firms in accessing training and try to design subsidies that take this characteristic into account, results suggest that subsidies are not having the expected effect.

GENERAL CONCLUSIONS

Summary of Results and Concluding Comments

This thesis analyses different questions related to total factor productivity (TFP) and some of its main determinants, as well as the relationship between them for a sample of Spanish manufacturing firms. Specifically, we studied the innovative activity and human capital, considering both the formal education of the labour force and the firm provided training. In every question analyzed here, we paid special attention to the role that firm size may play in conditioning firms' strategic decisions and the economic results of the firm in terms of productivity.

In Chapter 1 we provided a revision of the main index numbers suggested in the literature to measure TFP. The purpose of this Chapter is to choose an appropriate measure of TFP to perform the remaining analysis in the following Chapters. In selecting between the different indices, we discussed the weaknesses and strengths of different indices and tried to justify the choice of the index proposed by Good et al. (1996). After the comparison, this index was considered to have more desirable properties than other alternatives in the literature. Specifically, this index is superlative as it is derived from a translog production function, which is more general than other production functions. Moreover, it is transitive and it has a high degree of characteristicity. In addition, it separates efficiency and technological change, relaxes the assumption of perfect competition and is sample independent.

Using our preferred index, we calculated a measure of TFP for Spanish manufacturing firms over the period 1990-2002. In Chapter 2, we introduced the *Encuesta*

sobre Estrategias Empresariales (ESEE), the dataset used to calculate this measure and used in the remainder of the thesis. This dataset has been used by a great number of studies in empirical industrial organization in Spain. After some cleaning procedures, we obtained data for more than 13000 observations, around 800-1000 observations per year, corresponding to more than 2000 different firms. We briefly described the main variables involved in this index and depicted the behaviour of TFP in our period of analysis. Basically, we obtained that TFP increased between 1990 and 2002, however its pace of growth slowed down during the second half of the nineties. Moreover, we found that the TFP increases are not homogeneous along the distribution and the most productive firms are more capable of increasing their TFP levels.

Given the interest placed in the role of firm size, we compared TFP in small and large firms. Results confirmed that they show different patterns of behaviour in relation to productivity: in average large firms are more productive than small ones. However, differences between the two groups are not homogeneous and, for instance, we obtained that the most productive small firms are as productive as the most productive large firms. Nevertheless, differences between the two groups seem to decrease over time, which is due to small firms with intermediate and high TFP.

Innovative activity and human capital are generally considered as key elements improving firms' productivity. Using different measures of innovative activity and human capital, we found that firms that innovate more and use more human capital are more productive and that large firms make a more intensive use of these factors. Further descriptive analysis shows that small innovative firms are as productive as their larger counterparts, suggesting that innovation is a key element for small firms to achieve higher TFP levels. In the case of the qualification of the labour force, after controlling for this variable, large firms are more productive than small ones, suggesting that it is possible that large firms obtain higher returns from this investment.

Departing from these preliminary insights on the different patterns of small and large firms, in Part II we analysed the contribution of innovation and human capital in explaining the TFP gap between small and large firms, both as differences in the levels of these characteristics and differences in the returns that firms obtain from them. The

hypothesis is that returns to innovation and human capital may play a role in explaining the TFP gap in the sense that it is not only important to invest more in these factors to improve productivity, but also that these investments turn into higher productivity. In this sense, if the impact of these investments is low, there is less space to policies directed to increase TFP by stimulating a more intense investment. In Chapter 3, this analysis is performed in the mean of the TFP distribution using the Oaxaca-Blinder decomposition, while in Chapter 4 it is performed in the entire distribution, using the counterfactual distribution analysis. Both methodologies depart from the estimation of auxiliary regressions for small and large firms. Results from these estimations show that large firms obtain higher returns from their investments in these factors, whereas the effects for small firms are smaller and in some cases they are not significant. This adds evidence in favour of the idea that small and large firms have different incentives in their decisions to invest in technological and human capital.

The Oaxaca-Blinder decomposition shows that our variables of interest explain part of the average TFP gap between small and large firms: human capital explains quite a large part of the gap —both as differences in the level of qualified workers between small and large firms and differences in returns; innovation has a smaller contribution to explain the TFP gap and it is basically due to differences in this characteristic. These results suggest the importance of knowledge capital in explaining productivity differences between small and large firms. Moreover, they suggest that it is not only important to increase the knowledge capital in small firms, but also to improve the effects that the existing human capital has on productivity. This finding provides evidence on the hypothesis that returns play a role in explaining the higher TFP level in large firms. Departing from the previous evidence that firms are highly heterogeneous in productivity and in the use of knowledge capital, we analysed whether differences in returns are also heterogeneous along the distribution. The counterfactual distribution analysis shows that the contribution of differences in returns is considerably non-homogenous. Regarding our variables of interest, differences in returns explain a modest part of the TFP differential between small and large firms and this effect is concentrated in the higher part of the distribution, that is, in firms with TFP above the average. Thus, if small firms had returns to innovation and human capital similar to those

of large firms, only some of them would increase their TFP. This result provides further evidence on the existing heterogeneity at firm level, which is not only reflected in a different use of knowledge capital, but also in a different impact of knowledge capital on productivity.

In Part III of the thesis, we focused on firm-provided training, a component of human capital which is considered to have positive effects on firms' performance. Small firms are often found to provide less training than their larger counterparts. In this perspective, the difficulties of workers in small firms in accessing training can be considered as a limitation for the whole economy. In Chapter 5, we analysed such difficulties of small firms by trying to discover the main variables that explain the training gap between small and large firms. The hypothesis is that large firms provide more training because they have certain characteristics that allow them to dedicate more efforts to training workers (such as having a more qualified labour force or less temporary workers) or that require more training (as for instance the technological activity, the geographical scope of the market or the participation of foreign capital). In Chapter 6, we studied whether subsidies have positive effects on firm-provided training in the case of Spanish manufactures under the regulation of 2001 and 2002. Given that this regulation gives special importance to stimulating the provision of training in small firms, in this Chapter we also analysed the effects of subsidies in both size classes. Chapters 5 and 6 share a common empirical framework in which training provision decisions are considered as a double decision process, which is a novelty of this analysis. We estimated the effect of the mentioned determinants of training on the probability of providing training and on the expenditure on it. The results from these estimations suggest that the use of advanced technologies, innovation and the geographical scope of the market are important determinants of in-company training.

In Chapter 5, the results from the Oaxaca-Blinder decomposition point that the technological activity and the geographical scope of the market are important reasons explaining the training differential between small and large firms. As for the participation equation, we obtained that they explain a large part of the gap in favour of large firms. Regarding the quantity equation, the same variables are important in explaining the gap in

the expenditure on training in favour of large firms. In addition, the participation of foreign capital and the temporary workers explain also a large part of this gap in favour of small firms. All in all, these findings suggest that the lower provision of training in small firms seems to be strongly related with their technological activity and the geographical scope of their market. It provides evidence in favour of the hypothesis that small firms provide less training because they use new technology or innovate with lower intensity than large firms. It also favours the hypothesis that small firms require less training because they operate less in international markets, where competition is more severe and workers may require more specific skills. The acknowledged limitations of small firms in accessing training, led to a system of subsidies in Spain that has especial consideration for these firms. Our results on the effect of subsidies on training do not permit to be certain that subsidies have had the expected positive effect in the case of Spanish manufacturing firms in 2001 and 2002. Similar results are obtained for the sample of small and large firms. This suggests that the amount of public resources dedicated to training do not seem to clearly stimulate the provision of training.

Further Research

We can not but admit that there are some issues in this thesis that deserve further development. Next, the ones that we consider to be more relevant are summarized.

As a general question, it should be firstly mentioned that when using continuous variables, it becomes difficult to make a decision on how to split the sample in two groups. In our case, it would be appealing to avoid such decision on which is the appropriate threshold between large and small firms. In this direction, we suggest extending our analysis using the proposal by Hansen (2000), who uses threshold regression techniques and develops a statistical theory for threshold estimation in the regression context.

In Chapter 2, we compared the density functions of small and large firms using the Kolmogorov-Smirnov tests of stochastic dominance. However, these tests could not be applied to compare the predicted and counterfactual distributions in Chapter 4 as they are not independent. Chapter 4 could be extended by empirically testing the stochastic

dominance of these distributions using the suggestion by Li (1996), who develops Kolmogorov-Smirnov tests for non-independent distributions.

In relation to the counterfactual distribution analysis, a possible extension of Chapter 4 would deal with the incorporation of the residuals in the predicted and counterfactual distributions. This way, we could take profit of relevant information that may help explaining differences between small and large firms. In this line, we suggest transferring the idea by Juhn et al. (1993), who incorporate the residuals in the Oaxaca-Blinder decomposition, to the counterfactual distribution analysis.

Moreover, the available evidence on the relationship between TFP and technological and human capital may be further exploited to analyse other questions such as the effect of these variables on TFP growth. Also, we could benefit from the results obtained here to analyse the relationship between innovation and human capital. Particularly, an interesting issue to analyse is to what extent a more qualified labour force permits developing more technological activities, considering both innovations obtained in the firm and the adoption of new technologies developed outside the firm.

Part III only considers the workers qualification and the percentage of temporary as variables related with employees. However, it would be interesting to include other variables such as the age, gender or the percentage of unionized workers. In this line, using an employer-employee matched dataset could be very useful.

The analysis of training covers the period 2001 and 2002. However, it would be interesting to continue this analysis when new data are available. In relation to Chapter 6, it would be interesting to extend this analysis so as to compare the impact of subsidies on training during the III ANFC, as we did here, with the impact of subsidies under the new system that started in 2004, where firms knew beforehand the quantity of the subsidy that they would receive. This new system was designed in order to make training more accessible to firms, especially SMEs.

Finally, we have special interest in estimating the impact of training on firms' productivity for the case of Spain in line with Alba-Ramírez (1994) or Dearden et al. (2006). Actually, the results in Chapter 2 and other preliminary estimations suggest that firms that provide more training are associated to higher TFP levels.

REFERENCES

Abramowitz, M. (1956), "Resource and Output Trends in the United States Since 1870," *American Economic Review*, vol. 46, p. 5-23.

Acs, Z.J., Audretsch, D.B. and Feldman, M.P., (1994), "R&D Spillovers and Recipient Firm Size," *The Review of Economics and Statistics*, MIT Press, vol. 76(2), p. 336-340, May.

Aguirregabiria, V. and Alonso-Borrego, C. (2001), "Occupational structure, technological innovation, and reorganization of production," *Labour Economics*, Elsevier, vol. 8(1), p. 43-73, January.

Alba-Ramirez, A, (1994). "Formal Training, Temporary Contracts, Productivity and Wages in Spain," *Oxford Bulletin of Economics and Statistics*, Blackwell Publishing, vol. 56(2), p. 151-170, May.

Albert, C., García-Serrano, C., and Herranz V., (2005a), "Los determinantes de la formación es España y sus rendimientos", *WP Universidad de Alcalá de Henares*.

Albert, C., García-Serrano, C., and Herranz V., (2005b), "Firm-provided training and temporary contracts," *Spanish Economic Review*, Springer, vol. 7(1), p. 67-88, January.

Almeida, R. and Carneiro, P. (2005), "On-the-Job Training: Estimating Costs and Returns Using Firm Level Data", mimeo.

Alonso, C. and Collado, M. D. (1999), "Factor Demands and Innovation Activity: Evidence from Spanish Manufacturing Firms", *Fundación SEPI, Programa de Investigaciones Económicas*, Documento de Trabajo 9902.

Audretsch, D. (2002), "The Dynamic Role of Small Firms: Evidence from the U.S.", *Small Business Economics*, vol. 18, p.13–40.

Audretsch, D., Prince, Y.M. and Thurik, A.R. (1998), "Do Small Firms compete with Large Firms?," *Tinbergen Institute Discussion Papers* 98-013/3, Tinbergen Institute.

Aw, B.Y., Chung, S. and Roberts, M.J. (2003), "Productivity, output, and failure: a comparison of taiwanese and korean manufacturers," *Economic Journal,* Royal Economic Society, vol. 113(491), p. F485-F510, November.

Bailey, M., Hulten, C., and Campbell, D. (1992), "Productivity dynamics in manufacturing plants", *In Brookings Papers on Economic Activity: Microeconomics*, Brookings Institute, vol. 4, p. 187–267.

Baldwin, J. R., Gray, T., and Johnson, J. (1995), "Technology use, training and plant-specific knowledge in Manufacturing Establishments", *WP Statistics Canada,* No 86.

Balk, B. M. (1998), *Industrial Price, Quantity, and Productivity Indices: The Micro-economic Theory and an Application*, Boston; Dordrecht and London: Kluwer Academic.

Balk, B.M. (2001), "The Residual: On Monitoring and Benchmarking Firms, Industries, and Economies with respect to Productivity", Inaugural Address with number EIA-007-MKT, *Erasmus Research Institute of Management (ERIM), RSM Erasmus University.*

Barrett, A. and O'Connell, P.J. (2001), "Does Training Generally Work? The Returns to In-Company Training," *Industrial and Labor Relations Review*, vol. 54(3), p. 647-662.

Barrios, S. (2000), "Foreign Direct Investment and Productivity Spillovers," *Working Papers 2000-19,* FEDEA.

Barrios, S. Görg, H. and Strobl, E. (2003), "Explaining Firms' Export Behaviour: R&D, Spillovers and the Destination Market", *Oxford Bulletin of Economics and Statistics*, vol. 65, p. 475-496, September.

Barron, J.M., Black, D.A and Loewenstein, M.A. (1987), "Gender Differences in Training, Capital, and Wages", *Journal of Human Resources*, Vol. 28 (2), p. 343-364, Spring.

Barry, F., Görg, H. and Strobl, E. (2004), "Multinationals and Training: Some Evidence from Irish Manufacturing Industries," *Scottish Journal of Political Economy*, Scottish Economic Society, vol. 51(1), p.49-61.

Bartel, A. (1989), "Formal employee training programs and their impact on labor productivity: evidence from a human resources survey", *NBER Working Paper Series*, No. 3026.

Bartel, A. (1994), "Productivity gains from the implementation of employee training programs" *Industrial Relations*, Vol. 33 (4), p. 411-425, October.

Bartelsman, E.J. and Doms, M. (2000), "Understanding productivity: lessons from longitudinal micro datasets", *Journal of Economic Literature*, Vol. 38 (3), p. 569-594, September.

Belsley, D., Kuh, E. and Welsch R. (1980), *Regression Diagnostics, Identifying Influential Data and Sources of Collinearity.* New York: John Wiley and Sons.

Bernard, A.B. and Jones, C. I, (1996), "Comparing Apples to Oranges: Productivity Convergence and Measurement across Industries and Countries," *American Economic Review*, vol. 86(5), p. 1216-1238.

Black, D., Noel, B. and Wang, Z. (1999), "On-the-Job Training, Establishment Size, and Firm Size: Evidence for Economies of Scale in the Provision of Human Capital," *Southern Economic Journal*, July 66(1), p. 82-100.

Black, S.E. and Lynch L.M. (1996), "Human-capital investments and productivity," *American Economic Review*, Papers and Proceedings, p. 263-267, May.

Black, S.E. and Lynch, L.M. (1998), "Beyond the Incidence of Training: Evidence from a National Employers' Survey", *Industrial and Labor Relations Review*, p. 64-81, October.

Black, S.E. and Lynch, L.M. (2004), "What's driving the new economy?: the benefits of workplace innovation", *The Economic Journal*, Vol. 114(493), p. F97-F116, February.

Blinder, A. S. (1973), "Wage Discrimination: Reduced Form and Structural Estimates," *The Journal of Human Resources,* vol. 8(4), p. 436–455.

Blundell, R., Dearden, L., Meghir, C. and Sianesi, B. (1999), "Human Capital Investment: The Returns from Education and Training to the Individual, the Firm and the Economy," *Fiscal Studies*, vol. 20 (1), p. 1–23.

Bolton, P. and Dewatripont, M. (1994), "The Firm as a Communication Network," *Quarterly Journal of Economics*, CIX, p.809-839.

Buesa, M. and Molero, J. (2001), "*Innovación y Cambio Tecnológico*", in Lecciones de Economía Española, by J.L. García-Delgado, R. Myro and J.A. Martínez-Serrano, Ed. Civitas (5th Edition).

Busom, I. (2000), "An empirical evaluation of the effects of R&D subsidies," *Economic Innovation and New Technology*, vol . 9, p. 111-148.

Cameron, A.C. and Trivedi P.K. (2005), *Microeconometrics*, Princeton University Press, Princeton.

Carlaw, K.I. and Lipsey, R.G. (2003), "Productivity, Technology and Economic Growth: What is the Relationship?," *Journal of Economic Surveys*, vol. 17(3), p. 457-495.

Caves, D., Christensen, L.R. and Diewert, W.E. (1982a), "Multilateral Comparisons of Output, Input and Productivity Using Superlative Index Numbers," *The Economic Journal*, vol. 92, p. 73-86.

Caves, D., Christensen, L.R. and Diewert, W.E. (1982b), "The Economic Theory of Index Numbers and the Measurement of Input, Output, and Productivity', *Econometrica* vol. 50, p.1392-1414.

Coe, D.T. and Helpman, E. (1995), "International R&D Spillovers", *European Economic Review*, vol. 39, p. 859-87.

Coelli, T., Rao, D.S.P. and Battese, G.E., (2000), *An Introduction to Efficiency and Productivity Analysis*, Kluwer Academic Publishers.

Cohen, W. M. and Klepper, S. (1996), "Firm Size and the Nature of Innovation within Industries: The Case of Process and Product R&D", *Review of Economics and Statistics,* vol. 78, p. 232–243.

Cragg, J. G. (1971), "Some Statistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods," *Econometrica* vol. 39, p. 829-844.

Crépon, B., Duguet, E. and Mairesse, J. (1998). "Research, innovation, and productivity an econometric analysis at the firm level", *NBER Working Paper*, No. 6696, August.

Crespo, J. and Sanz, I. (2000) "La formación continua en España: implicaciones de política económica," *Papeles de Economía Española,* vol. 86, p. 280-294.

David, P.A., Hall, B.H. and Toole, A.A., (2000), "Is public R&D a complement or substitute for private R&D? A review of the econometric evidence," *Research Policy,* Elsevier, vol. 29(4-5), p. 497-529, April.

De la Fuente, A., Domenech. R., and Jimeno, J.F., (2003), "Human capital as a factor of growth and employment at the regional level. The case of Spain," *UFAE and IAE Working Papers 610.04.*

De la Fuente (2004), "Capital Humano y crecimiento. El impacto de los errores de medición y una estimación de la rentabilidad social de la educación." *D-2004-02 Documento de la Dirección General de Presupuestos, Ministerio de Economía y Hacienda.*

Dearden, L., Reed, H. and Van Reenen, J. (2000), "Who Gains when Workers Train? Training and Corporate Productivity in a Panel of British Industries", *IFS Working Paper* No. W00/04, March.

Dearden, L., Reed, H. and Van Reenen, J. (2006), "The Impact of Training on Productivity and Wages: Evidence from British Panel Data," *Oxford Bulletin of Economics and Statistics*, Department of Economics, University of Oxford, vol. 68(4), p. 397-421.

Delgado, M.A, Fariñas, J.C. and Ruano, S. (2002), "Firm productivity and export markets: a non-parametric approach", *Journal of International Economics*, vol. 57, p. 397–422.

Diewert, W.E. (1976), "Exact and Superlative Index Numbers", *Journal of Econometrics,* vol. 4, p.114-145.

Diewert, W.E. (1992b), "Fisher Ideal Output, Input and Productivity Indexes Revisited", *Journal of Productivity Analysis*, vol. 3(3), p. 211–248.

Diewert, W.E. (2005), "The Measurement of Performance: Productivity versus the Real Rate of Return" presented at the Tutorial "The Measurement of Business Capital, Income and Performance", at the UAB, September 2005.

Diewert, W.E. and Lawrence, (1999). "Measuring New Zealand's Productivity", New *Zealand Treasury Treasury Working Paper Series* 99, http://www.treasury.govt.nz/workingpapers/1999/99

DiNardo, J., Fortin, N.M. and Lemieux, T., (1996). "Labor Market Institutions and the Distribution of Wages, 1973-1992: A Semiparametric Approach," *Econometrica*, vol. 64(5), p. 1001-44, September.

Doraszelski, U. and Jaumandreu, J. (2006), "R&D and productivity: The knowledge capital model revisited", *presented at CEPR Meetings* April 2006.

Dow, W., and Norton, E. (2003), "Choosing Between and Interpreting the Heckit and Two-Part Models for Corner Solutions", *Health Services and Outcomes Research Methodology*, vol. 4(1), p. 5-18.

El-Attar, M. and López-Bazo, E. (2007), "Firm size and the entire distribution of wages. A semiparametric approach", *Applied Economics Letters*, forthcoming.

Eltetö, Ö. and Köves, P. (1964), "One index computation problem of international comparisons", *Statisztikai Szemle*, Vol. 7.

Ericson, R. and A. Pakes (1995), "Markov perfect industry dynamics: a framework for empirical analysis", *Review of Economic Studies*, vol. 62(1), p. 53-82.

Estrada, A. and López-Salido, J.D. (2001), "Sectoral and aggregate technology growth", *Banco de España - Servicio de Estudios, Documento de Trabajo, No* 0116.

Evans, D. S. and Leighton, L. S. (1989), "Why Do Smaller Firms Pay Less?," *Journal of Human Resources*, vol. 24(2), p. 299-318.

Fariñas, J. C. and Jaumandreu, J. (1999), "Diez años de Encuesta sobre Estrategias Empresariales (ESEE)", *Economía Industrial*, No. 329, p. 29–42.

Fariñas, J.C. and Martín-Marcos, A. (2001), "Tamaño Empresarial, Flexibilidad de Costes y Cambio Tecnológico", *Papeles de Economía Española*, No. 89-90, p. 275-285.

Fariñas, J.C. and Martín-Marcos, A. (2005), "Firm performance and export markets", mimeo.

Fariñas, J.C. and Ruano, S. (2004), "The Dynamics of Productivity: A Decomposition Approach Using Distribution Functions," *Small Business Economics*, vol. 22, p. 237-251.

Farrell, M. J. (1957), "The measurement of productive efficiency," *Journal of the Royal Statistical Society*, vol. 120, p. 252-290.

Fingleton, B. and López-Bazo, E. (2003), "Explaining the Distribution of Manufacturing Productivity in the EU Regions", in European regional growth; Fingleton, B. (ed.), Advances in Spatial Science. Heidelberg and New York: Springer.

Fisher, I. (1922), *The Making of Index Numbers*, Boston: Houghton-Mifflin.

Foster, L., Haltiwanger, J. and Krizan, C. J., (1998), "Aggregate Productivity Growth: Lessons From Microeconomic Evidence," *Economic Studies* 98-112, US Census.

Fundación Tripartita para la Formación en el Empleo (2003), "La pequeña y mediana empresa en el subsistema de formación contínua", *Boletín Estadístico de Formación Contínua*, no. 11, Octubre-Diciembre de 2003. http://www.fundaciontripartita.org.

Gardeazábal, J. and Ugidos, A. (2004), "More on Identification in Detailed Wage Decompositions", *The Review of Economics and Statistics*, vol. 86(4), p. 1034–1036.

Geroski, P.A. (1998), "An Applied Econometrician's View of Large Company Performance", *Review of Industrial Organization*, vol. 13, pp. 271-293.

Goerlich, F.J., Mas, M. and Pérez, F. (2002), "Las Fuentes del Crecimiento Sostenido en España y los Países del G7 (1970-2001)," *Moneda y Crédito*, Vol. 214, p.133-176.

Good, D.H., Nadiri, M.I. and Sickles R.C. (1996), "Index Number and Factor Demand Approaches to the Estimation of Productivity", *NBER Working Paper Series*, 5790. In Pesaran, M.H. and Schmidt, P. (eds.), Handbook of Applied Econometrics, Vol. II: Microeconomics, 14, Blackwell Publishers.

Görg, H. and Strobl, E. (2005), "Do Government Subsidies Stimulate Training Expenditure? Microeconometric Evidence from Plant Level Data", *IZA DP* No. 1606.

Griffith, R., Redding, S. and Van Reenen, J. (2004), "Mapping the two faces of R&D: productivity growth in a panel of OECD industries," *The Review of Economics and Statistics*, vol. 86(4), p. 883–895.

Griliches, Z. (1979), "Issues in Assessing the Contribution of Research and Development to Productivity Growth," *Bell Journal of Economics,* The RAND Corporation, vol. 10(1), p. 92-116.

Griliches, Z. and Regev, H. (1995), "Firm productivity in Israeli industry, 1979-1988," *Journal of Econometrics*, Vol. 65, pp. 175-203.

Groot and Maassen van den Brink (2003), "Firm-related training tracks: a random effects ordered probit model," *Economics of Education Review*, vol. 22, p. 581-589.

Gual, J. Jódar, S. and Ruiz, A. (2006), "El problema de la productivitat a Espanya: quin és el paper de la regulació?," *Documents d'Economia "La Caixa",* No 01.

Guilkey, D. K. and Murphy, J. L. (1993), "Estimation and testing in the random effects probit model", *Journal of Econometrics*, Vol. 59, p. 301–317.

Hall, B.H. and Mairesse, J. (1995), "Exploring the relationship between R&D and productivity in French manufacturing firms", *Journal of Econometrics*, vol. 65(1), p. 263-293.

Hall, R.E. (1990), "*Invariance Properties of Solow's Productivity Residual*", In Diamond (ed.), Growth/Productivity/Employment, Cambridge, MA: MIT Press, p. 71-112.

Hall, R.E., and Jorgenson, D.W. (1967), "Tax Policy and Investment Behavior," *American Economic Review*, Vol. 57(3), p. 391-414, June.

Haltiwanger, J.C., Lane, J.I. and Spletzer, J.R. (1999), "Productivity Differences across Employers: The Roles of Employer Size, Age, and Human Capital," *American Economic Review*, American Economic Association, vol. 89(2), p. 94-98, May.

Hansen, B. E. (2000), "Sample Splitting and Threshold Estimation," *Econometrica*, Econometric Society, vol. 68(3), p. 575-604, May.

Harmon, C., Oosterbeek, H. and Walker, I. (2003). "The Returns to Education: Microeconomics," *Journal of Economic Surveys*, Blackwell Publishing, vol. 17(2), p. 115-156.

Harrigan, J. (1997), "Cross-Country Comparisons of Industry Total Factor Productivity: Theory and Evidence", *Federal Reserve Bank of New York,* Research Paper: 9734.

Hashimoto, M. (1979), "Bonus Payments, on-the-Job Training, and Lifetime Employment in Japan", *Journal of Political Economy*, Vol. 87(5), pp. 1086-1104.

Heckman, J.J. (1979), "Sample Selection Bias as a Specification Error", *Econometrica*, Vol. 47(1), p. 153-162.

Herranz, V. and Toharia, L. (2006), "Do Temporary Contracts Increase Work Accidents? A Microeconometric Comparison between Italy and Spain", *Labour*, vol. 20, p. 475-504.

Holtmann, A. G. and Idson, T. L. (1991), "Employer Size and On-the-Job Training Decisions", *Southern Economic Journal*, Vol. 58 (2), p. 339-355.

Holzer, H.J., Block, R.N., Cheatham, M. and Knott, J.H. (1993), "Are training subsidies for firms effective? The Michigan experience", *Industrial and Labor Relations Review*, vol. 46, p. 625-636.

Hopenhayn, H. (1992), "Entry, exit and firm dynamics in long run equilibrium," *Econometrica*, Vol. 60, pp. 1127-1150, September.

Huergo, E. and Jaumandreu, J. (2004a), "Firms' age, process innovation and productivity growth", *Journal of Industrial Organization*, Vol. 22, pp. 541-559.

Huergo, E. and Jaumandreu, J. (2004b), "How does probability of innovation change with firm age?," *Small Business Economics*, vol. 22, p.193–207.

Huergo E and Moreno L (2006), "La productividad de las empresas manufactureras españolas en la década de 1990", in J Segura (Coord.) "La productividad en la economía española," Fundación Ramón Areces, Madrid.

Hughes, G. O'Connell, P.J. and Williams, J. (2004), "Company training and low-skill consumer-service jobs in Ireland," *International Journal of Manpower*, Vol. 25(1), p. 17-35.

Jenkins, S.P. (1994), "Earnings discrimination measurement. A distributional approach", *Journal of Econometrics*, vol. 61, p. 81-102.

Johnson, P.A. (2000), "A nonparametric analysis of income convergence across the US", *Economics Letters*, Vol. 69, p. 219-223.

Jorgenson, D.W. and Griliches, Z. (1972), "Issues in Growth Accounting: a reply to Edward F. Denison", *Survey of Current Business*, vol 55(2), p. 65-94.

Jovanovich, B. (1982), "Selection and the evolution of industry", *Econometrica*, Vol. 50(3), pp.649-670, May.

Juhn, C., Murphy, K. and Pierce, B. (1993), "Wage inequality and the rise in returns to skill," *Journal of Political Economy*, vol. 101(31), p. 410-442.

Kendrick, J. (1961), Productivity Trends in the United States, Princeton: Princeton University Press for the National Bureau of Economic Research.

Klepper, S. (1996), "Entry, Exit and Innovation Over the Product Life Cycle", *American Economic Review*, vol. 86, p. 562–583.

Kolmogorov, A. N., (1933), "Sulla determinazione empirica di une legge di distribuzione", *Giornale dell Istituto Italiano degli Attuari*, vol. 4, p. 83-91.

Lach, S. (2002), "Do R&D Subsidies Stimulate or Displace Private R&D? Evidence from Israel," *Journal of Industrial Economics*, Blackwell Publishing, vol. 50(4), p. 369-390, December.

Leung, S. F., and Yu, S. (1996) "On the choice between sample selection and two-part models", *Journal of Econometrics*, vol. 72, p.197-229.

Leuven, E. and Oosterbeek, H. (2004), "Evaluating the Effect of Tax Deductions on Training," *Journal of Labor Economics*, University of Chicago Press, vol. 22(2), p. 461-488, April.

Licandro, O., Maroto, R. and Puch, L. (2004), "Innovation, Investment and Productivity: Evidence From Spanish Firms." *EUI Working Paper* Eco No. 2004/7.

Lim, Y. and Hahn, C. (2003), "Bankruptcy Policy Reform and Total Factor Productivity Dynamics in Korea," *NBER Working Paper* No. W9810.

Lisbon Strategy, "Convergencia y Empleo. Programa Nacional de Reformas para España", Octubre (2005), http://www.msc.es/novedades/docs/Convergencia.pdf

López-Bazo, E. and Moreno, R. (2007), "Regional heterogeneity in the private and social returns to human capital", *Spatial Economic Analysis*, vol. 2 (1).

Lovell, M. C., (1993). "Simulating the inventory cycle," *Journal of Economic Behavior & Organization*, Elsevier, vol. 21(2), p. 147-179, June.

Lucas, R.E. (1978), "On the size distribution of Business Firms", *Bell Journal of Economics*, vol. 9(2), p. 508-523.

Lynch, L.M., (1993), "The Economics of Youth Training in the United States," *Economic Journal*, Royal Economic Society, vol. 103(420), p. 1292-1302, September.

Mairesse, J. and Sassenou, M. (1991), "R&D and Productivity: A Survey of Econometric Studies at the Firm Level", *NBER Working Paper*, No. 3666.

Manasse, P. and Stanca, L. (2003), "Working on the Train? The Role of Technical Progress and Trade in Explaining Wage Differentials in Italian Firms", *Centro Studi Luca D'Agliano, Development Studies Working Papers* No. 177.

Máñez, J. A., Rincón, A., Rochina, M. E., and Sanchis, J. A. (2005), "Productividad e I+D: un análisis no paramétrico", *Revista de Economía Aplicada*, No. 39, vol XIII, p. 47-86.

Máñez, J. A., Rochina, M. E., Sanchis, A. and Sanchis, J. A. (2004), "A Dynamic Approach to the Decision to Invest in R&D: the role of sunk costs", mimeo.

Máñez, J. A., Rochina, M. E., Sanchis, J. A. (2006), "Process Innovations and Firm Productivity Growth: Does Firm Size Matter?," paper presented al JEI 2006, mimeo.

Martin Marcos, A. (1990), "Estimacion del Stock de Capital Para los Sectores de la EI", *Fundación SEPI, Programa de Investigaciones Económicas, Documento Interno* No. 4.

Martin Marcos, A. and Suárez-Gálvez, C. (1997), "El Stock de Capital Para las Empresas de la Encuesta Sobre Estrategias Empresariales", *Fundación SEPI, Programa de Investigaciones Económicas, Documento Interno* No. 13.

Martin, S. (2002), *Advanced Industrial Economics* (2nd ed.), Blackwell Publishers Ltd, Oxford.

Martín-Pliego, F.J., De Juan, R., Merino, F., Rodríguez, D. and Suárez, C. (2001), "Las Empresas Industriales en 2001", *Fundación SEPI, Programa de Investigaciones Económicas.*

Motellón, E. and López-Bazo, E. (2005), "Discriminación por género en el acceso a la contratación indefinida", VIII Encuentro de Economía Aplicada, Murcia.

Myro, R. (2001), "*Crecimiento Económico y Cambio Estructural*", in Lecciones de Economía Española, by J.L. García-Delgado, R. Myro and J.A. Martínez-Serrano, Ed. Civitas (5th Edition).

Oaxaca, R. (1973), "Male-Female Wage Differentials in Urban Labor Markets", *International Economic Review,* vol.14, p. 693-709.

Oaxaca, R., and M. R. Ransom (1994), "On discrimination and the decomposition of wage differentials" *Journal of Econometrics,* vol. 61, p.5-21.

OECD (1993), "Methods Used by OECD Countries to Measure Stocks of Fixed Capital", *OECD Statistics Directorate in National Accounts: Sources and Methods* No. 2.

OECD (2003), "The Sources of Economic Growth in OECD countries," *OECD General Economics & Future Studies,* (ISBN 9264199454).

Oi, W.Y., (1983), "Heterogeneous firms and the organization of production", *Economic Inquiry,* vol. 21 (2), p.147-171.

Olley, G.T. and A. Pakes (1996), "The dynamics of productivity in the telecommunications equipment industry", *Econometrica,* vol. 64(6), p. 1263-1297.

Oosterbeek, H. (1996). "A Decomposition of Training Probabilities," *Applied Economics*, Taylor and Francis Journals, vol. 28(7), p. 799-805, July.

Oosterbeek, H. and van Praag, M. (1995), "Firm-Size Wage Differentials in the Netherlands," *Small Business Economics*, Springer, vol. 7(3), p. 173-182, June.

Ornaghi, C. (2006), "Spillovers in product and process innovation: Evidence from manufacturing firms", *International Journal of Industrial Organization,* vol.24, p.349–380.

Osterman, P. (1995), "Skill, Training, and Work Organization in American Establishments", *Industrial Relations*, Vol. 34(2), p. 125-46, April.

Otero, C. Muñoz, A. and Fernández-Rodríguez, C.J. (2002), "Vocational Education and Training in Spain", *Cedefop, Reference Series* 38.

Parellada M., Sáez F., Sanromà E., Torres C. (1999), *La formación continúa en las empresas españolas y el papel de las universidades*. Biblioteca Civitas Economía y Empresa: colección economía.

Parisi, M.L., Schiantarelli, F. and Sembenelli, A. (2002), "Productivity, Innovation Creation and Absorption, and R&D: Micro Evidence for Italy," *Boston College Working Papers in Economics* 526, Boston College Department of Economics.

Peraita, Carlos (2005), "Firm-sponsored training in regulated labour markets: evidence from Spain", *Applied Economics*, Vol. 37(16/10), p.1885-1898, September.

Pérez, F., Goerlich, F.J. and Mas, M. (1998), *Capitalización y Crecimiento Económico en España y sus Regiones 1955-1995*, Fundación BBVA.

Pérez, F., Maudos, J., Pastor, J.M. and Serrano, L. (2006), *Productividad e Internacionalización. El Crecimiento Español ante los Nuevos Cambios Estructurales*, Fundación BBVA.

Planas, J. (2005), "Vocational training in Spain: Changes in the model of skill production and in management modalities", *Berufs-Wirtsch.pädagog.* issue 7 of www.bpwat.de

Planas, J. and Rifa, J. (2003), "Consolidación y desarrollo de la formación continua en España". *Madrid: Fundación Tripartita para la Formación en el Empleo.*

Quah, D. (1996a), "Convergence empirics across economies with (some) capital mobility", *Journal of Economic Growth,* vol 1, p. 95-124.

Rajan, R. G., Zingales, L. and Kumar, K. B. (2001), "What Determines Firm Size?" *CRSP Working Paper* No. 496; and *USC Finance & Business Econ. Working Paper* No. 01-1.

Rigby, M (2004), "Training in Spain: an evaluation of the continuous training agreements (1993-2001) with particular reference to SMEs", *Human Resource Development International*, Vol. 7(1), p. 23-37.

Ruano, S. (2002), "Dinámica del empleo y de la Productividad. ¿Qué nos enseñan los datos microeconómicos?", *Economía Industrial*, No. 348, p. 99-110.

Sargant, F. P., (1943), "The Problem of Management and the Size of Firm: A Reply" *Economic Journal*, Vol. 44, p. 723-729.

Schumpeter, J.A. (1942), *Capitalism, Socialism and Democracy*, New York, Harper and Brothers.

Sheather, S. J. and Jones, M. C. (1991). "A reliable data-based bandwidth selection method for kernel density estimation", *Journal of the Royal Statistical Society,* September, vol. 53, p.683-690.

Sianesi, B. and Van Reenen, J.V. (2003), "The returns to education: macroeconomics", *Journal of Economic Surveys*, vol.17 (2), p. 157-200.

Silverman, B. W. (1986), *Density Estimation for Statistics and Data Analysis*, Chapman and Hall, New York.

Smith, V., Dilling-Hansen, M., Eriksson, T. and Strojer-Madsen, E. (2004), "R&D and productivity in Danish firms: some empirical evidence", *Applied Economics*, vol.36, p.1797–1806.

Smirnov, N. V., (1939), "On the estimation of the discrepancy between empirical curves of distribution for two independent samples", *Bull. Math. University of Moscow*, vol. 2, p. 3-14.

Solow, R. M. (1957), "Technical Change and the Aggregate Production Function", *The Review of Economics and Statistics*, vol. 39, p. 312-320.

Stokey, N. and Robert E. L. (1989), *Recursive Methods in Economic Dynamics*, Cambridge: Harvard University Press.

Suárez-Gálvez, C. (2001) "Presión financiera y comportamiento de las empresas manufactureras españolas", *Documento de Trabajo, Programa de Investigaciones Económicas*, p. 1-21.

Szulk, B. (1964), "Indices for multiregional comparisons", *Przeglad, Statystyczny*, Vol. 3.

Toro-Vizcarrondo, C., and Wallace, T. (1968), "A Test of the Mean Square Error Criterion for Restrictions in Linear Regression", *Journal of the American Statistical Association*, Vol. 63(322), p.558-572.

Wagar, T.H. (1997), "Determinants of formal training in large Canadian organizations," *International Journal of Training and Development*, Vol. 1(2), p. 82-90.

Yun, M. (2004), "Decomposing differences in the first moment," *Economics Letters*, Elsevier, vol. 82(2), p. 275-280, February.

Zábojník, J. and Bernhardt, D. (2001), "Corporate Tournaments, Human Capital Acquisition, and the Firm Size–Wage Relation", *The Review of Economic Studies*, vol. 68 (3), p. 693-716.