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Exporting and Economic Performance: Firm-level Evidence of Spanish Manufacturing

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1. INTRODUCTION

THE literature on firm productivity that uses longitudinal micro-level data sets points to exporting as one of the factors making some firms or plants more productive than others. The other factors are regulation, management/ownership, technology and human capital (see the survey by Bartelsman and Doms, 2000). There is a large body of empirical evidence that demonstrates that export-oriented firms are more productive than non-exporters. The list of studies includes, among others, Aw and Hwang (1995) on Taiwan; Bernard and Jensen (1995 and 1999) on the US; Bernard and Wanger (1997) on Germany; Clerides et al. (1998) on Colombia, Mexico and Morocco; Aw et al. (2000) on Taiwan and South Korea; Girma et al. (2004) on the UK; and Hallward-Driemeier et al. (2002) on Indonesia, Korea, Malaysia, the Philippines and Thailand. Three recent review articles on this empirical literature are Greenaway and Kneller (2005), López (2005) and Wagner (2007).

On the theoretical side, the existence of sunk costs associated with market research, product modification and other costs is the main argument outlined to explain why exporters are more efficient than non-exporters. Models of industry

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dynamics by Jovanovic (1982) and Hopenhayn (1992) indicate that higher entry costs will raise the required level of productivity to enter the market. As suggested by Aw et al. (2001), this group of models also applies to the entry of firms in export markets. According to this argument, differences in sunk entry costs can explain productivity differences between exporters and domestic-oriented firms. Second, building on these ideas and on the literature on hysteresis produced by Baldwin and Krugman (1989) and Dixit (1989), Roberts and Tybout (1997), Clerides et al. (1998) and Bernard and Jensen (1999 and 2004) have developed empirical models of the decision to export. The fact that a firm's previous export status is a determinant of the decision to export today is interpreted, in terms of these models, as evidence favourable to the existence of sunk entry cost in the export market. With the same data set that we use in this article, Campa (2004) confirms that breaking into foreign markets involves significant sunk starting-up costs. Third, more recent open economy models, such as the work by Melitz (2003), also predict the self-selection of the most productive firms into the export markets as a consequence of entry costs of exporting, as well as the reallocation of resources within an industry following trade liberalisation. Helpman (2006) reviews the theoretical literature emerging from this approach.

Concerning the underlying causal mechanism linking productivity to exporting, two not mutually exclusive explanations have been proposed: (1) the self-selection hypothesis, which considers that firms self-select into the export market according to their productivity level; and (2) the learning-by-exporting hypothesis, which alternatively considers that once firms are in the export market, they can take advantage of economies of scale or acquire knowledge from a greater exposure to better practices that foster learning. Both mechanisms are plausible, but the available evidence is much more favourable to the self-selection hypothesis than to the hypothesis of further productivity improvement after entry in the export market takes place. An exhaustive review of the evidence about both hypotheses can be found in Wagner (2007).

In a previous paper, Delgado et al. (2002) report total factor productivity differences between exporters and non-exporters on the basis of a sample of Spanish manufacturing firms. The empirical analysis focuses on the use of non-parametric techniques and confirms higher levels of productivity for exporting firms with respect to non-exporting firms, as well as evidence favourable to the self-selection of most productive firms into the export market. In this paper, we extend the previous analysis in three directions. First, we investigate additional economic performance differences between exporters and non-exporters. We systematically explore the magnitude of these differences for various performance measures such as size, productivity, wages, the composition of labour force and R&D activities. Estimates of export premia are reported after controlling for time, industry, size, age and various firm characteristics. Second, in the previous paper we used index numbers to measure total factor productivity (TFP). The use of index numbers may yield biased estimates of firm-specific productivity. In this paper we offer estimates of TFP differences between exporters and non-exporters based on the estimation of production functions. Third, we explore again the self-selection and learning-by-exporting hypotheses, examining whether or not firms with different trajectories between the export and the domestic market, i.e. continuing, entering or exiting firms from the export market, show systematic differences in the level and evolution of their economic performance measures.

The results confirm the empirical patterns reported in the previous literature that uses micro panel data to measure the relationship between productivity and exporting. First, many indicators of economic performance such as productivity, size, wages and innovation are greater in exporting firms. Second, TFP differences between exporters and non-exporters estimated with parametric methods are remarkably similar to those estimated using index numbers. Third, performance differences and transition patterns between the export market and the domestic market indicate higher performance for entering exporters with respect to non-exporters at the moment of entry. We find evidence of selection in the entry and the exit side of the export market and no systematic changes in performance between non-exporters and exporters after entry takes place.

The rest of the paper is organised as follows: Section 2 describes the main characteristics of the data set used in the analysis and presents some basic evidence on the magnitude of performance differences between exporters and non-exporters. Section 3 presents the estimation procedure and the magnitude of TFP differences between exporters and non-exporters obtained from estimated production functions. Section 4 presents the evidence on the relationship between productivity and patterns of entry and exit to the export market, and conclusions are given in Section 5.

2. PATTERNS OF ECONOMIC PERFORMANCE FOR EXPORTERS AND NON-EXPORTERS

In this section, we describe the main characteristics of the data set used in the analysis and we also provide some basic descriptive evidence on the magnitude of performance differences between exporters and non-exporters. This evidence includes estimates of export premia after controlling for time, industry, size, age and other firm characteristics.

The data set we employ is a longitudinal survey of Spanish manufacturing firms that comes from the *Encuesta sobre Estrategias Empresariales* (ESEE). The survey provides a representative sample of the population of Spanish manufacturing firms with ten or more employees (see Fariñas and Jaumandreu, 1999, for technical details about the data set). Over the period 1990–1999, the ESEE collected 18,680 observations that correspond to 3,151 manufacturing firms. The data set is an unbalanced panel of firms, as newly created firms have been surveyed annually according to the same sampling criterion that was used for the initial sample of firms in the base year, and exiting firms have been recorded in subsequent years.

One of the characteristics of the sample of firms is that it is representative of the population of Spanish manufacturing firms with more than ten employees. Taking into account these sampling properties, we estimate some basic characteristics of the population of exporting firms. In particular, the sample reproduces some of the stylised facts reported by the literature on exporting firms. First, exporters are a small fraction of the total number of firms. In the base year, only 29.8 per cent of the population of manufacturing firms with more than ten employees reports exporting anything. Second, this group of exporting firms accounts for 65.4 per cent of the output of Spanish manufacturing, which means that exporters are bigger than non-exporters. Third, exporters sell most of their output domestically. The average share of exports with respect to output is 21.4 per cent for the group of exporters. These three stylised facts hold consistently with the evidence reported by Bernard et al. (2003) for US manufacturing plants, and Eaton et al. (2004) for French manufacturing firms.

From the overall database, the set of firms available for estimation makes up an unbalanced panel of firms containing 10,145 observations that correspond to 1,403 firms. The units included for estimation were required to have information on the whole set of variables used in the analysis and to have four or more consecutive annual observations over the period 1990–1999. Full details of the variables used in the analysis are presented in the Data Appendix.

The sample allows a classification of firms according to their trajectories in the domestic and export markets over the period 1990–1999. From the point of view of export market participation, the set of firms can be classified into five groups: continuing exporters, non-exporters, entering exporters, exiting exporters and switching exporters. Firms exporting over the observed period define the group of continuing exporters. The group of non-exporters corresponds to firms not selling abroad throughout the time period. Entry and exit in the export market define two additional groups of firms: the group of entering exporters that corresponds to firms becoming exporters during the period without further changes in their export status in the rest of the period; and the group of exiting exporters that corresponds to firms ceasing to export and not re-switching. Finally, we define a special group of firms which switches their export status more than once during the period. It is not easy to interpret the exact nature of this group of firms appropriately. In some cases, switchers may identify firms selling abroad intermittently; in other cases, it may simply indicate that the firm is leaving the export market progressively.

Table 1 reports mean values for a variety of firm characteristics. The comparison considers all firms and two size groups of small and large firms both in the year 1999. We distinguish between the group of firms employing between ten

TABLE 1
Mean Characteristics for Exporters and Non-exporters in 1999
(Exporters are defined as continuing and entering exporters over the period 1990–1999)

	All Firms		*Small Firms*		*Large Firms*	
	Exporters	*Non-exporters*	*Exporters*	*Non-exporters*	*Exporters*	*Non-exporters*
Production (000€)	37,724.0	5,800.8	9,438.9	2,883.2	70,812.1	38,896.7
Production – Exports (000€)	26,425.0	5,800.8	6,248.8	2,883.2	52,252.2	38,896.7
Employment (number)	253	51	64	30	474	291
Capital stock (000€)	10,274.9	1,857.9	1,933.8	606.3	20,032.5	16,054.8
Labour productivity (€ per hour)	23.3	15.2	19.9	14.7	27.3	21.6
Total factor productivity	8.0	7.5	8.1	7.5	7.9	7.1
Capital per hour (€ per hour)	18.5	10.8	13.3	9.5	24.6	25.4
Wage per hour (€ per hour)	14.6	10.8	12.3	10.3	17.3	16.8
Qualified workers/Total empl. (per cent)	10.7	6.6	10.2	6.2	11.3	11.1
R&D activities (per cent of firms)	53.7	14.4	34.3	11.6	76.4	46.9
R&D effort (per cent)	1.1	0.3	0.7	0.2	1.6	1.0
Age (years)	31	20	23	19	39	33
Foreign ownership (per cent of firms)	24.3	2.8	11.3	1.1	39.6	21.9

and 200 employees (small firms) and the group of manufacturing firms with more than 200 employees (large firms), as firms participating in the survey were chosen according to a different selective sampling scheme for both groups of firms. Given the procedure used, both samples of small and large firms permit the estimation of population parameters such as the mean for both groups of firms. Exporters are defined as the sum of two groups of firms: continuing exporters and entering exporters over the period 1990–1999. Non-exporters are defined as the rest of the firms. Differences between exporters and non-exporters do not change when exporters are defined as firms exporting at *t*, independently of the other periods.[1]

Size differentials between exporters and non-exporters are substantial. This is probably the most striking difference between exporters and non-exporters. The size disparity between these two groups of firms is substantial in terms of production, employment and capital stock. On average, exporters are 6.5 times larger than non-exporters in terms of output measured by the value of production in the year 1999. The size difference remains when export revenues are excluded from the calculation of output for exporters. In terms of employment and capital stock, the difference is slightly lower than for output. Within the two size categories considered, exporters are also significantly larger than non-exporters. The difference between exporters and non-exporters is larger in the group of small firms. In 1999, exporting firms are more than three times as large as non-exporters in terms of output and capital and more than twice as large in terms of employment. Size differences between exporters and non-exporters are much lower for the group of large firms.

Exporting firms are also more productive than non-exporting firms. Measured either in terms of labour productivity or total factor productivity, exporters have higher productivity. On average for 1990 and 1999, the difference in labour productivity is 38.5 per cent and the difference for total factor productivity is 11 per cent. These differences hold within each size category, both for the groups of small and large firms, and across industries. Labour productivity is greater for exporters for all two-digit-level manufacturing industries of the NACE (Classification of economic activities in the European Community). With the exceptions of machinery and equipment (NACE 29), other transport equipment (NACE 25) and rubber and plastic products (NACE 25), in the other industries, total factor productivity of exporters is greater than for non-exporters.[2]

Capital inputs also differ for exporters and non-exporters. Capital per hour is higher for exporting firms. Within each size category, exporters are more

[1] The results that we obtain using alternative definitions of exporting firms are not reported in the text.

[2] Productivity differences across industries are not reported in the text.

capital-intensive than non-exporters, particularly in small firms where the capital-labour ratio is 40 per cent greater in 1999.

Exporting firms show higher levels of wage per hour. Average wages per hour are 35 per cent higher for exporters. Wage differentials between exporters and non-exporters are substantially higher for the group of small firms. In addition, the composition of employment differs across firm size and export status: small firms have a lower proportion of qualified workers than large firms; and exporting firms, within each size category, employ more qualified workers in relative terms than non-exporting firms.

Looking at R&D activities, once again we observe systematic differences between exporters and non-exporters. The average proportion of exporters that carry out R&D activities in 1999 is 53.7 per cent and for non-exporters is 14.4 per cent. After controlling for size differences between firms, exporters are more likely performers of R&D activities than non-exporters. Similarly, exporters have a higher R&D effort measured in terms of the ratio of R&D expenditure to sales. R&D effort is almost four times greater for exporters with respect to non-exporters in 1999.

Firm age and degree of foreign ownership are two additional characteristics that differ greatly between exporters and non-exporters. Exporters are older than non-exporters and the average age difference is ten years. With respect to foreign ownership, the degree of involvement of foreign-owned companies in the population of Spanish manufacturing firms is high and it is positively related to exporting. The percentage of firms with a majority of foreign capital participation is greater in the group of exporting firms, with more than 20 per cent of the firms within this group having 50 per cent or more of foreign-owned equity, whereas in the group of non-exporters, the rate of participation is approximately five per cent.

To estimate the difference between exporters and non-exporters more precisely, we calculate the average difference between both groups of firms after controlling simultaneously for time, size, industry and other firm characteristics correlated with firm performance. Using a similar specification as in Bernard and Jensen (1999 and 2004), export premia are estimated from a regression of the form:

$$\ln X_{it} = \alpha + \beta Export_{it} + \lambda Size_{it} + \rho Foreign_{it} + \mu Age_{it} + \sum_{I} \gamma_I Industry_i + \sum_{T} \delta_T Year_t + \varepsilon_{it}, \quad (1)$$

where X_{it} is some characteristic of firm i at time t; $Export_{it}$ is a dummy variable indicating the export status of firm i; $Size_{it}$ is the log of employment defined by the number of workers in each firm i at time t; $Foreign_{it}$ is a dummy indicating majority foreign ownership with 50 per cent or more of foreign-owned equity; Age_{it} is the log of firm age at time t; $Industry_i$ is a set of 18 two-digit NACE manufacturing industry dummies; $Year_t$ is a collection of ten year dummies from

1990 to 1999; and ε_{it} is a random error. The omitted categories for size, industry and year are small firms of 10–20 employees, ferrous and non-ferrous metals industry and the year 1990.

Table 2 reports results from the estimation of equation (1). The export status of firms is defined taking into account the entire sequence of export activity for each firm. In particular, the dummy variable $Export_{it}$ identifies exporting firms with the groups of continuing exporters and entering exporters.[3] Wald tests of joint significance for industry and time dummy sets are also reported in Table 2. After controlling for these variables and for size, age and foreign ownership effects, the sign of the estimated coefficient β indicates that exporting is positively and significantly correlated with various measures of business performance. The largest difference is found in the size of exporters. Exporters are larger than non-exporters. Taking the value of production as the measure of size, exporters are almost three times the size of non-exporters.[4] Bernard and Jensen (2004), Bernard and Wagner (1997) and Girma et al. (2004) have found a similar pattern for the US, Germany and the UK, respectively.

Labour productivity is also significantly higher for exporters. We find that value added per hour of work is 17 per cent higher for exporters. Part of this difference is the result of higher capital intensity, as exporters use a stock of capital per unit of labour 31 per cent higher than non-exporters. Total factor productivity is also seven per cent higher for exporters after controlling for size, age, industry and the other control variables.

Export premia are also estimated for other labour market indicators. Workers in exporting firms benefit from higher wages than non-exporter workers. On average, wages are six per cent higher for exporters with respect to non-exporters. The mean wage differential is smaller than the mean labour productivity difference between exporters and non-exporters. Part of the wage gap is due to differences in the composition of the workforce across the two types of firms. The share of qualified workers in total employment is two percentage points higher for exporting firms.

Export premia for other characteristics, such as the decision to undertake research and development activities, are significant. The probability of a firm's decision to undertake R&D activities is higher for exporters as opposed to non-exporters. We find that the probability is 13 per cent higher for exporters. Similar results are obtained for R&D effort. Exporting firms invest in R&D, in relative terms, more heavily than non-exporting firms. R&D effort is on average 2.9 points higher for exporting firms.

[3] Similar regressions have been estimated with $Export_{it}$, identifying exporters according to their current export status. The results obtained with this specification are very similar to those shown in Table 2. They are not reported in the text.

[4] The log approximation underestimates the difference: for the coefficient β, $\exp(\beta) - 1$ gives approximately the proportional difference between exporters and non-exporters.

TABLE 2
The Premium to Exporting for Various Firm Characteristics
(Exporters are defined as continuing and entering exporters over the period 1990–1999)

Dependent Variable	*Exporter Dummy (t-statistic)*	*Other Control Variables:*				
		Log (Size) (t-statistic)	*Foreign Ownership (t-statistic)*	*Log (Age) (t-statistic)*	*Industry Wald Test (p-value)*	*Time Wald Test (p-value)*
Production	1.33	–	1.45	0.54	1,117	75
	(47.0)		(35.8)	(34.4)	(0.00)	(0.00)
Employment	0.94	–	1.12	0.46	696	62
	(40.3)		(33.7)	(35.4)	(0.00)	(0.00)
Capital stock	1.42	–	1.76	0.69	1,080	32
	(38.9)		(33.7)	(34.1)	(0.00)	(0.00)
Labour productivity	0.17	0.08	0.20	0.07	1,336	80
	(12.9)	(14.3)	(10.7)	(10.1)	(0.00)	(0.00)
Total factor productivity	0.07	0.00	–0.01	0.00	135	137
	(7.7)	(1.2)	(–0.4)	(0.1)	(0.00)	(0.00)
Capital per hour	0.24	1.04	0.37	0.12	1,317	306
	(10.1)	(108.1)	(11.0)	(9.0)	(0.00)	(0.00)
Wage per hour	0.05	0.09	0.19	0.09	3,334	1,119
	(6.5)	(29.3)	(18.2)	(22.0)	(0.00)	(0.00)
Qualified workers/Total employment	1.90	0.27	2.74	–0.14	1,815	112
	(9.2)	(3.2)	(9.4)	(–1.2)	(0.00)	(0.00)
R&D activities	0.13	3.52	–0.07	–0.01	150	15
	(6.6)	(0.00)	(–2.3)	(–0.8)	(0.00)	(0.09)
R&D effort	2.9	2.20	–5.9	0.52	798	6
	(6.4)	(12.0)	(–9.4)	(2.1)	(0.00)	(0.78)

Notes:
Numbers in rows are coefficients and test values estimated from regressions as (1) in the text. For industry and time dummies, we report the Wald test of joint significance for the sets of 17 and nine dummy variables, respectively. Reported statistics are estimated with asymptotic variance matrices that are heteroscedasticity-consistent. All dependent variables are in logs except the qualified workers/total employment and R&D effort *ratios*. The probability of undertaking R&D activities is estimated by a linear probability model. In this estimation, all control variables are defined as dummy variables, size and age in particular (in both cases the reported coefficient is a Wald test of the size and age effect).

Overall, the results presented in this section confirm the existence of substantial differences between exporters and non-exporters. Many indicators of economic performance such as productivity, size, wages and other firm characteristics are greater in exporting firms.

3. MEASURING PRODUCTIVITY DIFFERENCES BETWEEN EXPORTERS AND NON-EXPORTERS WITH PRODUCTION FUNCTIONS

Among the methods that can be used to measure productivity, the most popular alternative is the choice of an index number approach. Either bilateral or multilateral indices have been proposed to perform comparisons among groups of firms (see Caves et al., 1982). For productivity comparisons between exporters and non-exporters, these types of index numbers have been applied by Aw et al. (2000 and 2001) and Delgado et al. (2002), among others. However, the use of index numbers requires the imposition of a set of restrictive assumptions to get unbiased measures of total factor productivity and fails to address the simultaneity between productivity and input choices by firms.

This section develops an estimation procedure based on the estimation of production functions to measure total factor productivity differences between exporting firms and non-exporting firms. Van Biesebroeck (2003) has addressed this issue more generally, evaluating whether or not exporters are more productive than non-exporters through the comparison of different methodologies. The aim of this section is to assess whether productivity differences between exporters and non-exporters are robust to alternative measurement methods.

Index number measures are flexible in the specification of the technology without forcing the same input trade-off to be uniform across firms, but parametric methods assume a homogeneous production technology for all firms. Consistent estimation of production functions faces the endogeneity problem of firms choosing inputs knowing their productivity levels. Two main alternative identifying assumptions have been implemented to address the endogeneity problem in the estimation of production functions. The first approach is based on semi-parametric methods and has been developed by Olley and Pakes (1996). The second approach relies on the use of instrumental variables uncorrelated with productivity.

Given the characteristics of the data set we use, we apply instrumental variables for the estimation of production functions. A general approach following this strategy has been proposed by Blundell and Bond (1998) and applied to the estimation of production functions in Blundell and Bond (2000) and Bond (2002). The estimated model considers that firm i produces at time t according to a Cobb-Douglas production function, that in linear form can be expressed as:

$$y_{it} = \alpha l_{it} + \beta m_{it} + \gamma k_{it} + a_{it}, \tag{2}$$

where y_{it} is log of output, l_{it} is log of labour input, m_{it} is log of intermediate inputs, and k_{it} is log of capital input; α, β and γ are the output elasticities with respect to labour, intermediate inputs and capital, respectively. The production technology presents constant returns to scale if $\alpha + \beta + \gamma = 1$. The term a_{it} can be interpreted as the level of TFP and can be decomposed in three error components:

$$a_{it} = \eta_i + \eta_t + u_{it}, \tag{3}$$

where η_i is an individual effect that captures firm-specific productivity differences which are fixed over time, η_t captures macroeconomic shocks in productivity which are common to all firms, and u_{it} picks up idiosyncratic productivity shocks. The static representation of the production function can either be estimated or, alternatively, the idiosyncratic shock, u_{it}, may adopt an autoregressive form, capturing factors such as omitted characteristics that persist or non-instantaneous adjustment. In the latter case, u_{it} can be expressed as:

$$u_{it} = pu_{it-1} + e_{it}, \tag{4}$$

where e_{it} is an idiosyncratic error term. The later assumption permits the following dynamic representation of the production function:

$$y_{it} = \delta_1 y_{it-1} + \delta_2 l_{it} + \delta_3 l_{it-1} + \delta_4 m_{it} + \delta_5 m_{it-1} + \delta_6 k_{it} + \delta_7 k_{it-1} + \delta_8(\eta_i + \eta_t) + e_{it}, \tag{5}$$

where the parameters to be estimated are:

$$\delta_1 = \rho,\ \delta_2 = \alpha,\ \delta_3 = -\rho\alpha,\ \delta_4 = \beta,\ \delta_5 = -\rho\beta,\ \delta_6 = \gamma,\ \delta_7 = -\rho\gamma,\ \delta_8 = 1 - \rho. \tag{6}$$

This set of parameters implies three common factor restrictions:

$$\delta_3 = -\delta_1\delta_2;\ \delta_5 = -\delta_1\delta_4;\ \delta_7 = -\delta_1\delta_6, \tag{7}$$

which can be tested and/or imposed for the estimation of the parameter vector $(\alpha, \beta, \gamma, \rho)$.

Furthermore, the estimation of equation (5) permits us to measure productivity differences between exporters and non-exporters through the average difference of η_i across both groups of firms. Therefore, parametrising the firm-specific component η_i by means of a dummy variable equal to one for the group of exporters and zero otherwise, we test for the average difference of total factor productivity between exporters and non-exporters. Griffith (1999) applies a similar approach to the measure of productivity differences between foreign and domestic-owned companies.

With respect to estimation issues, unobserved heterogeneity and potential simultaneity in the estimation of production functions of the form of (5) have been addressed using the GMM first-differenced estimator (Arellano and Bond, 1991). A statistical shortcoming of this approach has recently been pointed out by Blundell and Bond (2000), who argue that when the explanatory variables are persistent over time, lagged levels of these variables are weak instruments for the regression equation in differences. Company variables such as sales, production, employment, capital, hours, etc., found in micro panel data sets, tend to be highly persistent, as documented in Blundell and Bond (2000), Griffith (1999) and Bond (2002). Therefore, in the estimation of equations of the form (5), the instrument weakness has negative consequences on both the asymptotic efficiency and the small-sample bias of the difference estimator.

Arellano and Bover (1995) and Blundell and Bond (1998) have proposed an alternative system estimator that reduces the biases associated with the standard difference estimator. This estimator combines the regression in differences with the regression in levels in a system. The instruments for the regression in differences are the lagged levels of variables consistent with the moment conditions. For the other component of the system, the equation in levels, the instruments are given by the lagged differences of the variables. This latter part of the system requires additional moment conditions that are only valid under the assumption of no correlation between the variables in differences and the fixed effect, although there may be correlation between the right-hand-side variables in levels and the firm-specific effect. This assumption results from the stationary condition $E[X_{i,t+p}] = E[X_{i,t+q}\eta_i]$, for all p and q, where X is the set of explanatory variables in the moment conditions.

The data set used for the estimation is the same as in Section 2. This set of firms is an unbalanced panel where the units included for estimation were required to have information on the whole set of variables and to have four or more consecutive annual observations. The Data Appendix gives a full description of the variables used in the estimation of equation (5). We report results for the whole set of firms and for three industries defined at the two-digit level of the NACE classification: textiles and clothing (NACE 17 and 18); wooden products and furniture (NACE 36); and the food industry (NACE 15). These three industries are among the set of sectors with the largest number of observations available and have been chosen for this reason.[5]

Table 3 reports mean values for various characteristics of exporters and non-exporters. The fraction of exporting firms differs across industries, with the food industry exhibiting the lowest level. Size differentials between exporters and

[5] Three additional industries have been considered. As specification tests do not confirm the validity of the GMM estimators in these industries, results are not reported, although exporters exhibit higher productivity as well.

TABLE 3
Mean Characteristics for Exporters and Non-exporters, 1999

	All Industries		*Textile and Clothing*		*Wooden Products and Furniture*		*Food Industry*	
	Exporters	*Non-exporters*	*Exporters*	*Non-exporters*	*Exporters*	*Non-exporters*	*Exporters*	*Non-exporters*
Number of firms (per cent)	53.8	46.2	51.3	48.7	35.7	64.3	31.9	68.1
Production (000€)	37,724.0	5,800.8	27,862.9	2,282.7	12,967.3	1,452.3	70,101.5	5,237.0
Employment (number)	253	51	271	51	105	22	311	31
Capital stock (000€)	10,274.9	1,857.9	7,750.0	585.4	1,667.6	211.1	14,659.3	1,004.8
Labour productivity (€ per hour)	23.3	15.2	18.1	9.7	14.6	11.2	28.3	13.4
Total factor productivity	8.0	7.4	7.9	6.9	8.2	7.2	8.2	6.9
Export intensity (per cent)	27.7	0.0	20.9	0.0	16.4	0.0	25.1	0.0

TABLE 4
All Industries
Production Function: Alternative Estimators
(Dependent variable: output y_{it})

	(1) *OLS*	*(2)* *Differences GMM*	*(3)* *System GMM*
y_{it-1}	0.675 (0.015)	0.504 (0.060)	0.671 (0.044)
l_{it}	0.276 (0.019)	0.114 (0.099)	0.206 (0.072)
l_{it-1}	–0.178 (0.019)	–0.081 (0.080)	–0.101 (0.063)
m_{it}	0.498 (0.018)	0.569 (0.043)	0.585 (0.033)
m_{it-1}	–0.281 (0.019)	–0.205 (0.049)	–0.360 (0.038)
k_{it}	0.036 (0.006)	0.043 (0.047)	0.009 (0.036)
k_{it-1}	–0.019 (0.006)	–0.022 (0.037)	–0.022 (0.034)
$Exporters_i$	0.012 (0.004)		0.058 (0.029)
Entering exporters$_i$	0.020 (0.006)		0.038 (0.016)
Continuing exporters$_i$	0.008 (0.004)		0.077 (0.037)
Low export intensity$_i$	0.011 (0.004)		0.052 (0.027)
High export intensity$_i$	0.013 (0.005)		0.075 (0.033)
Instruments	–	$t-3$	$t-3$ and $\Delta(t-2)$
Sargan (p-value)	–	0.037	0.051
Sargan-difference (p-value)	–	–	0.392
m1 (p-value)	0.000	0.000	0.000
m2 (p-value)	0.004	0.153	0.001
Comfac (p-value)	0.026	0.480	0.114
CRS (p-value)	0.007	0.008	0.007
No. of observations (firms)	8,742 (1,403)	7,339 (1,403)	8,742 (1,403)

Notes:
All regressions are estimated in DPD (see Arellano and Bond, 1998); a set of year dummies and a set of industry dummies are included in all models; numbers in parentheses are two-step robust standard errors; Sargan is the p-value from a test of over-identifying restrictions, which test the overall validity of instruments for the GMM estimators; Sargan-difference is the p-value from a test of the validity of the additional restrictions imposed on the system estimator with respect to the difference estimator; m1 and m2 are the p-values from a test of first- and second-order serial correlation; Comfac is the p-value from a test of the common factor restrictions; CRS is the p-value from a test of constant returns to scale; column (2) presents the results from a differences GMM estimator that uses $y_{it-3} \ldots y_{it-5}$, $l_{it-3} \ldots l_{it-5}$, $m_{it-3} \ldots m_{it-5}$ and k_{it-3} and earlier as instruments; the results of column (3) are from a system GMM estimator with the same instruments as in column (2) plus instruments $(y_{it-2} - y_{it-3})$, $(l_{it-2} - l_{it-3})$, $(m_{it-2} - m_{it-3})$ and $(k_{it-2} - k_{it-3})$.

non-exporters are substantial in terms of production, employment and capital stock. Exporting firms are more productive than non-exporters. Measured either in terms of labour productivity or total factor productivity, exporters have higher productivity.

We begin by presenting the estimates of the coefficients from a regression of the form of (5) for the whole set of firms (Table 4). This aggregate estimation is complemented by industry estimations that are reported in Tables 5 to 7 for three industries: textiles and clothing; timber, wooden products and furniture; and the food industry.

Table 4 presents the estimations of equation (5) using OLS, first-differenced and the system estimator for the whole sample of firms. The coefficients that are reported in the central part of the table correspond to two parametrisations of the firm-specific component η_i (entering/continuing exporters; and low/high export intensity), which will be commented on in the next section. While there are a number of similarities among the various estimates, our preferred estimation method uses the GMM system estimator. These estimations include a complete set of year dummies and industry dummies that are included in all estimations to control for common aggregate productivity shocks to all firms and for industry shocks. The OLS estimates of column (1) indicate that exporters have, on average, higher total factor productivity levels than non-exporters. The OLS coefficients are biased if unobserved specific firm effects are correlated with the explanatory variables. Columns (2) and (3) present first-difference GMM estimates and system GMM estimates, respectively. In column (2), the levels of output, intermediate and labour inputs dated $(t-3)$, $(t-4)$ and $(t-5)$ and capital input dated $(t-3)$ and earlier, are used as instruments for the difference equation. For the system estimator, column (3) uses the same level instruments as in column (2), plus differences of output, intermediate, capital and labour inputs dated $(t-2)$.

The consistency of the GMM estimators depends on whether lagged values of the explanatory variables are valid instruments in the production function equation. Four specification tests are reported to address this issue (Arellano and Bond, 1998). The Sargan test rejects the non-validity of the instruments at the five per cent level, although within the limit. The second test is the Sargan-difference test, which examines the null hypothesis that the lagged differences are uncorrelated with the residuals. The Sargan-difference test statistic does reject the non-validity of the additional restrictions imposed on the system estimator. Even with an uncorrelated original error term, first-order serial correlation of the differenced error is expected and confirmed by test statistics. Finally, the test fails to reject the null hypothesis of absence of second-order serial correlation, although not for the system GMM. Overall, the reported specification tests indicate the validity of the moment conditions used in the system GMM.

Although the pattern of signs on current and lagged regressors in the estimations is consistent with the AR(1) error specification, the common factor restrictions test is rejected for the OLS estimator. Constant returns to scale are also rejected. However, the common factor restrictions are easily accepted in the GMM results, and constant returns to scale are also rejected for the first-difference and system estimates.

Results indicate a high degree of persistence, with a coefficient on the lagged dependent variable significant and equal to 0.67 with the system estimator. The results in the system GMM indicate that exporters have a permanently higher level of total factor productivity than non-exporters. The magnitude of the coefficient indicates that after conditioning on inputs, exporters have about 5.8 per cent more output than non-exporters.

TABLE 5
Textiles and Clothing
Production Function: Alternative Estimators
(Dependent variable: output y_{it})

	(1) OLS	*(2) Differences GMM*	*(3) System GMM*
y_{it-1}	0.774 (0.026)	0.551 (0.126)	0.618 (0.031)
l_{it}	0.345 (0.037)	0.497 (0.142)	0.535 (0.035)
l_{it-1}	−0.251 (0.035)	−0.060 (0.156)	−0.404 (0.034)
m_{it}	0.397 (0.032)	0.174 (0.063)	0.404 (0.021)
m_{it-1}	−0.272 (0.032)	−0.136 (0.085)	−0.232 (0.023)
k_{it}	0.067 (0.017)	0.006 (0.026)	0.056 (0.026)
k_{it-1}	−0.062 (0.015)	0.008 (0.024)	−0.004 (0.028)
Exporters$_i$	0.043 (0.012)		0.106 (0.021)
Entering exporters$_i$	0.037 (0.019)		0.083 (0.018)
Continuing exporters$_i$	0.046 (0.012)		0.103 (0.025)
Low export intensity$_i$	0.041 (0.013)		0.114 (0.022)
High export intensity$_i$	0.047 (0.013)		0.105 (0.025)
Instruments	–	$t-3$	$t-3$ and $\Delta(t-2)$
Sargan (p-value)	–	0.271	0.829
Sargan-difference (p-value)	–	–	0.988
m1 (p-value)	0.024	0.000	0.000
m2 (p-value)	0.123	0.285	0.116
Comfac (p-value)	0.001	0.733	0.342
CRS (p-value)	0.000	0.021	0.651
No. of observations (firms)	1,072 (172)	904 (172)	1,072 (172)

Notes:
All regressions are estimated in DPD (see Arellano and Bond, 1998); a set of year dummies and a set of industry dummies are included in all models; numbers in parentheses are two-step robust standard errors; Sargan is the p-value from a test of over-identifying restrictions, which test the overall validity of instruments for the GMM estimators; Sargan-difference is the p-value from a test of the validity of the additional restrictions imposed on the system estimator with respect to the difference estimator; m1 and m2 are the p-values from a test of first- and second-order serial correlation; Comfac is the p-value from a test of the common factor restrictions; CRS is the p-value from a test of constant returns to scale; column (2) presents the results from a differences GMM estimator that uses $y_{it-3} \ldots y_{it-5}$, $l_{it-3} \ldots l_{it-5}$, $m_{it-3} \ldots m_{it-5}$ and $k_{it-3} \ldots k_{it-5}$ as instruments; the results of column (3) are from a system GMM estimator with the same instruments as in column (2) plus instruments $(y_{it-2} - y_{it-3})$, $(l_{it-2} - l_{it-3})$, $(m_{it-2} - m_{it-3})$ and $(k_{it-2} - k_{it-3})$.

Tables 5 to 7 report additional results from the estimation of the dynamic Cobb-Douglas production function for three sectors: textiles and clothing; wooden products and furniture; and the food industry. We do not comment on the results for each sector separately but indicate some general patterns. The specification tests shown for the three industries indicate that the validity of instruments cannot be rejected. The comparison of coefficients from first-differenced and system equations is consistent with expectations of first-differenced coefficients to be

TABLE 6
Wooden Products and Furniture
Production Function: Alternative Estimators
(Dependent variable: output y_{it})

	(1) OLS	*(2) Differences GMM*	*(3) System GMM*
y_{it-1}	0.539 (0.074)	0.187 (0.036)	0.322 (0.014)
l_{it}	0.232 (0.048)	0.056 (0.031)	0.125 (0.011)
l_{it-1}	−0.101 (0.046)	0.057 (0.030)	−0.040 (0.010)
m_{it}	0.580 (0.033)	0.571 (0.037)	0.609 (0.012)
m_{it-1}	−0.240 (0.055)	−0.071 (0.020)	−0.055 (0.010)
k_{it}	0.015 (0.012)	0.016 (0.017)	0.023 (0.006)
k_{it-1}	−0.009 (0.011)	−0.013 (0.007)	−0.005 (0.005)
Exporters$_i$	0.018 (0.015)		0.033 (0.006)
Entering exporters$_i$	0.038 (0.018)		0.056 (0.007)
Continuing exporters$_i$	0.007 (0.017)		0.014 (0.009)
Low export intensity$_i$	0.031 (0.004)		0.077 (0.008)
High export intensity$_i$	−0.003 (0.005)		−0.027 (0.008)
Instruments	–	$t-2$	$t-2$ and $\Delta(t-1)$
Sargan (p-value)	–	0.370	0.511
Sargan-difference (p-value)	–	–	0.695
m1 (p-value)	0.212	0.000	0.000
m2 (p-value)	0.107	0.476	0.573
Comfac (p-value)	0.054	0.958	0.768
CRS (p-value)	0.000	0.000	0.002
No. of observations (firms)	605 (102)	503 (102)	605 (102)

Notes:
All regressions are estimated in DPD (see Arellano and Bond, 1998); a set of year dummies and a set of industry dummies are included in all models; numbers in parentheses are two-step robust standard errors; Sargan is the p-value from a test of over-identifying restrictions, which test the overall validity of instruments for the GMM estimators; Sargan-difference is the p-value from a test of the validity of the additional restrictions imposed on the system estimator with respect to the difference estimator; m1 and m2 are the p-values from a test of first- and second-order serial correlation; Comfac is the p-value from a test of the common factor restrictions; CRS is the p-value from a test of constant returns to scale; column (2) presents the results from a differences GMM estimator that uses $y_{it-2} \ldots y_{it-4}$, $l_{it-2} \ldots l_{it-4}$ and $m_{it-2} \ldots m_{it-4}$ as instruments; the results of column (3) are from a system GMM estimator with the same instruments as in column (2) plus instruments $(y_{it-1} - y_{it-2})$, $(l_{it-1} - l_{it-2})$ and $(m_{it-1} - m_{it-2})$.

biased downwards due to the weakness of instruments. The pattern of signs on current and lagged regressors is consistent with the assumed error specification and the common factor restriction is not rejected at the ten per cent level. The hypothesis of constant returns is rejected for the wooden products and furniture industry with the system GMM estimates. The coefficients of the lagged dependent variable are in line with the aggregate estimation, with the exception of the

TABLE 7
Food Industry
Production Function: Alternative Estimators
(Dependent variable: output y_{it})

	(1) OLS	*(2) Differences GMM*	*(3) System GMM*
y_{it-1}	0.612 (0.046)	0.239 (0.047)	0.528 (0.025)
l_{it}	0.156 (0.036)	0.144 (0.034)	0.139 (0.017)
l_{it-1}	−0.079 (0.033)	0.004 (0.035)	−0.071 (0.015)
m_{it}	0.566 (0.076)	0.566 (0.038)	0.559 (0.019)
m_{it-1}	−0.270 (0.077)	0.080 (0.040)	−0.153 (0.024)
k_{it}	0.038 (0.020)	0.074 (0.027)	0.088 (0.016)
k_{it-1}	−0.015 (0.020)	−0.120 (0.021)	−0.104 (0.015)
Exporters$_i$	−0.008 (0.013)		0.015 (0.026)
Entering exporters$_i$	0.015 (0.016)		0.029 (0.024)
Continuing exporters$_i$	−0.024 (0.015)		0.018 (0.029)
Low export intensity$_i$	−0.000 (0.015)		0.012 (0.027)
High export intensity$_i$	−0.023 (0.019)		−0.044 (0.020)
Instruments	–	$t-3$	$t-3$ and $\Delta(t-2)$
Sargan (p-value)	–	0.244	0.293
Sargan-difference (p-value)	–	–	0.350
m1 (p-value)	0.062	0.002	0.000
m2 (p-value)	0.117	0.357	0.943
Comfac (p-value)	0.401	0.000	0.081
CRS (p-value)	0.011	0.747	0.597
No. of observations (firms)	902 (147)	755 (147)	902 (147)

Notes:
All regressions are estimated in DPD (see Arellano and Bond, 1998); a set of year dummies and a set of industry dummies are included in all models; numbers in parentheses are two-step robust standard errors; Sargan is the p-value from a test of over-identifying restrictions, which test the overall validity of instruments for the GMM estimators; Sargan-difference is the p-value from a test of the validity of the additional restrictions imposed on the system estimator with respect to the difference estimator; m1 and m2 are the p-values from a test of first- and second-order serial correlation; Comfac is the p-value from a test of the common factor restrictions; CRS is the p-value from a test of constant returns to scale; column (2) presents the results from a differences GMM estimator that uses $y_{it-3} \ldots y_{it-5}$, $l_{it-3} \ldots l_{it-5}$, $m_{it-3} \ldots m_{it-5}$ and $k_{it-3} \ldots k_{it-5}$ as instruments; the results of column (3) are from a system GMM estimator with the same instruments as in column (2) plus instruments $(y_{it-2} - y_{it-3})$, $(l_{it-2} - l_{it-3})$, $(m_{it-2} - m_{it-3})$ and $(k_{it-2} - k_{it-3})$.

wooden product and furniture industry, where the degree of persistence is slightly lower with a coefficient of 0.3.

The set of coefficients estimating the average difference between exporters and non-exporters indicates that these differences are significant in the system GMM. In two sectors – textiles and clothing; and wooden products and furniture

– exporters have an output, conditional on inputs, that is 10.6 per cent and 3.3 per cent higher than non-exporters, respectively. For the food industry, the estimated difference is also favourable for exporters, with an output 1.5 per cent greater than that of non-exporters, although the difference is not significant.

Overall, the results indicate that exporting firms have, on average, 5.8 per cent permanently higher total factor productivity than non-exporting firms. Delgado et al. (2002), using index numbers and a similar sample of Spanish manufacturing firms, obtain a very similar TFP difference between exporters and non-exporters. The magnitude of the productivity differences estimated across industries suggests the existence of some degree of heterogeneity. Exporting firms have higher productivity in textiles and clothing, wooden products and furniture, and the food industry, although in the latter case the difference is not significant.

4. ENTRY/EXIT IN THE EXPORT MARKET AND ECONOMIC PERFORMANCE

The underlying causal mechanism linking exporting to productivity is unclear. Two different arguments have been proposed. The first is the self-selection of most productive firms into the export market. The second hypothesis suggests that the positive relationship between exporting and productivity reflects the fact that exporting brings additional benefits to the firm. Both mechanisms are plausible and not mutually exclusive.

Delgado et al. (2002), using a data set of Spanish manufacturing firms, find evidence favourable to the self-selection that we will summarise briefly. The productivity-level distribution of different cohorts of entering exporters, before they enter the export market, stochastically dominates the productivity distribution of non-exporters. This selection mechanism works both for firms entering and exiting the export market. In the latter case, the *ex-ante* productivity-level distribution of exiting firms is stochastically dominated by the productivity-level distribution of continuing exporters. With respect to learning-by-exporting, no systematic evidence in favour of this hypothesis was found in the data set. The productivity growth distribution of entering exporters, after entry takes place, shows no difference with respect to the productivity growth distribution of non-exporters. Both results are basically consistent with the evidence reported by Bernard and Jensen (1999) and Aw et al. (2000).

In this section, once again we explore whether or not firms with different trajectories between the export and the domestic markets show patterns in their economic performance consistent with either the selection or the learning hypothesis. We begin by reparametrising the firm-specific component η_i in the estimated production function (5). These reparametrisations permit us to interpret the new estimated coefficients in terms of the self-selection and the learning-by-exporting hypotheses. The estimation of TFP differences for these additional characteristics is made in the same way as differences between exporters and non-exporters were estimated in Section 3. The coefficients that are reported in the central panel of Tables 4 to 7 correspond to two characteristics of exporting firms. The rest of the coefficients and the specification tests are not reported, as they are essentially the same as those reported for the original specification.

The first characteristic we consider classifies exporters into two groups: entering exporters and continuing exporters. The coefficient attached to the variable *entering-exporters*$_i$ measures the average difference in TFP between entering firms and non-exporters. The productivity of entering exporters is obtained by averaging observations around the period of entry in the export market. Therefore, the coefficients can be interpreted as the productivity difference, measured around the moment of entry, between entering exporters and non-exporters. These coefficients can be interpreted as approximations to the *ex-ante* productivity differences between exporters and non-exporters and a positive and significant coefficient provides evidence favourable to self-selection of the most productive firms in the export market.

The evidence presented in Tables 4 to 7 confirms that entering exporters have a higher TFP with respect to non-exporters. For the whole sample of firms, the TFP is 3.8 per cent higher for entering exporters than for non-exporters, and the difference is also significant for continuing exporters. In the textile and clothing industry, TFP differences for entering exporters with respect to non-exporters is 8.3 per cent; in the wooden products and furniture industry, the difference is 5.6 per cent, although significant in the limit; and in the food industry, the difference is 2.9 per cent, but not significant. The productivity premium for continuing exporters is also reported and permits to compare productivity differences between entering and continuing exporters. With the exception of the furniture industry (Table 6) we cannot reject the null hypothesis that the productivity premium of entering exporters is equal to the premium of continuing exporters. Therefore, productivity differences between both groups of firms are rather small and not statistically significant.

The second characteristic of exporters that we consider is export intensity, defined by the share of exports to total sales at the firm level. Taking as a reference the average level of export intensity for the sample of exporters in each industry, two groups of firms are defined: the group of firms with high export intensity (greater than the average) and the low export intensity group. Two arguments have been proposed to justify the relationship between export intensity and firm productivity at the firm level. First, Bernard et al. (2003) demonstrate that more productive firms typically sell in more markets. This may reflect higher export intensity, as firms selling abroad in more markets also have greater export intensity. In this case, self-selection will induce a positive correlation between productivity and export intensity. Second, if externalities from exporting exist at the firm level, i.e. learning-by-exporting, it is likely that they will be higher the more the firm exports. This is suggested by Aw et al. (2000), among others. Therefore, both for reasons of self-selection and learning-by-exporting, TFP differences between exporters and non-exporters must be an increasing function of export intensity.

The coefficients attached to the variables *low/high export intensity*$_i$ show no clear pattern. For the whole sample of firms (see Table 4), productivity differences are positively related to export intensity, although the difference between both coefficients is relatively small. For textiles and clothing productivity, differences between both categories are not statistically significant. For both the wooden products and furniture industry and the food differences with respect to non-exporters are lower when export intensity increases. Overall, these coefficients show evidence of little systematic effect of trade exposure on firm productivity.

To further explore the magnitude of productivity differences among firms with different transition patterns between the export and the domestic markets, we run additional regressions similar to those reported in Section 2 for the estimation of export premia, i.e. equation (1). In order to estimate productivity differences among firms with different trajectories between the export and the domestic market, we substitute in equation (1) the variable *Export*$_i$ with a set of dummies describing the following groups of firms: continuing exporters, entering exporters, exiting exporters, switching exporters and non-exporters. The omitted group is non-exporters, and consequently the estimated coefficients measure productivity differences between non-exporters and the rest of the groups. According to the selection hypothesis, the ranking of productivity differences should be consistent to the export status of firms. In particular, after controlling for size, age, ownership, industry and time, the average productivity of entering exporters should be greater than the productivity of non-exporters. Furthermore, considering the existence of selection on the exit side of the market, the average productivity of continuing exporters should be greater than the productivity of exiting exporters.

As we mentioned before in Section 2, export-premia coefficients approximate differences in performance among groups of firms with different transition patterns in the export market. The first row of Table 8 reports the results for the whole set of industries and the level of TFP as the dependent variable. The productivity of continuing exporters and entering exporters is significantly higher than the productivity of the omitted group of non-exporters. In particular, the coefficient of entering exporters confirms the existence of self-selection of more productive firms into the export market. In addition, the average productivity of exiting exporters is not significantly different with respect to the group of non-exporters, and the null hypothesis of equal productivity between exiting exporters and continuing exporters can be rejected at any significance level. Therefore, the ranking of TFP confirms that continuing exporters have a higher productivity level than exiting exporters (selection on the exit side of the market) and entering

TABLE 8
Productivity Performance by Export Status

	Dependent Variable	*Continuing Exporters (t-statistic)*	*Entering Exporters (t-statistic)*	*Switching Exporters (t-statistic)*	*Exiting Exporters (t-statistic)*	*Control Variables:*				
						Log (Size) (t-statistic)	*Foreign Ownership (t-statistic)*	*Log (Age) (t-statistic)*	*Industry Wald Test (p-value)*	*Time Wald Test (p-value)*
All industries	TFP level	0.07 (6.8)	0.09 (7.2)	0.05 (4.1)	−0.01 (−0.6)	0.00 (1.1)	−0.00 (−0.3)	−0.00 (−0.0)	126 (0.00)	137 (0.00)
	TFP growth	0.02 (1.3)	0.01 (0.7)	−0.00 (−0.2)	−0.01 (−0.4)	0.00 (0.4)	−0.00 (−0.2)	−0.00 (−0.7)	6 (1.00)	106 (0.00)
	TFP growth (matched sample)	–	0.01 (1.2)	–	–	−0.00 (−0.5)	0.01 (0.4)	0.01 (1.5)	13 (0.67)	24 (0.00)
Textiles and clothing	TFP level	0.18 (4.7)	0.12 (2.1)	0.13 (2.6)	0.11 (0.6)	0.01 (1.5)	−0.01 (−2.1)	−0.04 (−2.1)	–	24 (0.00)
	TFP growth	0.01 (1.0)	0.02 (0.8)	−0.00 (−0.1)	0.01 (0.5)	0.03 (1.1)	−0.01 (−0.2)	−0.03 (−1.2)	–	27 (0.00)
	TFP growth (matched sample)	–	−0.00 (−0.1)	–	–	−0.00 (−0.4)	–	0.01 (1.0)	–	13 (0.12)
Wooden products and furniture	TFP level	0.01 (0.2)	0.10 (2.0)	0.06 (1.3)	0.10 (2.5)	0.03 (1.3)	−0.23 (−3.1)	0.04 (1.7)	–	24 (0.00)
	TFP growth	0.00 (0.1)	0.03 (1.6)	0.00 (0.2)	−0.01 (−0.7)	0.00 (0.4)	−0.09 (−2.9)	0.02 (1.2)	–	22 (0.01)
	TFP growth (matched sample)	–	0.05 (1.6)	–	–	−0.01 (−0.4)	−0.15 (−1.6)	0.07 (2.5)	–	41 (0.00)
Food industry	TFP level	0.03 (0.5)	0.06 (1.0)	0.17 (3.7)	−0.64 (−1.3)	0.04 (2.2)	−0.03 (−0.4)	−0.00 (−0.0)	–	5 (0.72)
	TFP growth	0.05 (1.95)	0.07 (2.2)	0.04 (1.9)	−0.16 (−0.9)	−0.00 (−0.0)	−0.03 (−1.2)	−0.03 (−2.0)	–	6 (0.66)
	TFP growth (matched sample)	–	0.05 (1.4)	–	–	−0.00 (−0.3)	−0.07 (−1.5)	−0.01 (−1.0)	–	6 (0.65)

Notes:
Numbers in rows are coefficients and test values estimated from regressions as (1) in the text, where the variable $Export_i$ is decomposed into four dummies: Continuing exporters, Entering exporters, Switching exporters and Exiting exporters. For industry and time dummies, we report the Wald test of joint significance for the sets of 17 and nine dummy variables, respectively (i.e. test of the null hypothesis that their estimated coefficients are equal). Reported statistics are estimated with asymptotic variance matrices that are heteroscedasticity-consistent. Dependent variables in levels are in logs.

exporters have a higher productivity than non-exporters (selection on the entry side of the market).

Table 8 reports export productivity differences for the three industries we are considering: textiles, furniture and the food industry. Results confirm the self-selection of entering exporters relative to non-exporters in textile and furniture. For the food industry, the productivity difference between entering exporters and non-exporters is positive but not significant. With respect to the exit side of the market, we find evidence of self-selection of exiting firms in the textile and food industries but not in the furniture industry.

Finally, Table 8 reports regressions that have the rate of change in TFP as their dependent variable. These regressions are reported to test the view that entry in the export market provides the firm benefits that result in higher productivity. If this view is correct, the productivity gap between export starters and non-exporters should increase after entry. The evidence reported in the second row of Table 8 indicates no significant differences in productivity growth among the five groups of firms with different transition patterns between the export and the domestic market. Particularly, after entry, the productivity growth of entering exporters is not significantly different with respect to the productivity growth of firms remaining outside the export market. Therefore, differences in productivity levels between exporting firms and non-exporting firms do not significantly change after entry in the export market.

The rows corresponding to the textile and the furniture industries report coefficients indicating that, after entry takes place, the growth of TFP of export starters is not significantly different with respect to the productivity growth of non-exporters. However, the coefficient is positive and significant for the food industry.

Interpreting the evidence on post-entry TFP growth differences between entering exporters and non-exporters as favourable or unfavourable to the learning-by-exporting hypothesis requires controlling for self-selection. Two approaches have been used in the literature. The first consists of the estimation of a simultaneous equation model composed of a probit model that explicitly models a firm's decision to export and an equation that captures the evolution of productivity (as, for example, in Clerides et al., 1998). The second approach to control for self-selection is with a matching estimator (as in Wagner, 2002, and Girma et al., 2004). We apply the latter approach.

The basic idea of matching is to select from the set of non-exporters those firms in which the distribution of the variables affecting the outcome variable is as similar as possible to the distribution of entering exporters, i.e. the group of treated firms. To do so, we adopt the 'propensity score matching method'.[6] Each treated firm is matched with a control, the non-exporters with the closest propensity

[6] The matching is performed in STATA as described in Sianesi (2001).

score. This propensity score is calculated as the predicted value from a probit regression of a dummy variable that takes the value one if the firm enters the export market and zero otherwise. This probit includes the initial levels of TFP, size, age, ownership and a set of industry dummies as explanatory variables. A non-exporter, which is the closest in terms of its propensity score to an entering exporter, is then selected as a match for the former, using the nearest-neighbour matching method. By picking non-exporting firms with characteristics similar to export starters, we correct from selection bias. In the final sample, we select 153 non-exporters as a match for the 141 treated firms (entering exporters). This sample of control firms is used to estimate the TFP growth export premium.

Table 8 reports the coefficients on entering exporters for the matched sample. With the exception of the food industry, all coefficients are not significant. In the case of the food industry, entering exporters have a significant coefficient for the unmatched sample but this coefficient is not significant for the matched sample. This evidence does not favour the learning-by-exporting hypothesis and coincides with the majority of earlier studies. Interestingly, some of the papers that have found evidence of learning, such as Blalock and Gertler (2004) for Indonesia and Van Biesebroeck (2005) for six sub-Saharan countries, suggest the possibility that the existence of learning effects were related to the level of development of exporters' countries: exporters from less developed countries may improve their productivity through exporting.

5. SUMMARY

This paper uses a microeconomic data set to explore performance differences between exporting and non-exporting firms in the Spanish manufacturing sector. We apply three different analyses. First, we measure export premia for different performance measures such as labour productivity, wages, the composition of the labour force, R&D expenditure, degree of innovation and type of ownership. Second, we measure TFP differences between exporters and non-exporters, estimating production functions that control for unobserved heterogeneity and simultaneity bias. Third, we explore whether or not firms with different trajectories between the domestic and the export market show systematic *ex-ante* differences in their performance levels.

The results indicate that after controlling for size, industry, time, age and the type of ownership, exporting is positively and significantly correlated with various measures of business performance. Indicators of economic performance such as productivity, size, wages and innovation are greater in exporting firms. Our empirical estimates parallel those reported in the literature for other countries.

The estimation of production functions indicates that exporting firms have, on average, around six per cent permanently higher TFP. This magnitude is quite similar to the productivity difference estimated using index numbers, both in this paper and previously in Delgado et al. (2002). Therefore, these results confirm that the magnitude of the productivity premium for exporters is robust to the measurement of technology with different methodologies, i.e. using either the parametric methods or the index number measures. A second pattern of results refers to productivity differences across industries. The evidence obtained suggests the existence of some degree of heterogeneity in the magnitude of the productivity differences.

We also find systematic patterns in the relationship between performance at the firm level and transitions between the export and the domestic market. Three basic regularities emerge from the data set. First, entering exporters have higher performance levels than non-exporters before they enter the export market. Second, our findings are also consistent with self-selection on the exit side of the market as continuing exporters have higher performance than exiting exporters. Third, differences between exporters and non-exporters do not significantly change after entry in the export market takes place. These results, first of all, do not contradict the majority of earlier studies that have found evidence favourable to the hypothesis of self-selection; and, secondly, our results do not confirm the learning-by-exporting hypothesis, although the evidence concerning this question is more mixed in the rest of the literature.

DATA APPENDIX

The data source of this paper is the *Encuesta sobre Estrategias Empresariales* (ESEE), an annual survey conducted by the Spanish Ministry of Industry and Energy. The survey refers to a representative sample of Spanish manufacturing firms with ten or more employees. In the base year, firms were chosen according to a selective sampling scheme with the probabilities of firm participation contingent on their size category (see Fariñas and Jaumandreu, 1999, for more details). Over the period 1990–1999, the ESEE collected 18,680 observations that correspond to 3,151 manufacturing firms. From this set of firms, 10,145 observations that correspond to 1,403 firms were available for estimation. The units included for estimation were required to contain information on the whole set of variables used in the analysis and to have four or more consecutive annual observations. In what follows, we give a description of the variables used in the analysis.

– *Age*. Firm age is computed as the difference between the calendar year at t and the birth-year reported by the firm.
– *Capital input*. The net capital stock at current replacement value is computed recursively from an initial estimate of the capital stock and from time series of a firm's investments in equipment goods series. The perpetual inventory formula used for the estimation of the capital stock is:

$$k_t = I_t + k_{t-1}(1 - d_t)\frac{P_t}{P_{t-1}},$$

where I_t represents investment in equipment, d_t stands for depreciation rates and P_t corresponds to a price index for equipment published by the *Instituto Nacional de Estadística*. The initial value of the net capital stock is estimated considering the book value of the capital equipment and the average age of the equipment. Replacement values of the capital stock are expressed in real terms.

– *Capital per hour*. This is defined as the ratio between the net capital stock at current replacement value and the number of effective hours of work per year.
– *Employment*. This is the average number of workers during the year.
– *Export intensity*. This is defined as the ratio between the value of exports and total sales. The ratio is used to define two groups of firms: *low export intensity* firms are those producers with export intensity that is below the average industry level; *high export intensity* firms correspond to producers with export intensity greater than or equal to the average industry level.
– *Export status*. Firms are classified according to their export market participation over the period. We construct a set of dummies that classifies firms into five groups: *continuing exporters*, firms exporting over the entire period; *non-exporters*, firms not selling abroad during the time period; *entering exporters*, firms becoming exporters during the period without further changes in the rest of the period; *exiting exporters*, firms ceasing to export and not re-switching; and *switching exporter*, firms switching their export status more than once over the period. The export status of the firm is also defined according to the current export status. With this alternative definition, exporters may include continuing exporters and observations that correspond to entering, exiting and switching firms.
– *Foreign*. Dummy variable indicating that foreign ownership is 50 per cent or more of total equity.
– *Intermediate inputs*. Material inputs are measured by the cost of intermediate inputs, which includes raw materials purchases, energy and fuel costs and other services paid for by the firm. Intermediate inputs are expressed in real terms using individual price indices of intermediate inputs reported by the firm.
– *Labour input*. Labour is measured by the number of effective hours of work per year, which is equal to normal hours plus overtime hours minus non-working hours.
– *Labour productivity*. This is defined as the ratio of value added in real terms to the number of yearly effective hours of work.
– *Output*. The value of gross production of goods and services is expressed in real terms using individual price indices for each firm.
– *Qualified worker/Total employment*. This ratio is defined by the quotient between the number of highly qualified workers (engineers and graduates) and the average number of workers during the year.

– *R&D activities*. This is a dummy variable that takes the value one when the firm incurs internal or external R&D expenditures. These expenditures reflect investments to reduce cost by improving the production process and to develop and introduce new and improved products.
– *R&D effort*. This is defined by the ratio between total R&D expenditures and gross production. Total R&D expenditures reflect the cost of R&D activities plus expenditures on imported technology (patent licences and technical assistance).
– *Size*. Log of employment defined by the average number of workers.
– *Total factor productivity*. The index of firm-level productivity is measured as follows:

$$\ln TFP_{it} = \ln Q_{it} - \alpha_{ik} \ln K_{it} - \alpha_{il} \ln L_{it},$$

where Q_{it} is added real value, K_{it} is real capital, and L_{it} is labour input (effective hours). Input shares (α_{ik}, α_{il}) are measured for each firm as the fraction of the cost of the input over total costs. The cost of labour is measured by the sum of wages, social security contributions, and other labour costs paid by the firm. The cost of capital is computed with the estimation of the user cost of capital, which is measured by the cost of the firm's long-term external debt plus depreciation rates minus the variation of the price index for capital goods.
– *Wage per hour*. Ratio of labour cost to the number of yearly effective hours of work. The labour cost is measured by the sum of wages, social security contributions, and other labour costs paid for by the firm.

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