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Export intensity and the productivity gains of exporting*

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Abstract

This paper analyses whether the productivity gains associated with learning-by-exporting (controlling for self-selection) depend on the intensity of the firm exporting activity. Results from a representative sample of Spanish manufacturing firms indicate that the yearly average gains in productivity are larger for those firms that increase their export to sales ratio.

Keywords: export intensity; learning-by-exporting; productivity; endogenous Markov; semi-parametric approach

JEL classification: C13, C14, C33, C36, D24, F1

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1. Introduction.

There is evidence to show that exporters are generally more productive than non-exporters (Wagner, 2012). In this paper we seek to investigate whether the productivity gains associated with exporting depend on the intensity of the firm exporting activity.

To empirically assess this question we need to address two issues. First, it is well known that a minimum productivity level is a precondition for export participation (Melitz, 2003). Thus, to estimate the ex-post productivity improvement (learning-by-exporting, LBE hereafter) one needs to take into account that only the *ex-ante* more productive firms are able to sell abroad (self-selection). Second, for such an estimate to make sense, past export experience should be allowed to impact future productivity (De Loecker, 2010). In fact, using the same data to analyze the impact of the decision to export on productivity, Manjón *et al.* (2012) find no evidence of LBE when assuming that productivity follows an exogenous Markov process, whereas they obtain yearly average gains in productivity of 3.6% when past export experience is allowed to affect productivity.

2. Empirical strategy.

First, we obtain an estimate of productivity using a Cobb-Douglas production function and a semi-parametric approach. Second, we use matching techniques to estimate the extra yearly average cumulative productivity growth (EPG hereafter) for each export starter. Lastly, we use regression analysis to analyze whether the

productivity gains associated with LBE depend on the intensity of the firm exporting activity.

2.1. Productivity estimates.

Our starting point is the following Cobb-Douglas production function (in logs):

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_a a_{it} + \beta_m m_{it} + \omega_{it} + \eta_{it} \quad (1)$$

where the output of firm i at time t (y_{it}) depends linearly on its labor (l_{it}), capital (k_{it}), age (a_{it}), intermediate materials (m_{it}), productivity (ω_{it}, assumed to be observable by the firm but not by the analyst) and a random error (η_{it}). Besides the usual assumptions on the timing of input choices (Ackelberg *et al.*, 2007), we make two more assumptions (following De Loecker, 2010) to estimate (1).

First, we consider different demands of intermediate materials for exporters and non-exporters:

$$m_{it} = m_E\left(k_{it}, a_{it}, \omega_{it}\right) \quad (2)$$

where the subscript E distinguishes between exporters and non-exporters. Since the demand of intermediate materials is assumed to be monotonic in productivity, it can be inverted and plugged into the production function (1) to obtain:

$$y_{it} = \beta_l l_{it} + 1(non-\exp) H_0\left(k_{it}, a_{it}, m_{it}\right) + 1(\exp) H_1\left(k_{it}, a_{it}, m_{it}, E_{it}\right) + \eta_{it} \quad (3)$$

where 1(*non-exp*) and 1(*exp*) are indicator functions for non-exporters and exporters. Functions H_0 and H_1 will be proxied by third degree polynomials in their respective arguments.

Second, we assume that firm's export experience (E_{it-1}) determines the dynamics of productivity in the following way:[1]

$$\omega_{it} = E\left[\omega_{it}\middle|\omega_{it-1}, E_{it-1}\right] + \xi_{it} = f\left(\omega_{it-1}, E_{it-1}\right) + \xi_{it} \tag{4}$$

Plugging (4) into (1) and using (2), we obtain:

$$\begin{aligned} y_{it} &= \beta_l l_{it} + \beta_k k_{it} + \beta_a a_{it} + \beta_m m_{it} + 1(non-\exp) F_0\left(k_{it-1}, a_{it-1}, m_{it-1}\right) + \\ &+ 1(\exp) F_1\left(k_{it-1}, a_{it-1}, m_{it-1}, E_{it-1}\right) + u_{it} \end{aligned} \tag{5}$$

where F_0 and F_1 are unknown functions to be proxied by third degree polynomials in their respective arguments, E_{it-1} includes an export dummy and the export value, and $u_{it}=\xi_{it}+\eta_{it}$.

We estimate (3) and (5) jointly by GMM for each industry,[2] using appropriate instruments and moment conditions for each equation (Wooldridge, 2009), and then compute firm-year values of productivity using (5).

2.2. Export intensity and the EPG of export starters.

We use firms' productivity estimates to analyze whether export intensity impacts export productivity growth. Notice, however, that comparing the productivity growth of export starters (after starting to export) and non-exporters is problematic, since the observed differences can arise from both LBE and self-selection.[3] An estimate of the EPG requires a comparison of the productivity

[1] We assume that the firm decides whether to export in *t* knowing its productivity in *t*-1.

[2] Metals; non-metallic minerals; chemicals; machinery; transport equipment; food, drink and tobacco; textile, leather and shoes; timber and furniture; paper and printing.

[3] A firm is an export starter at period *t* if it has not exported during the sample periods previous to *t* (and it has been observed in the sample for at least two years before *t*). A firm is a non-exporter if

growth between *t* and *t*+*s* of export starters (Δy^1_{it+s}) and the growth had they not started to export (Δy^0_{it+s}). The problem is that (Δy^0_{it+s}) is not observable. We overcome this problem using propensity score matching techniques (Rosenbaum and Rubin, 1985).

Thus, we match firms on the basis of the probability to export for the first time. In particular, we obtain this probability (propensity score) from a probit model in which the set of firms characteristics are lagged productivity, capital, age, size, industry and year dummies (widely used variables to test for self-selection into starting to export).

We use nearest neighbors matching (Becker and Ichino, 2002) to identify for each export starter the 4 non-exporters with the closest propensity score from the pool of non-exporters in *t*. Then, we calculate the EPG corresponding to each export starter as the difference between its actual rate of productivity growth and the weighted average of the rate of growth of the 4 matched non-exporters $\left(\Delta y^1_{it+s} - \Delta y^C_{it+s}\right)$.

Then, we use individual EPG as dependent variable in a set of regressions that analyze the influence of export intensity on the extent of LBE. In particular, our dependent variable is the EPG of export starters from *t* to *t*+4. This means that we report results from a sample of export starters that export five consecutive years (persistent export starters). This allows us to analyze the effect of export intensity

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it has not exported in any of the periods it is observed in the sample (and it has been observed in the sample for at least two years).

and its evolution, and to clean our LBE analysis from the influence of occasional exporters.

3. Results.

3.1. Data and descriptive analysis.

The data we use are drawn from the *Encuesta sobre Estrategias Empresariales* for 1990-2008. This is an annual panel survey representative of Spanish manufacturing firms classified by industrial sectors and size categories.[4]

As can be observed in Figure 1, export intensity of Spanish persistent export starters in the first year of exporting is biased to very low export intensity values. In this histogram, there are two large spikes: one corresponding to export starters with export intensity below 2.5% (44% of the persistent export starters) and another corresponding to export starters with export intensity between 2.5% and 5% (16% of the persistent export starters). Export starters with export intensity above 5% represent 40% of total persistent export starters.

[Figure 1]

After five years of exporting the histogram still shows two large spikes corresponding to export starters with export intensity below 2.5% and with export intensity between 2.5% and 5% (Figure 2). However, these spikes are lower: the percentage of persistent exporters with export intensity below 2.5% is now 37% (7% lower than in the initial exporting year); the percentage with export intensity between 2.5%-5% is now 12% (4% lower than in the initial exporting year); and,

[4] See http://www.fundacionsepi.es/esee for details.

finally, persistent export starters with export intensity above 5% represent now 51% of total persistent export starters (11% higher than the initial exporting year). Therefore, we observe an increase of the intensive margin for persistent exporters.

[Figure 2]

3.2. Estimates.

We report results on the relation between EPG and export intensity in Table 1. In column one, we include just a constant, which measures the EPG of export starters over non-exporters without taking into account export intensity. The second column further includes export intensity the first year exporting and its square. Neither the estimate of initial export intensity nor its square is significant. The third column includes as covariate, besides the constant, the annual rate of growth of export intensity over the period t-t+4. The estimate of this variable is positive and significant, suggesting that the EPG is higher for export starters that deepen their export to sales ratio. Finally, in column four we include all covariates, obtaining again that neither export intensity nor its square is significant. Also, the annual export intensity growth is positive and significant.

[Table 1]

The lack of significance of export intensity the first year exporting suggests that the main factor explaining the EPG of export starters is the change from not exporting to exporting (as captured by the constants), and not the share of exports in total sales. However, once firms start to export, those that deepen their export relationships enjoy higher EPGs. This suggests that although the productivity gains of exporting may work initially through the extensive margin (whether firms

export or not), for firms that continue exporting the intensive margin (how much firms export) determines the extent of their productivity gains.

4. Conclusions.

This paper investigates the role of the intensity of the firm exporting activity on LBE using matching techniques. Our results indicate that the productivity gains of Spanish manufacturing firms starting to export are larger for those persistent export starters that increase their export to sales ratio.

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Figure 1: Export intensity of export starters the year they start exporting.

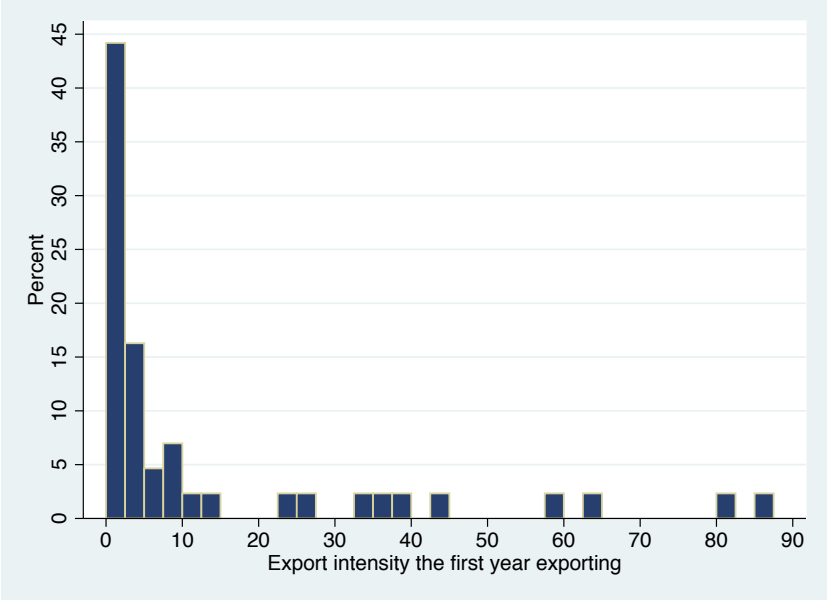

Figure 2: Export intensity of export starters after 5 years exporting.

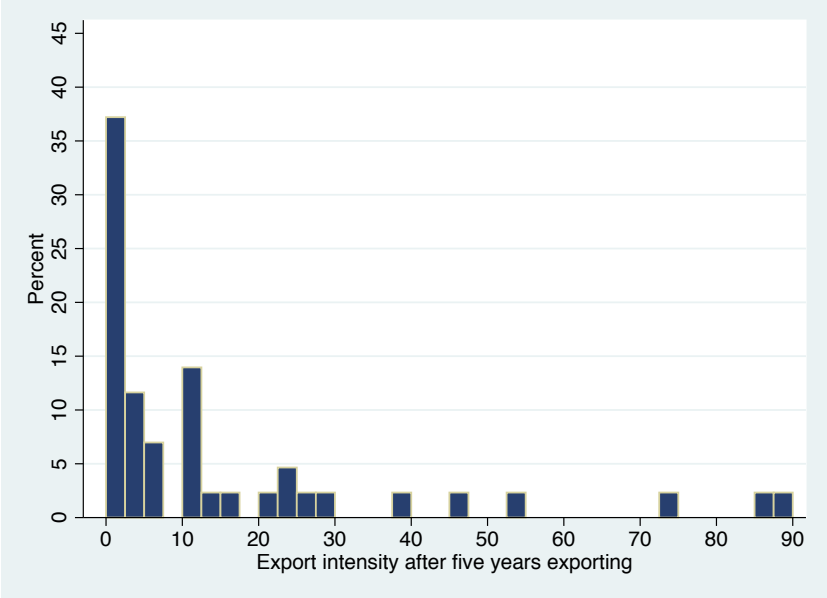

Table 1. Productivity gains and export intensity.

Covariates	**(i)**	**(ii)**	**(iii)**	**(iv)**
Constant	0.036***	0.045***	0.028***	0.030**
	(0.001)	(0.002)	(0.009)	(0.046)
Export intensity in *t*	-	-0.000	-	0.001
		(0.786)		(0.729)
Export intensity in *t* squared	-	-0.000	-	-0.000
		(0.793)		(0.519)
Annual export intensity growth rate (from *t* to *t+4*)	-	-	0.054***	0.050**
			(0.009)	(0.028)

[a] *p*-values in parenthesis using subsampling standard errors (Abadie and Imbens, 2008).
[b] *, **, *** indicates significance at 10%, 5% and 1%.