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From productivity to exporting or vice versa?

Evidence from the Tunisian manufacturing sector

Mohamed Ayadi[1] and Wided Mattoussi[2]

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Abstract: In this paper, we explore the link between firm productivity and exporting using three firm level datasets of 1323 Tunisian manufacturing firms from 2004 to 2006. In particular, we examine whether more productive firms self-select into export markets, and whether exporters achieve productivity improvements through learning by exporting effects. We then explore the link between innovation (as a channel linking productivity to exporting) and exporting. The analysis has been conducted on two clusters of firms. The first cluster distinguishes exporters from non-exporters and the second distinguishes fully exporting firms from others. The results suggest that fully exporting firms self-select more often into export markets and, therefore, have much less to gain from exporting because of their likely longer prior exporting experience. The analysis has been extended to deal with sectoral studies. The study finds that, in the long run, fully exporting firms in sectors characterized by subcontracting regimes, such as the textile and electronics industries, experience a distinct decline in the scope for learning by exporting. Moreover, the scope for learning might also be influenced by export destination, as in the case of the agro-food industries.

Keywords: manufacturing industry, learning by exporting, self-selection, innovation, Tunisia
JEL classification: F140, L63, L67, O55

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1 Introduction

Enhancing the competitiveness of a country's industry is a key issue for economic growth. A bulk of literature and several empirical analyses suggest that competitiveness is closely related to the efficiency, innovation activity and global engagement of firms. Recent research on the exporting behaviour of firms has established several empirical regularities. Exporting firms are known to be superior to non-exporters in terms of productivity, capital-intensity, wages, and size. The productivity premium of exporting firms has received special attention from economists, who have sought, in particular, to test the validity of two dominant hypotheses: (i) the self-selection hypothesis, which states that productive firms are likely to self-select into export markets; and (ii) the learning by exporting hypothesis, which states that exporting is an important source of knowledge accumulation for improving firm capabilities. It has been often argued that an export-oriented strategy increases efficiency at the firm level (Grossman and Helpman 1991; Krugman 1988; Rodrik 1988).

Developing countries that have adopted an export-oriented industrialization strategy have grown faster than those that have adopted an import-substitution strategy (see Balassa 1978; Donges 1976). One possible explanation is that export-oriented firms are more efficient than import substitution-oriented ones (see Bhagwati and Srinivasan 1979; Krueger 1980). This explanation is more compelling since firms that adopt import-substitution strategies do not compete with seasoned and more advanced firms. This reasoning also suggests that the potential gains from exporting are very likely not only to be large in developing countries but also to be much higher than in the developed world. For instance, in an analysis of the causal relationship between exporting and productivity at firm level in the US economy, Bernard and Jensen (1995, 1999a, 1999b) found weak evidence of learning by exporting, suggesting that exporting does not offer great scope for learning in this economy because it is the most competitive and the most technologically advanced. This implies that firms in the poorest countries (with poor technology and low productivity) may have much more to gain from exposure to international export markets.

> Exporting offers the maximum scope for the increased discipline of competition and contact with foreign customers provides the maximum scope for learning opportunities. … From a policy perspective, whether or not firms learn from exporting is an important issue. Africa's domestic markets for manufactures [*sic*] are so small that if African countries are to industrialise, it will have to be through exports. At present there is a substantial competitiveness gap, and under learning by exporting such a gap can be reduced endogenously through increased international trade (Bigsten et al. 2004: 117–18).

Large productivity premiums of new exporters compared to those of non-exporters imply that the decision to start exporting is determined by factors that affect the productivity of firms. This, in turn, implies that there is an important channel linking productivity and exporting, namely innovation. On the one hand, a firm's decision to start exporting may be driven by prior decisions to innovate and, consequently, improve productivity; on the other hand, an increase in a firm's exporting activity, due to an increased scale of sales, feeds back into its productivity by increasing process innovations.

In this paper, we explore the link between firm productivity and exporting decisions and between innovation[1] and exporting using a production-function approach. The empirical analysis is based

[1] In this analysis, we do not distinguish between product and process innovation.

on three firm level datasets using accounting, industrial and exporting flow surveys conducted on 1323 Tunisian manufacturing firms from 2004 to 2006.

The Tunisian government has been relatively successful in creating a congenial environment for export-oriented foreign investors. Tunisia is becoming an attractive destination for European investment[2] because of geographical and cultural proximity. The offshore sector[3] represents more than 48 per cent of the manufacturing sector in Tunisia; almost 70 per cent of manufacturing exports come from firms that have been benefiting from an offshore status since 1972 and whose entire production is exported to the European Union (EU). This peculiarity of the Tunisian manufacturing industry provided the rationale for conducting this study's empirical analysis on two clusters of firms: (i) exporters (including fully and partially exporting firms) versus non-exporters and (ii) fully exporting firms versus others.

We begin the analysis by testing various predictions for the manufacturing industries, ignoring the effect of sectoral specificities. No evidence of self-selection is found in partially exporting firms. In contrast, there is robust statistical support for fully exporting firms to self-select into export markets. These firms are likely to exhibit superior productivity since they are more competitive than others, increasing their incentives to self-select into export markets. Strong evidence is also found for the learning by exporting effect in the first cluster of firms; however, the evidence for the second cluster of firms is much weaker, suggesting that the scope for learning by exporting is less in fully exporting firms (mainly composed of subcontractors with relatively longer previous exporting experience and for which exporting is guaranteed).

This study provides strong evidence of a two-way relationship between innovation and the decision to export. While previous innovation activity is found to increase the probability of current exporting activity, the latter is found to drive innovation activity. In addition, the impact of innovation on triggering export decision is found to be slightly less for fully exporting firms. This suggests that fully exporting firms have less incentive to innovate than partially exporting ones because they are already technologically advanced (they have almost similar technological advancement as countries to which they export). This result supports the evidence for less scope for learning by exporting in this cluster of firms. In contrast, the effect of exporting on innovation is found to increase slightly for fully exporting firms, implying that this cluster of firms has a greater ability to acquire new knowledge because of greater exposure to more mature markets and greater ability to adopt best-practice technologies.

We then extend the basic analysis to include sectoral specificities. Indeed, Tunisian exports of manufacturing products are mainly concentrated on textile and clothing, which constitute almost 70 per cent of manufacturing products. However, some new products have emerged—such as beam wires commanded by European mass-produced vehicles, electronic components, plastic products, essential oils and detergents—for which foreign demand has exhibited a rapid increase. This suggests that the relationships explored in the basic analysis are very likely to be sector-specific. The study focuses on four sector groups: (i) the textile/clothing and leather/footwear industries, (ii) the mechanical/electric and electronics industries,[4] (iii) the agro-food industries, and (iv) all other manufacturing firms.

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[2] Even firms from BRICS (Brazil, Russia, India, China and South Africa) and North America are increasing their investments.

[3] Kearney's 2009 Global Services Location Index (GSLI) ranked Tunisia as the '17th most attractive offshoring destination in the world' (*African Manager* 2009).

[4] Together, they represent more than 24 per cent of the whole industry, but 62 per cent of exporting firms in 2007.

The study finds weak evidence of self-selection in both clusters of firms in the textile/clothing industry. One plausible explanation for failing to detect a direct self-selection effect is the strong persistence of firm productivity which could mask the self-selection effect. No statistical support is found for learning by exporting in either cluster. The fact that most firms comprising this sector are seasoned subcontractors with long experience in the export markets may have reduced their scope for learning. With respect to the link between innovation and exporting decisions, the analysis provides evidence for the positive impact of previous innovation on increasing the incentives for current exporting in partially exporting firms; in contrast, the analysis shows that exporting does not drive ongoing innovation. As for fully exporting firms, no evidence is found for the impact of innovation on increasing the likelihood of exporting.

The study finds no evidence of self-selection in partially exporting firms in the electronics sector. In contrast, the statistical support for self-selection is strong in fully exporting firms. There is no evidence of learning by exporting in partially exporting firms. One explanation that could be put forward is that an increase in efficiency in this sector, which is known to be capital-intensive, is associated with more intensive utilization of capital in such a way as to mask the direct effect on exporting. However, evidence for the learning by exporting effect is quite strong in fully exporting firms. This finding seems to be counterintuitive because these firms are mainly subcontractors and also specialize in task-based production, which may well reduce their scope for learning. However, upon careful inspection, this finding is likely to be due to the dynamics of learning—the electronics sector having emerged in the country during the last decade means that its firms do not have long experience in exporting activities. This suggests that the potential gains from learning are very likely to be higher than for the textile sector. In analysing the link between innovation and exporting decisions, we find evidence for the positive impact of previous innovation on increasing the incentives for current exporting in partially exporting firms; exporting, in turn, is found to drive innovation in these firms (which are heavily dependent on foreign technologies). As for fully exporting firms, innovation is not a prior decision to exporting; contrarily, exporting is found to drive innovation.

Our findings for the agro-food sector show no evidence of self-selection in partially exporting firms.[5] One possible explanation is that in this quite specific sector it is not efficiency that drives export decision but rather other exogenous factors including the availability of high-quality agricultural products (such as olive oil and dates) and industrial policies that facilitate and encourage exporting activity. There is also no evidence of learning by exporting in partially exporting firms; in contrast, the evidence for this is quite strong in fully exporting ones. One plausible explanation is that the scope for learning is greater when firms export to high-income countries (e.g. EU) than when they export to medium- and/or low-income countries. The study by De Loecker (2007) supports this, reporting that productivity gains are higher for firms exporting to high-income regions; however, his study does not provide a detailed discussion of the reasons why learning by exporting effects differ depending on the destination of exports. In exploring the link between innovation and exporting decision, we find no evidence for the positive impact of previous innovation on increasing the incentives for current exporting; also, no evidence is found to show that exporting might drive innovation.

Finally, the empirical analysis provides no evidence of self-selection in both clusters of firms in the remaining manufacturing industries. In contrast, there is a strong statistical support for the learning by exporting effect in partially exporting firms, but none in fully exporting ones. Our analysis confirms that innovation precedes the decision to export in both clusters of firms, but the effect

[5] Here, we do not discuss the behaviour of fully exporting firms for reasons explained in the subsection 'Estimates of self-selection for the agro-food sector'.

is slightly less for fully exporting ones. Exporting is found to drive innovation in both clusters of firms, with a slightly stronger effect in fully exporting ones.

This paper is structured as follows. In Section 2, we describe the methodology for testing the correlation between productivity and exporting for two clusters of firms: (i) exporters versus non-exporters and (ii) fully exporting firms versus others. We describe the dataset and outline the basic descriptive statistics used. We present the results for self-selection and learning-by exporting effects in the two clusters of firms. In Section 3, we explore the link between exporting and innovation using a similar approach as in Section 2. Section 4 is devoted to sectoral studies, where we investigate issues addressed in previous sections distinguishing between four main pillars of the Tunisian manufacturing industry: (i) the textile/clothing and leather/footwear industries, (ii) the mechanical/electric and electronics industries, (iii) the agro-food industries, and (iv) the remaining manufacturing industries (including mining, energy and miscellaneous industries). We give some policy recommendations in Section 5 and present conclusions in Section 6. (Some tables are relegated to the appendix.)

2 Exploring the link between exporting and productivity

Firm productivity and export decisions are closely related. Since exporting is associated with a fixed cost, this implies that firms must be sufficiently efficient in order for them to become profitable to export. Thus, the choice to export or to sustain exporting activity relies on firm efficiency—this phenomenon is termed as self-selection. Alternatively, exporting may allow firms to acquire external knowledge or economies of scale that may well feed back into efficiency gains—a phenomenon known as learning by exporting. This reasoning suggests that there is a bidirectional link between firm efficiency and export decisions. Investigating this causality link is very demanding[6] and, therefore, we restrict the analysis to exploring the correlation between efficiency and exporting.

We analyse the link between exporting and efficiency using a production-function approach. This approach allows us to examine self-selection by showing that exporting firms experience a rise in productivity prior to joining the export market. Learning by exporting implies that firms facing foreign competition can accumulate a stock of (external) knowledge through their relationship with foreign competitors—they can have information about production techniques and the technical specifications of competing products and can benefit from the technical information provided by foreign buyers as well as from plant visits by engineers or other technical staff. Exporters are likely to have better information about the evolution of foreign consumers' demand trends and preferences. In short, contact with a wide range of foreign customers is likely to provide a wealth of learning opportunities.

2.1 Dataset

Our empirical analysis is based on three firm level datasets using accounting, industrial, and export flow surveys conducted on 1323 Tunisian manufacturing firms from 2004 to 2006. These data are compiled from surveys conducted annually by the Institut National de la Statistique, Tunisia, on all manufacturing firms. From the initial dataset we drop all firms for which data on variables of interest, such as sales, numbers of employees, and export flows, are missing for at least one year.

[6] We have tried to investigate the causality link using the instrumental variables technique (we could not use the simultaneous equations technique because the four hypotheses required different estimation techniques). Unfortunately, we had weak instruments to control for the endogeneity of the variables of interest.

Consequently, our balanced panel dataset is composed of 1323 firms. This unique dataset (we were the first to conduct this micro-level study after 2004) allows us to test whether a firm's probability of becoming an exporter or continued participation in export markets derives from efficiency gains prior to joining export markets. Moreover, we test for the congruent hypothesis that exporting improves a firm's productivity.[7] This dataset also allows us to explore whether exporting activity drives innovation and, alternatively, whether innovation is indeed a prior decision to exporting.

In this dataset, partially exporting firms represent 13.08, 13.26, and 11.01 per cent of total manufacturing firms in 2004, 2005, and 2006, respectively; in contrast, fully exporting firms represent 26.69, 25.91, and 23.60 per cent of total manufacturing firms in 2004, 2005, and 2006, respectively.

2.2 Empirical methodology

In our analysis, we use two clusters of firms. In the first cluster, we distinguish exporters (including partially and fully exporting firms) from non-exporters. In the second cluster, we distinguish firms devoting their entire production to exports from others (partially exporting firms and non-exporters). The rationale for this distinction is driven by a peculiarity of the Tunisian manufacturing sector: almost 70 per cent of exports come from the offshore sector in which firms are mainly subcontractors, benefiting from several advantages including technological advances and export guarantees. Moreover, pooling partially and fully exporting firms may well mask more than reveal real features of fully exporting firms.

On the one hand, fully exporting firms (for which exporting is necessary for survival) might be the most efficient, triggering thereby their decision to enter export markets. They may also have greater ability to accumulate knowledge and/or more incentives to engage in innovation to withstand intense foreign competition. On the other hand, these firms might be mainly subcontractors and/or specialized in task-based production. For such firms to be chosen by foreign investors to benefit from this (subcontracting) regime, they should have experienced an increase in efficiency in previous periods. This implies that they are likely to be the most competitive and also the most technologically advanced and, hence, the least likely to be characterized by efficiency benefits from exporting. Moreover, they may have fewer incentives to invest in innovation activity either because they are already technologically advanced or because there is no complexity in the production process requiring such investment to occur.

2.3 Modelling and estimation procedure

Table 1 presents the descriptive statistics of our empirical variables. The variables we use in the analysis are defined as follows:

- *CAPFOREIGN_1*: An indicator variable for capital-owning status; it is assigned a value 1 if a firm's capital is foreign during the previous year and 0 otherwise.
- *CAPITAL_1*: A firm's financial resources during the previous year expressed in trillions of constant (2004) US$.
- *FIRMAGE_1*: Age of a firm (decades). This is a measure of a firm's survival.
- *FIRMSIZE_1*: The number of a firm's employees (thousands) in the previous year (including administrators, technicians, simple workers).

[7] Enhancing a firm's efficiency could be traduced by a decline in its production cost if we resort to the use of a production-cost approach (see Clerides et al. 1998).

- *INNOV*: The proportion of engineers and technicians with different degrees of qualification in a firm's workforce during the current year.
- *INNOV_1*: The proportion of engineers and technicians with different degrees of qualification in a firm's workforce during the previous year.
- *OUTPUT*: Sales of the current year—revenue from real output sold during the current year expressed in thousands of constant (2004) US$.
- *OUTPUT_1*: Sales of the previous year—revenue from real output sold during the previous year expressed in thousands of constant (2004) US$.
- *PAREXP*: An indicator variable for export status; it is assigned a value 1 if a firm is an exporter (including partially and fully exporting firms) during the current year and 0 otherwise.
- *PAREXP_1*: An indicator variable for export status; it is assigned a value 1 if a firm is an exporter (including partially and fully exporting firms) during the previous year and 0 otherwise.
- *TOTEXP*: An indicator variable for export status; it is assigned a value 1 if a firm is devoting its entire production to exporting during the current year and 0 otherwise.
- *TOTEXP_1*: An indicator variable for export status; it is assigned a value 1 if a firm is devoting its entire production to exporting during the previous year and 0 otherwise.

Table 1: Summary of descriptive statistics

Variable	Unit of measure	Observations	Mean	Std. Dev.	Min.	Max.
CAPFOREIGN_1	Binary variable	2736	0.1900585	0.3924188	0	1
CAPITAL_1	Trillions of constant (2004) US$	2728	2.80e-11	1.83e-10	4.01e-15	3.43e-09
FIRMAGE_1	Decades	2736	1.929349	1.461102	0	14.1
FIRMSIZE_1	Individuals	2736	0.1901104	0.5460478	0	9.487
INNOV	Percentage	2721	0.7846324	0.2500312	0	1
Log*INNOV*	—	2651	-0.2939156	0.5081729	-4.867535	0
INNOV_1	Percentage	2717	0.7820502	0.2539912	0	1
OUTPUT	Thousands of constant (2004) US$	2735	1.65e+07	9.24e+07	0	2.30e+09
OUTPUT_1	Thousands of constant (2004) US$	2736	1.50e+07	7.94e+07	0	1.75e+09
PAREXP	Binary variable	2736	0.4736842	0.4993983	0	1
PAREXP_1	Binary variable	2736	0.4671053	0.499008	0	1
TOTEXP	Binary variable	2701	0.3061829	0.460992	0	1
TOTEXP_1	Binary variable	2712	0.3064159	0.4610896	0	1

Source: Authors' compilation of empirical variables of analysis.

Modelling self-selection

We model the self-selection effect as the probability of firm *i* exporting in period *t*, regressed on lagged exporting, lagged sales and lagged firm characteristics (we use a one-period lag).

The probit (or probability unit) models for the first and second clusters of firms are given respectively by the following equations:

$$\text{Prob}(PAREXP_{i,t} = 1) = \Phi(PAREXP_{i,t-1}, OUTPUT_{i,t-1}, Z_{i,t-1}) \quad (1)$$

and

$$\text{Prob}(TOTEXP_{i,t} = 1) = \Phi(TOTEXP_{i,t-1}, OUTPUT_{i,t-1}, Z_{i,t-1}), \quad (2)$$

where $PAREXP_{i,t}$ and $TOTEXP_{i,t}$ are the lagged export status for partially exporting firms and fully exporting ones, respectively; $OUTPUT_{i,t-1}$ is the lagged sales; $Z_{i,t-1}$ is a vector of lagged control variables including firm age, firm size, capital-intensity, and capital-owning status; and i and t are firm and time indices, respectively.

In this model, we assume export participation depends on variables such as previous export participation, output, firm size, and capital-intensity. Previous export participation is included in the model as a control for fixed costs associated with entering the export market (see Roberts and Tybout 1997). Similarly, firm size, measured here as the number of employees, has a fixed-cost interpretation in that exporting typically is associated with costs too large for small firms to incur; for instance, it may be necessary for the exporting firm to set up a marketing department to investigate marketing channels, meet export orders etc. It might also indicate the size of the scale of production. Previous output, capital-intensity, and the degree of foreign direct investment (FDI), for which we control using capital-owning status, are included in the model to capture a potential self-selection process by which certain firms choose to export because they are relatively efficient. The key variable here is *OUTPUT_1*, the coefficient of which is a sufficient statistic for self-selection whenever it is positive and statistically significant.

Moreover, following the literature, the model allows for dynamics in the form of a lagged dependent variable (for instance, see Bigsten et al. 2004; Damijan and Kostevc 2006; Keiko and Lechevalier 2010; Nickell 1996). One potential reason for dynamics of this form is that any change in a firm's behaviour and characteristics may take time to feed into efficiency (i.e. to reach the new long-run productivity level). The inclusion of a lagged dependent variable also makes serial correlation of the residual less likely.

Modelling learning by exporting

We model learning by exporting as a simple linear regression of firm i sales[8] in period t on lagged sales, lagged exporting, and other lagged firm characteristics (again, we use a one-period lag). The estimation procedures for the first and second clusters of firms are given respectively by the following linear regressions:

$$OUTPUT_{i,t} = \alpha_1 PAREXP_{i,t-1} + \alpha_2 OUTPUT_{i,t-1} + \alpha_3 Z_{i,t-1} + u_{i,t} \quad (3)$$

and

$$OUTPUT_{i,t} = \alpha_1 TOTEXP_{i,t-1} + \alpha_2 OUTPUT_{i,t-1} + \alpha_3 Z_{i,t-1} + u_{i,t}, \quad (4)$$

where $PAREXP_{i,t-1}$ and $TOTEXP_{i,t-1}$ are the lagged export status for partially exporting firms and fully exporting ones, respectively; $OUTPUT_{i,t-1}$ is lagged sales; $Z_{i,t-1}$ is a vector of lagged control variables including firm age, firm size, capital-intensity, and capital-owning status; α_1 is the key parameter to be estimated (it provides evidence of the learning by exporting effect whenever it is positive and significant); and $u_{i,t}$ is a residual, assumed to be serially uncorrelated and to capture efficiency shocks.

[8] 'Value added production functions are the most common in the literature; however research by Basu and Fernald (1995) shows that adopting a value added production function can yield misleading results if there is imperfect competition or increasing returns to scale' (in Bigsten et al. 2004: 118, n4).

The key variable for learning is lagged exporting; as learning is unlikely to be instantaneous, this effect operates with a one-period lag.

Estimates of self-selection

Table 2 illustrates the estimation results of the self-selection effect for the two clusters of firms.

Table 2: Determinants of the self-selection effect, probit estimation

	Exporters vs non-exporters		Fully exporting firms vs others	
Independent variable	Coefficient	Marginal effect	Coefficient	Marginal effect
PAREXP_1/TOTEXP_1	2.959***	0.861***	3.173***	0.751***
	(0.080)	(0.011)	(0.109)	(0.053)
OUTPUT_1	0.254	0.101	8.84***	1.15***
	(0.807)	(0.321)	(2.92)	(0.238)
FIRMSIZE_1	0.037	0.015	0.933***	0.121***
	(0.132)	(0.053)	(0.220)	(0.027)
FIRMAGE_1	-0.013	-0.005	-0.228	0.029***
	(0.028)	(0.011)	(0.059)	(0.009)
CAPITAL_1	-0.650	-0.259	-29.9***	-3.87***
	(0.675)	(0.269)	(7.95)	(0.041)
CAPFOREIGN_1	0.659***	0.256***	0.910***	0.175***
	(0.122)	(0.044)	(0.130)	(0.045)
CONSTANT	-1.536***		1.695***	
	(0.078)		(0.118)	
Observations	2728	2728	2692	2692

Note: Robust standard errors are in parentheses; *, **, and *** denote variables significant at 10%, 5%, and 1%, respectively.

Source: Authors' calculations based on empirical variables of analysis.

(i) Exporters versus non-exporters

Table 2 shows no evidence of self-selection in the first cluster of firms. Although the coefficient of *OUTPUT_1* is positive as expected, it is not statistically significant. Lagged exporting status, which accounts for the sunk cost of entry into export markets (Roberts and Tybout 1997), has a positive and significant coefficient, strengthening the view that prior involvement in the export market increases the likelihood of maintaining the same status. Firms with previous exporting experience are also more likely to maintain their status since export promotion efforts have long-term effects in terms of sustaining exports. An alternative interpretation is that a firm's current involvement in exporting activity may lower the fixed costs of engaging in exporting in subsequent periods.

Firm size—measured by the number of employees—is positively related to a firm's likelihood of becoming an exporter, although its coefficient is not statistically significant. The negative coefficient of *FIRMAGE_1* is not consistent with the literature (the most obvious stylized fact is that exporting firms tend to be the largest and oldest). However, the negative sign could be attributed to the reduced ability of older firms to adapt to the dynamics of industrial changes and evolution; especially, the variety of these firms managed by seasoned veterans that may stick to the

use of old managerial strategies and/or are more risk averse to the adoption of new technologies[9] or new ways of production. The positive and significant coefficient of *CAPFOREIGN_1* is along expected lines. Foreign-owned firms are more inclined to export; these firms tend to be more experienced and have instituted buffers (including knowledge of foreign market characteristics, trends in consumer demand and technological improvements, and better governance strategies) that help them keep up with foreign competitors.

(ii) Fully exporting firms versus others

Table 2 provides strong statistical support for self-selection in the second cluster of firms. The coefficient of *OUTPUT_1* is positive and highly significant, consistent with the findings of Bernard and Jensen (1999a) and Greenaway and Kneller (2007), which only confirms sufficiently high productivity level export to foreign markets. Moreover, the dichotomy between fully exporting firms and others increases the marginal effect of *OUTPUT_1* from 0.101 to 1.15, suggesting that fully exporting firms may exhibit superior productivity (through import/adoption of better governance strategies, best-practice technologies) allowing them to be more competitive than others and, therefore, serving as an incentive to self-select into export markets.

Past exporters are more likely to continue exporting. This is captured by the positive and significant coefficient of *TOTEXP_1*; however, its marginal effect decreases slightly from 0.861 to 0.751. A host of factors may account for this decline. First, the sunk cost of entry into export markets may be lower for this category of firms (composed mainly of subcontractors that have strict exporting arrangements and benefit from facilities such as fiscal incentives channelled through tax concessions). Second, fixed costs associated with current exporting may be lower than costs in previous periods.

The coefficient of *CAPFOREIGN_1* is positive and highly significant and is along expected lines. However, its marginal effect is less for this cluster of firms (it falls from 0.256 to 0.175) possibly because of the higher rate at which foreign capital exhibits decreasing returns to scale (based on the stylized fact that foreign-owned firms are likely to have more foreign involvement than others).

The likelihood of becoming an exporter increases with the size of the firm. Large firms may produce and sell on a large scale or may enjoy lower fixed costs associated with exporting as compared with small firms. This is in line with the findings of Helpman et al. (2004) and verified by subsequent empirical contributions.

Estimates of learning by exporting

Table 3 summarizes the estimates of the learning by exporting effect for the two clusters of firms.

Table 3: Determinants of the learning by exporting effect, ordinary least squares

Independent variable	Exporters vs non-exporters	Fully exporting firms vs others
PAREXP_1/TOTEXP_1	1.426***	0.611
	(0.516)	(0.645)
OUTPUT_1	1.184***	1.185***
	(0.004)	(0.004)
FIRMAGE_1	-0.060***	-0.060***
	(0.006)	(0.006)
FIRMSIZE_1	-0.008	-1.23
	(16.7)	(17.4)
CAPITAL_1	(2.23)	(2.26)

[9] There is a similar effect for farmers to adopt new irrigation technologies (see Koundouri et al. 2006).

CAPFOREIGN_1	-0.511	-0.160
	(0.661)	(0.729)
CONSTANT	-0.448	-0.031
	(0.483)	(0.478)
Observations	2727	2703
R-squared	0.983	0.983

Note: Robust standard errors are in parentheses; *, **, and *** denote variables significant at 10%, 5%, and 1%, respectively.

Source: Authors' calculations based on empirical variables of analysis.

(i) Exporters versus non-exporters

Table 3 provides strong evidence of learning by exporting in the first cluster of firms; the coefficient of *PAREXP_1* is positive and significant at less than 1 per cent. The positive coefficient of *OUTPUT_1* captures the persistence of a firm's efficiency over time (efficiency may have long-term effects)—exporting firms are likely to have a greater ability to adjust technology and productivity over time because of their exposure to competition. The coefficients of all control variables are of the wrong sign and/or are statistically insignificant.

(ii) Fully exporting firms versus others

Table 3 is consistent with predictions of the learning by exporting effect in the second cluster of firms, with the positive and almost significant coefficient of *TOTEXP_1* (significant at 12.1 per cent). This coefficient becomes significant at 10 per cent when we substitute[10] a variable controlling for innovation in place of the one controlling for FDI. One possible explanation is that *CAPFOREIGN_1* absorbs most of the effect upon increasing firm efficiency so as to mask the direct effect of exporting.

The marginal effect of *TOTEXP_1* is less than that of *PAREXP_1*. At first glance, this result may be surprising since it appears to imply that fully exporting firms acquire less knowledge than partially exporting ones and benefit less from exposure to competition in export markets, although exporting is the sole factor for their survival. However, upon careful exploration of the dynamics of learning by exporting, we observe that almost all fully exporting Tunisian firms are subcontractors with relatively long exporting experience and strict export arrangements. Therefore, the potential gains from current exporting activity is likely to be lower than those from prior exporting (the firms experience a gradual decline in the scope for learning) and also lower than the relative gains from learning to export in partially exporting ones. Moreover, fully exporting firms are likely to keep pace with technological advances and benefit from superior managerial skills compared to local firms.

The positive and significant coefficient of *OUTPUT_1* captures the persistence of a firm's efficiency over time—more productive firms invest to enhance productivity. The positive coefficient of *FIRMAGE_1* suggests that older firms are more efficient at allocating resources that will allow them to converge towards technical efficiency. Engaging in innovation through equipment modernization and more research and development (R&D) investments is likely to increase the number of new products[11] and/or improve production methods[12] that, in turn, feeds back into higher productivity. Including the variable log*INNOV_1* in the specification changes

[10] We did not report this finding here.

[11] This is termed as product innovation, which means 'products new to the firm' rather than 'products new to the relevant market'.

[12] This is termed as process innovation.

the coefficient of *FIRMAGE_1*. This helps differentiate between old managers who are less inclined to innovate and those who have more incentives to modernize management tools.

3 Exploring the link between innovation and exporting

The analysis conducted until now has ignored a key factor that affects productivity, namely innovation. Several empirical studies have addressed the substantial heterogeneity in firm productivity within and between industries (see Bartelsman and Doms 2000). However, theoretical models on firm evolution or firm dynamics do not give a plausible and convincing explanation of what really causes firm heterogeneity and difference in their evolution; instead, they simply assume that productivity is exogenous to a firm. However, models of firm dynamics (see Hopenhayn 1992; Jovanovic 1982) and their extension to international trade (see Melitz 2003) assume that productivity is assigned to a firm by luck of draw from a random distribution. After making a draw, there is therefore no way for a firm to change its path—a path to its survival or demise.

Contrastingly, the endogenous growth theory relates firm productivity to decisions, such as investment into R&D and innovation. Romer (1990) has argued that technological improvements are driven by investment of resources into R&D activity, and that a firm's innovative activity is central to its technological progress and productivity growth. Drawing on the advances of Vernon (1966) in the product lifecycle theory, Klepper (1996) has shown that product innovation dominates the early stage of the product lifecycle, whereas process innovation becomes relevant in the later stages, once production volumes have increased and firm efficiency becomes increasingly important. More recently, Costantini and Melitz (2007) drew on this distinction by building a model showing that anticipation of trade liberalization may cause a firm to bring forward the decision to innovate in order to 'dress up' for future participation in the export market.

The literature (see Cassiman et al. 2010; Damijan et al. 2010; Keiko and Lechevalier 2010; Romer 1990) suggests that, on the one hand, a firm's decision to enter exporting markets may be driven by its prior decision to innovate a product, which will be translated into improvement in the firm's productivity. On the other hand, an increase in a firm's exporting activity, following an increased scale of sales, feeds back into its productivity by increasing process innovations. On the basis of this reasoning, two causal links can be identified in the relationship between productivity and exporting, both of which are related to firm innovation activity. Indeed, product innovation may play a more important role in the decision to start exporting—a firm's decision to invest in R&D and make product innovations drives its productivity and triggers the decision to start exporting. Successful exporting may drive process innovation which, in turn, positively affects its productivity growth. This suggests that the causality between innovation and exporting may run in both directions. As mentioned, investigating causality is very demanding[13]; this is why in the remainder of this section we restrict the analysis to investigating the correlation between innovation and exporting. We use the same methodology as for exploring the link between productivity and exporting—we study the link between exporting and innovation by modelling joint decisions using both probit and ordinary least square models.

Before proceeding with the econometric analysis, we clarify how we propose to measure innovation activity.

[13] See footnote 6.

3.1 Proxy measure of innovation activity

Given the absence of data regarding investment in R&D and since actual innovation is not directly observable, we need to find a suitable proxy measure. Anecdotal evidence and intuition suggest that the availability of a team of engineers, scientists and technicians with suitable qualifications and know-how in R&D activities is a plausible source of innovation (Kriaa and Karray 2010). Considering a measure of human capital is necessary to account for the skills embodied in a firm's employees. This human capital injects greater skills and knowledge into the organization, which is likely to enhance its capabilities to innovate. Therefore, the measure of human capital chosen as a proxy for innovation is defined as follows:

> $INNOV_{i,t}$: The proportion of engineers and technicians with different degrees of qualification in the total labour force of firm i (total number of employees) during period t.

In the literature, variables that are very likely to capture labour displacement are usually used, which may account for actual innovation better than expenditure in R&D that may or may not lead to innovation (potential for sunk R&D expenditures—firms may well expend on R&D, although they may not be innovating). Notice that we do not discriminate between product and process innovations.

3.2 Modelling and estimation procedure

Modelling exporting activity (exporting equation)

We model exporting status using a probit model—the probability of firm i exporting in period t is regressed on lagged exporting, lagged innovation, and lagged control variables capturing some firm characteristics (we use a one-period lag). The probit models for the first and second clusters of firms are given respectively by the following equations:

$$\text{Prob}(PAREXP_{i,t} = 1) = \Phi(PAREXP_{i,t-1}, INNOV_{i,t-1}, Z_{i,t-1}) \quad (5)$$

and

$$\text{Prob}(TOTEXP_{i,t} = 1) = \Phi(TOTEXP_{i,t-1}, INNOV_{i,t-1}, Z_{i,t-1}), \quad (6)$$

where $PAREXP_{i,t-1}$ and $TOTEXP_{i,t-1}$ are lagged export status for partially and fully exporting firms, respectively; $INNOV_{i,t-1}$ is the lagged innovation; $Z_{i,t-1}$ is the same vector of control variable used for exploring the link between exporting and productivity; and i and t are firm and time indices, respectively.

Modelling innovation activity (innovation equation)

Innovation activity is modelled in line with Aw et al. (2005) and Girma et al. (2007) who ascribe similar determinants to innovation and exporting status. The innovation equation is then modelled as a linear regression of firm i innovation in period t on lagged innovation, exporting, and other firm characteristics.

The estimation procedures for the first and second clusters of firms are given respectively by the following linear regressions:

$$INNOV_{i,t} = \beta_1 PAREXP_{i,t-1} + \beta_2 INNOV_{i,t-1} + \beta_3 Z_{i,t-1} + v_{i,t} \quad (7)$$

and

$$INNOV_{i,t} = \beta_1 TOTEXP_{i,t-1} + \beta_2 OUTPUT_{i,t-1} + \beta_3 Z_{i,t-1} + v_{i,t} \quad (8)$$

Here, β_1 is the key parameter to be estimated—if positive and statistically significant, it supports the hypothesis that successful exporting drives innovation leading to productivity growth. $v_{i,t}$ is a residual, assumed to be serially uncorrelated and to capture shocks that may affect innovation activity.

Estimates of exporting activity (exporting equation)

Table 4 summarizes the estimates of the exporting equation for the two clusters of firms.

Table 4: Exporting equation, probit estimation

	Exporters vs non-exporters		Fully exporting firms vs others	
Independent variable	Coefficient	Marginal effect	Coefficient	Marginal effect
PAREXP_1/TOTEXP_1	2.948***	0.859***	3.131***	0.798***
	(0.081)	(0.011)	(0.110)	(0.037)
INNOV_1	0.441***	0.176***	0.846***	0.147***
	(0.168)	(0.067)	(0.277)	(0.052)
FIRMSIZE_1	-0.024	-0.009	0.744***	0.130***
	(0.133)	(0.053)	(0.223)	(0.032)
FIRMAGE_1	0.0004	0.0002	-0.217***	-0.038***
	(0.282)	(0.011)	(0.059)	(0.011)
CAPITAL_1	-0.273	-0.109	-15.8***	-2.75***
	(0.529)	(0.211)	(5.33)	(0.616)
CAPFOREIGN_1	0.627***	0.244***	0.908***	0.218***
	(0.125)	(0.0454)	(0.132)	(0.045)
CONSTANT	-1.888***		-2.402***	
	(0.158)		(0.264)	
Observations	2709	2709	2674	2674

Note: Robust standard errors are in parentheses; *, **, and *** denote variables significant at 10%, 5%, and 1%, respectively.

Source: Authors' calculations based on empirical variables of analysis.

(i) Exporters versus non-exporters

Prior innovation activity increases the likelihood of current export status, and its coefficient is significant at less than 1 per cent, in the first cluster of firms. Therefore, the decision to enter export markets may be driven by prior decisions to innovate. Previous exporting experience increases the likelihood of maintaining the same status. The positive and significant coefficient of *CAPFOREIGN_1* implies that firms with a higher foreign capital share are better equipped to join export markets since they are better governed and have superior technical know-how and marketing experience. These advantages are readily translated into production scale upgrading and strengthening export capabilities.

(ii) Fully exporting firms versus others

There is strong statistical support for the positive impact of lagged innovation on exporting ability of the second cluster of firms. However, the marginal effect in this cluster of firms is slightly less

than that in partially exporting ones (the marginal effect falls from 0.176 to 0.147). Fully exporting firms are mainly subcontractors for which exporting is guaranteed. This may well mask most of the effect of previous innovation on exporting.

The positive and significant coefficient of lagged exporting is along expected lines, as explained in previous sections. Moreover, the marginal effect of lagged exporting declines slightly compared to previous settings (it falls from 0.859 to 0.797), implying that the sunk cost of exporting is very likely to be less important for fully exporting firms.

We offer two explanations: first, a firm's fixed cost of engaging in exporting is reduced compared to previous involvement in exporting. Second, a firm's fixed cost is inversely related to its marginal cost of production (see Lewis and Sappington 1989). Our findings may indicate a decline in the marginal cost of firm production, which may be translated into large-scale production and sales increasing a firm's involvement in export activity. This argument is strengthened by the positive and highly significant coefficient of *FIRMSIZE_1*, implying that large firms have large fixed costs associated with production and are very likely to engage in large-scale production. The coefficient of *CAPFOREIGN_1* has the expected positive sign. For this cluster of firms, the coefficient of *FIRMAGE_1* is still negative, but it becomes statistically significant referring to the rigidity of older management systems.

Estimates of innovation activity (innovation equation)

Table 5 summarizes the estimates of the innovation equation for the two clusters of firms.

Table 5: Innovation equation, ordinary least squares

Independent variable	Exporters vs non-exporters	Fully exporting firms vs others
PAREXP_1/TOTEXP_1	0.042***	0.068***
	(0.008)	(0.010)
INNOV_1	0.608***	0.582***
	(0.015)	(0.015)
FIRMSIZE_1	0.024**	0.024**
	(0.010)	(0.010)
FIRMAGE_1	-0.009***	-0.007***
	(0.003)	(0.003)
CAPITAL_1	-0.140***	-0.142***
	(0.001)	(0.001)
CAPFOREIGN_1	0.037***	0.018
	(0.010)	(0.011)
CONSTANT	0.299***	0.319***
	(0.013)	(0.014)
Observations	2697	2673
R-squared	0.482	0.470

Note: Robust standard errors are in parentheses; *, **, and *** denote variables significant at 10%, 5%, and 1%, respectively.

Source: Authors' calculations based on empirical variables of analysis.

(i) Exporters versus non-exporters

The coefficient of lagged exporting status is positive as expected and is strongly significant in the first cluster of firms. A positive coefficient of lagged exporting status implies that exporting leads to new knowledge and not just investment in new knowledge. The positive and significant coefficient of lagged innovation is consistent with the sunk-cost line of reasoning.

Firm size predicts innovation fairly well. The coefficient of *FIRMSIZE_1* is positive and significant at less than 1 per cent. This is consistent with predictions that innovation activity correlates positively with the size of the firm, indicating the importance of scale in research activity (see

Barrios et al. 2003; Damijan et al. 2010; Love and Roper 2002). Large firms are considered to be relatively more innovative than small ones, because of their capacity to spread risks over a portfolio of projects and their access to financial resources, giving them an advantage over small firms for investing in R&D. An alternative explanation is that large firms may have greater absorptive capacity, so even when these firms do not innovate, they continue to invest in R&D activity to enhance their absorptive capacity.

As noted in previous sections, older firms may be less innovative, except those that have already invested in innovation activities. This intuition is supported by the positive coefficient of *INNOV_1* and the negative coefficient of *FIRMAGE_1*. On the basis of this reasoning, large firms may have greater absorptive capacity allowing them to benefit more from technological spillover of other firms' R&D (Cohen and Levinthal 1990). The positive and highly significant coefficient of *CAPFOREIGN_1* implies that these firms have better access to more advanced technologies and might be endowed with more financial resources, enabling them to invest in innovation activities.

(ii) Fully exporting firms versus others

In the innovation equation, the positive and significant coefficient of lagged exporting status is along expected lines, as noted earlier in the first cluster of firms. Moreover, the coefficient of this variable increases slightly in fully exporting firms in contrast to the differentiation in exporters/non-exporters (it increases from 0.042 to 0.068). Therefore, fully exporting firms have the capacity to acquire new knowledge because of their exposure to more mature markets. Lagged innovation, which takes into account the sunk cost of engaging in innovation activity in previous periods, increases the incentives for current innovation; its coefficient is statistically significant.

Firm size predicts innovation fairly well. The slightly larger coefficient for fully exporting firms implies that these firms invest slightly more in research activity as a result of higher scales of production or to maintain technological advances.

4 Sectoral studies

In the foregoing analysis, we have ignored the role of sectoral specificities on efficiency and exporting status and on innovation and exporting activity. Some phenomena could be quite strong for some sectors, but much weaker for other sectors; however, the overall effect could be statistically significant for the whole industry. This means that conducting the analysis for the whole industry could well mask more than reveal some issues of interest, which suggests that our hypotheses are very likely to be sector-specific. As a background to the sectoral analysis, we provide a brief sketch of the manufacturing sector in Tunisia.

Since 1970, Tunisia has pursued diversification strategies to improve competitiveness in global markets. Four decades later, the manufacturing industry is very diverse and is dominated by three export sectors: (i) textile/clothing and leather/footwear industries, (ii) mechanical/electric and electronics industries, and (iii) agro-food industries. Each of these three sectors generate more than one billion Tunisian dinars (TND) in exports and represent 76 per cent of industrial companies, 87 per cent of exports, almost 62 per cent of FDI, and more than 83 per cent of jobs.

Tunisian exports of manufacturing products are mainly concentrated in textile and clothing, which constitute almost 70 per cent of manufacturing products. The textile and clothing industries sector is composed of some 2094 industrial enterprises employing at least ten persons, of which 1656 produce exclusively for the export market. The sector consists of 971 enterprises with foreign

participation, of which 635 are wholly (100 per cent) foreign-owned. The leading foreign investors in the textile and clothing sector are Italy, Belgium, Holland, France, Algeria, and the United States. Tunisia is among the top 15 garment suppliers in the world and has the advantage of being close to the European market. It is the fifth largest garment supplier and the leading trouser supplier to the EU. Other important products are work wear and lingerie. The main foreign investors in the apparel sector in Tunisia are France, Germany, Belgium, and Italy. Textile and clothing exports reached 4420 million TND in 2006, up from 4020 TND in 2001. The clothing sector alone represents 91 per cent of those exports: 72 per cent for woven garments and 19 per cent for knitted goods. Textile and clothing exports represent 36 per cent of total Tunisian exports (see Chambre de Commerce et d'Industrie du Centre, n. d.).

However, during the past decade a number of new product exports have emerged (such as wiring, cables, automotive cable harnesses, cut-off, electrical command apparatus, refrigerators, material and machines for cold systems, batteries, lighting apparatus, switches, circuit breakers etc.), products for which foreign demand has rapidly increased. Thanks to integration and strong exports, the rate of coverage for the mechanical/electric and electronics sector has risen considerably, up from 66 per cent in 2000 to 114 per cent in 2008. The EU, one of the most competitive markets in the world, remains the favourite destination for this sector's goods. With its expertise and experience in the electric and electronics industry, Tunisia is currently hosting more than 50 companies operating in manufacturing products and components for the aerospace industry (e.g. Anjou Électronique, Latecoere, Safran Group, and Zodiac produce electric and electronic components designed for Airbus, Boeing, Eurocopter, Dassault, Embraer, and Bombardier). The development of the electric, electronics, and household appliance sector in Tunisia is based on a two-pronged strategy: (i) manufacture of finished products for the local and African markets; and (ii) manufacture of sub-assemblies or components for export to Europe.

The last (and not the least) pillar of the Tunisian manufacturing industry is the agro-food sector. The sector's production in 2007 generated about 8.9 billion TND, up from 8.2 billion in 2006. Growth is led by key agro-food products, ongoing upgrading in all branches and significant development in neighbouring markets. Exports have enjoyed an increase by almost 300 per cent in the period 2002–07, rising from 557 million to 1616 million TND. More than 1000 firms in the agro-food sector have at least ten employees; 156 of these export their entire production and 104 are financed at least partially by foreign holdings. Firms producing oils/fats and cereals and handling cold storage represent almost 70 per cent of the overall number of businesses in this sector. Olive oil is the primary agro-food product exported by this sector, with almost 180,000 tonnes exported each year and earnings amounting to an average 43 per cent of agro-food exports. Olive oil production is an age-old tradition in Tunisia. Large volumes of high quality available for export has made Tunisian olive oil well known for its sensory-pleasing characteristics, solidifying Tunisia's position on traditional markets in the EU and opening prospects for exports to new markets like the United States, Japan, and Middle Eastern countries.

In the remainder of this paper, we investigate the role of efficiency/innovation on firm export status and vice versa in the four main industry sectors identified at the beginning of this study. (Results for the last sector—other manufacturing firms—will not be reported here because they are almost similar to those presented above).

4.1 Textile/clothing and leather/footwear industries

We use a balanced panel data of 327 firms to explore the relationship between export status and productivity/innovation. Firms producing exclusively for the export market represent 86.4, 84.8, and 85.8 per cent of the sample in 2004, 2005, and 2006, respectively. In contrast, the partially exporting firms represent 4.9, 5.1, and 4.4 per cent in 2004, 2005, and 2006, respectively.

Exploring the link between exporting and productivity in the textile sector

Estimates of self-selection for the textile sector: Appendix Tables A1a and A1b illustrate the results of self-selection for the first and second cluster of firms, respectively, in the textile sector.

(i) Exporters versus non-exporters (textile sector)

There is evidence of self-selection in partially exporting firms in the second specification. Lagged output increases the likelihood of current exporting, although this relationship is not statistically significant. In contrast, when we eliminate the control variable *CAPFOREIGN_1* from the specification (not reported here), the coefficient of lagged output becomes significant at 8.3 per cent. It is possible that *CAPFOREIGN_1* absorbs much of the effect of triggering and/or sustaining exporting activity and masks the direct effect of firm efficiency on exporting (foreign owners have better management tools and better access to best-practice technologies, and are endowed with more financial resources to invest in innovation). However, the coefficient of lagged exporting is positive and highly significant, indicating persistence in export status. Firm size predicts export status fairly well, because of the likely large scale of production. The coefficient of *FIRMAGE_1* is statistically significant at less than 1 per cent, but its sign is not along expected lines.

(ii) Fully exporting firms versus others (textile sector)

Efficiency premiums increase the likelihood of exporting, but the coefficient of lagged output is insignificant, providing little evidence of self-selection in this cluster of firms. The possible reason for this result is that fully exporting firms of this sector are mainly subcontractors characterized by strict export arrangements that mask the direct effect of efficiency in increasing exporting. The coefficient of lagged exporting is positive and significant at less than 1 per cent (sunk cost of exporting activity); its marginal effect is greater by one-third compared to the premium for exporting firms as a whole, indicating a larger scale of sales in fully exporting firms. Firm size is positively correlated to export status and its coefficient is significant at less than 5 per cent. In contrast, its marginal effect is slightly less than that for exporting firms as a whole, indicating that for fully exporting firms other factors (including advantages facilitating and encouraging exporting) may interfere with the large scale of sales that increase the likelihood of exporting. The positive and significant coefficient of *CAPFOREIGN_1* is along expected lines. Foreign-owned firms have greater ability to export, and the marginal effect in fully exporting firms is greater by two-thirds compared to that in exporting firms as a whole (0.063 compared to 0.021).

Estimates of the learning by exporting for the textile sector: Appendix Tables A2a and A2b illustrate the results for the learning by exporting effect for the first and second cluster of firms, respectively, in the textile sector.

(i) Exporters versus non-exporters (textile sector)

There is no evidence of learning by exporting in this cluster of firms. Export orientation in the textile sector goes back to the beginning of the 1970s; older firms, thus, are likely to have long exporting experience, reducing their scope for learning.

The positive and highly significant coefficient of *OUTPUT_1* is along expected lines. It captures the persistence of firm efficiency and export status. The remaining control variables are statistically insignificant.

(ii) Fully exporting firms versus others (textile sector)

Similarly, there is no evidence of learning by exporting in this cluster of firms composed mainly of subcontractors with a long history of exporting experience, reducing their scope for learning. Past efficiency premiums increase current efficiency (the coefficient of lagged output is positive and significant at less than 1 per cent). The regime of exporting does not affect the coefficient.

Exploring the link between exporting and innovation in the textile sector

Estimates of export activity (exporting equation) for the textile sector: Appendix Tables A3a and A3b illustrate the results for the estimates of export activity for the first and second cluster of firms, respectively, in the textile sector.

(i) Exporters versus non-exporters (textile sector)

In the export equation, the coefficient of lagged innovation is positive as expected, indicating that innovation precedes the decision to export. Prior export experience increases the likelihood of maintaining exporting status (lagged exporting is positive and highly significant, indicating lower future fixed costs associated with exporting). The coefficient of *FIRMSIZE_1* is significant at less than 5 per cent, implying that large firms are very likely to engage in large scales of production and thereby export more. The positive and strongly significant coefficient of *CAPFOREIGN_1* is along expected lines.

(ii) Fully exporting firms versus others (textile sector)

In the export equation, the coefficient of lagged innovation is positive but not significant. There is strong statistical support for a positive correlation between prior exporting experience and current exporting status (lagged exporting is positive and statistically significant). Moreover, its marginal effect is stronger than for the exporters/non-exporters, suggesting that sunk costs of exporting are very likely to be more important for fully exporting firms because of the large scale of exporting. The coefficients of *FIRMSIZE_1* and *CAPFOREIGN_1* have the expected positive signs. Although the coefficient of *FIRMSIZE_1* is not significant, that of *CAPFOREIGN_1* is significant at less than 5 per cent as expected.

Estimates of innovation activity (innovation equation) for the textile sector: Appendix Tables A4a and A4b illustrate the results for the estimates of innovation activity for the first and second cluster of firms, respectively, in the textile sector.

(i) Exporters versus non-exporters (textile sector)

In the innovation equation, the coefficient of lagged exporting is negative and insignificant. Prior experience in innovation increases the incentives for current innovation owing to lower future fixed costs associated with innovation. Firm size predicts innovation fairly well, indicating a positive correlation between firm size and the scale of research activity. The coefficient of *CAPFOREIGN_1* is positive and highly significant (the interpretation is similar to that given in previous sections).

(ii) Fully exporting firms versus others (textile sector)

The coefficient of lagged exporting is positive but statistically insignificant. Prior experience in innovation increases the incentives for current innovation (sunk cost of innovation). Its coefficient is statistically significant and similar to the exporters/non-exporters. While the two clusters of firms seem to invest the same in absolute value, in relative terms, partially exporting firms that are

technological latecomers may have more incentives to invest in R&D and innovation activities in order to catch up with subcontractors that have kept pace with technological advances (as compared to local firms). Firm size and FDI predict innovation fairly well and their coefficients remain at levels fairly similar to those of the other cluster of firms.

4.2 Mechanical/electric and electronics industries

The empirical analysis for this sector is based on a balanced panel data of 48 firms. In this dataset, partially exporting firms represent 16.4, 23.4, and 20.0 per cent of the sample in 2004, 2005, and 2006, respectively. In contrast, fully exporting firms represent 62.7, 53.2, and 46.3 per cent in 2004, 2005, and 2006, respectively. The relatively small size of the sample can be a source of biases in our results.

Exploring the link between exporting and productivity in the electronics sector

Estimates of self-selection for the electronics sector: Appendix Tables A1a and A2b illustrate the results for the estimates of the self-selection effect for the first and second cluster of firms, respectively, in the electronics sector.

(i) Exporters versus non-exporters (electronics sector)

There is no evidence of self-selection in partially exporting firms. In contrast, there is strong statistical support for the positive impact of prior exporting experience on the likelihood of maintaining exporting status. The coefficient of *FIRMSIZE_1* is positive and significant, implying that the larger the fixed costs related to exporting the more likely it is that only large firms will be able to bear them.

(ii) Fully exporting firms versus others (electronics sector)

Contrastingly, there is strong statistical support for the self-selection hypothesis in fully exporting firms. The coefficient of lagged exporting is positive and significant at less than 1 per cent. Moreover, its marginal effect increases from 0.480 to 0.746 compared to the other cluster, indicating the importance of sunk costs of exporting in fully exporting firms. Firm size predicts a firm's decision to start or continue exporting. Its marginal effect is stronger, indicating that either the larger scale of production or the lower fixed cost of fully exporting firms helps them to enter export markets or to maintain their exporting status.

Estimates of learning by exporting for the electronics sector: Appendix Tables A2a and A2b illustrate the results for the learning by exporting effect for the first and second cluster of firms, respectively, in the electronics sector.

(i) Exporters versus non-exporters (electronics sector)

Again, there is no evidence of learning by exporting in this cluster of firms. Several interpretations can be put forward to justify this result. It may be that only a small number of these firms are partial exporters or that they may have low exporting capacity, implying that they are not well exposed to international export markets and, therefore, exhibit less scope for learning. The small sample size may introduce selectivity bias, providing weak evidence of learning effects. The capital-intensive nature of the sector may well imply that an increase in efficiency is associated with more intensive utilization of capital in such a way as to mask the direct effect of exporting. The positive and highly significant coefficient of *OUTPUT_1* is along expected lines. The coefficients of the remaining control variables are insignificant.

(ii) Fully exporting firms versus others (electronics sector)

There is strong evidence of learning by exporting in this cluster of firms. Unlike subcontracting firms in other sectors, the electronics sector is relatively young (it has emerged during the last decade) and does not have long previous experience in export markets and, thus, has much more to gain from such exposure. Lagged output increases firm productivity and its coefficient is significant at less than 1 per cent. Firms with a large capital base are more likely to join export markets. The coefficient is larger for this cluster of firms, indicating higher productivity of capital in these firms (endowed with better governance strategies and advanced technologies).

Exploring the link between exporting and innovation in the electronics sector

Estimates of export activity (exporting equation) for the electronics sector: Appendix Tables A3a and A3b illustrate the results of the determinants of exporting activity for the first and second cluster of firms, respectively, in the electronics sector.

(i) Exporters versus non-exporters (electronics sector)

In the export equation, the coefficient of lagged exporting is positive and strongly significant. The positive and highly significant coefficient of *CAPFOREIGN_1* is also along expected lines. Explanations similar to those presented in previous sections can be offered. The coefficients of the remaining control variables are insignificant.

(ii) Fully exporting firms versus others (electronics sector)

In the export equation, the coefficient of lagged innovations is negative. The coefficient of lagged exporting is positive and statistically significant. Its marginal effect is stronger (0.732 compared to 0.57 in the other cluster), implying that the sunk cost of exporting plays an important role in the export decision of fully exporting firms. The coefficients of *FIRMSIZE_1* and *CAPFOREIGN_1* have the expected positive signs, although these coefficients are insignificant.

Estimates of innovation (innovation equation) for the electronics sector: Appendix Tables A4a and A4b illustrate the results of the determinants of innovation activity for the first and second cluster of firms, respectively, in the electronics sector.

(i) Exporters versus non-exporters (electronics sector)

In the innovation equation, the coefficient of lagged exporting is positive and significant at 5.3 per cent. In this sector, firms are heavily dependent on technological advancement, increasing their incentives and efforts to innovate. Lagged innovation, which takes into account the sunk cost of engaging in innovation activity in previous periods, increases the incentives for current innovation, although its coefficient is insignificant. Firm size is a good determinant of innovation as expected. The coefficients of the remaining control variables are insignificant.

(ii) Fully exporting firms versus others (electronics sector)

In the innovation equation, the positive and strongly significant coefficient of lagged exporting is along expected lines, as explained in the previous section. Moreover, the coefficient increases slightly, suggesting that fully exporting firms with a likely large scale of sales may have more financial returns from their exports allowing them to invest more in innovation activity. Lagged innovation is positively correlated with the current involvement in innovation activity, although its coefficient is statistically insignificant. However, this could be the result of biases caused by the small sample size. Firm size and capital-intensity increase the incentives for innovation, but their

coefficients are insignificant. The coefficients of the remaining control variables are not statistically significant

4.3 Agro-food industries

The empirical analysis for this sector is based on a balanced panel data of 87 firms. In this dataset, partially exporting firms represent 37.3, 39.9, and 25.4 per cent of the sample in 2004, 2005, and 2006. Fully exporting firms represent 6.7, 5.8, and 7.8 per cent in 2004, 2005, and 2006. Similar to the analysis for the electronics sector, the relatively small percentage of fully exporting firms can be a source of biases in our results.

Exploring the link between exporting and productivity in the agro-food sector

Estimates of self-selection for the agro-food sector: Appendix Tables A1a and A1b illustrate the results for the estimates of self-selection for the first and second cluster of firms, respectively, in the agro-food sector.

(i) Exporters versus non-exporters (agro-food sector)

There is no evidence of self-selection in partially exporting firms (in addition, the sign of the variable of interest is negative). One possible explanation is that in this quite specific sector it is not efficiency that drives export decision but rather other exogenous factors including the availability of high-quality agricultural products[14] (such as olive oil, well known for its sensory-pleasing characteristics, and dates, known for their delicious taste and nutritional and natural qualities) and industrial policies that encourage exporting either through liberalization of agriculture[15] or by granting priority to the export of some products (such as olive oil, the integration of which in the world market is not by chance but rather the result of olive-growing policies of the Tunisian government since 1962, granting absolute priority in the export of olive oil and encouraging grain oils and the subvention of their prices in consumption).

The coefficient of lagged exporting is positive and significant at less than 1 per cent, indicating the large sunk cost of previous exporting activity. *CAPITAL_1* does not play a significant role in the exporting status. This might be because this sector is not capital-intensive or because of the support for export that this sector benefits from (for instance, the fund export promotion FOPRODEX gives direct support for certain agricultural sectors, transportation support for agro-food and crafts products, and support for marketing and promotional activities of exporting firms).[16]

Estimates of learning by exporting for the agro-food sector: Appendix Tables A2a and A2b illustrate the results for the estimates of the learning by exporting effect for the first and second cluster of firms, respectively, in the agro-food sector.

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[14] 'Tunisia is the number two world exporter of olive oil (after the European Union) and the first world exporter of dates (in terms of value)' (Foreign Investment Promotion Agency (FIPA-Tunisia) 2009).

[15] Tunisia has started to liberalize its agriculture after the signature of the GATT agreement, and has taken part in the trade talks on agriculture held under the auspices of the WTO at the end of 1999. It has also engaged in a partnership with the European Union (EU), which stipulates, among others, the creation of a free trade area for industrial goods in 2010, the reinforcement of political cooperation and, more recently (in 2011), a conclusion of a protocol concerning the trade of agricultural products.

[16] Results for the second cluster of firms are not discussed since they were not insightful.

(i) Exporters versus non-exporters (agro-food sector)

There is no evidence of learning by exporting in this cluster of firms. At first, one might think about the dynamics of learning here, in that agro-food firms have experienced long previous exporting activity (in particular, this sector has adopted an export-oriented strategy since 1962, with policies encouraging olive oil exporting to the EU), which is very likely to be the driving factor in reducing the scope for learning. However, because of major differences between this and other sectors, for example, owing to the influence of exogenous factors, another explanation might be put forward. Indeed, partially exporting firms are likely to export mainly to medium- and/or low-income countries such as Libya, Algeria, and Morocco which, according to De Loecker (2007), offers less scope for learning compared to export to high-income countries such as in the EU where markets are very demanding. This finding is well supported by the greater scope for learning by exporting in fully exporting firms that export mainly to the EU (Italy, Spain, France), United States, and Switzerland (for instance, these countries receive 88 per cent (2002) to 98 per cent (2005 or 2006) of total Tunisian olive oil exports; see Angulo et al. 2011). Second, Tunisian agricultural products devoted to exporting are mainly olive oil and dates which do not require large processing, thereby greatly reducing the scope for learning.

The positive and highly significant coefficient of *OUTPUT_1* is along expected lines. It captures the persistence of firm efficiency over time. The coefficient of lagged firm size is positive but insignificant. The coefficient of *FIRMAGE_1* is negative and significant at 5 per cent, implying that older firms managed by seasoned managers may be rooted in traditional practices and are less receptive to innovative techniques. The coefficients of the remaining control variables are insignificant.

(ii) Fully exporting firms versus others (agro-food sector)

There is evidence of learning by exporting in this cluster of firms—the coefficient of lagged exporting is positive and significant at 10 per cent. The scope for learning is greater for fully exporting firms than for partially exporting ones, unlike in the textile sector. The possible reason is that these firms export mainly to high-income countries (e.g. EU) where efficiency gains from exporting is likely to be higher than those from export to medium- and/or low-income countries (see De Loecker 2007; for instance, olive oil exports to the EU comply fully with standards of hygiene and quality). Lagged output increases firm productivity and its coefficient is significant at 1 per cent. The coefficient of lagged firm size is not significant. The coefficient of *FIRMAGE_1* is negative and significant. The coefficients of the remaining control variables are statistically insignificant.

Exploring the link between exporting and innovation in the agro-food sector

Estimates of export activity (exporting equation) for the agro-food sector: Appendix Tables A3a and A3b illustrate the estimates of export activity for the first and second cluster of firms, respectively, in the agro-food sector.

(i) Exporters versus non-exporters (agro-food sector)

In the export equation, the coefficient of lagged innovation is positive as expected, but statistically insignificant, indicating that innovation is not a prior decision to exporting. However, when interpreting carefully, one can see that investing in innovation activities is a prior decision to firm creation, in that this sector already employs highly skilled engineers and technicians (at reasonable wage costs). Indeed, the sector employs 25 per cent of the country's engineers (Foreign Investment Promotion Agency (FIPA-Tunisia) 2009). Moreover, this sector's firms receive 'external

knowledge' through the assistance of several centres like the Agro-Food Technical Center,[17] a technical organization that serves food professionals, works for the development and promotion of the food processing sector, and provides assistance to various branches of this industry. This may well offset the real effect of the internal innovation undertaken by firms in this sector. Lagged exporting is positive and highly significant, indicating the importance of sunk cost of previous exporting. The coefficients of the remaining control variables are statistically insignificant.

(ii) Fully exporting firms versus others (agro-food sector)

In the export equation, the coefficient of lagged innovation is positive, although it is not significant. There is strong statistical support of the positive correlation between lagged exporting and the involvement in current exporting (sunk cost of previous exporting). Moreover, its marginal effect is stronger than that of the previous cluster, suggesting that sunk costs of exporting are very likely to be more important for fully exporting firms because of the large scale of exporting. The coefficient of *FIRMSIZE_1* is negative and significant at less than 1 per cent. This may refer to the possibility of congestion, undermining labour productivity, and negatively affecting the scale of production. The coefficient of *FIRMAGE_1* is also negative, but it is statistically significant at less than 5 per cent, pointing to the likely rigidity of older managing systems.[18]

5 Policy recommendations

The principal aim of this study was to explore the link between firm productivity and exporting decisions on the one hand and the link between innovation (as a channel linking productivity to exporting) and exporting on the other hand. We first looked at the entire manufacturing sector and then extended the analysis to specific sectoral categories. The various findings of the sectoral studies reveal several striking features that constitute the cornerstones of our policy recommendations presented here.

One strand of our findings shows less scope for learning by exporting in fully exporting firms in the textile sector compared to firms in the electronics sector, although fully exporting firms in both sectors are mainly composed of subcontractors that benefit from similar advantages. This raises the question: Why do firms in two sectors sharing similar attributes not learn in the same way from exporting? We attribute the differences to different dynamics of learning. While the textile sector has benefited from the subcontracting regime since the beginning of the 1970s, the electronics sector only emerged more recently (during the last decade). Subcontracting firms with strict export agreements benefit more in the short term; however, in the long term and subsequent to reaching the peak of the learning curve, benefits from exporting gradually decline. This suggests that industrial policies of emerging economies should consider subcontracting as an intermediary stage for economic development in order to acquire the necessary knowledge and abilities to increase firm competitiveness and reduce technological dependency on foreign investors, moving

[17] It was created by decree of the Minister of Industry, 29 February 1996, pursuant to Act No. 94-123 of 28 November 1994 concerning the technical centres in industrial sectors. The statute was approved by decree of the Minister of Industry, 25 September 1996.

[18] The estimates of the correlation between exporting and innovation for the agro-food sector are not discussed because no evidence of this relationship has been established for either cluster of firms in either direction.

from the beaten track of subcontracting to co-contracting and then to finished products with higher added value.

By the same token, the scope for learning by exporting in the electronics sector is bound to be short-lived. Exports of this sector to high-income countries (a circumstance in which learning is likely to be greater than exports to medium- and/or low-income countries) are exclusively based on manufacture of sub-assemblies or components. The conjunction of the decreased scope for learning by exporting in the long term and the task-based feature of production (where there is no complexity even in complex industries like the electronics sector), which undermines a firm's ability and incentives to acquire the necessary knowledge of the complete production process, keeps firms in this sector heavily dependent on foreign investors and technologies. The electronics sector in Tunisia would benefit from abandoning subcontracting traditions that rely exclusively on task-based production in favour of finished products with higher added value. Policy efforts should focus on expanding investment in intensive training and R&D targeted towards enhancing the ability of firms to assimilate and exploit existing technological knowledge at early stages of development, encouraging involvement in innovation per se by creating new products or producing existing products in later stages.

A second strand of findings shows that export orientation in the agro-food sector is not driven by efficiency considerations but rather by exogenous factors (including the availability of unique agricultural products and industrial policies that promote exporting). We argue that the sector can increase gains by focusing more on export promotion that targets endogenous efficiency improvements. One way to realize this objective is to change the structure of this sector's products. The sector should move from general quick, easy, and secure profit products towards more sophisticated and industrialized products with higher added value such as food processing. There is more scope for investing in efficiency improvements and technological advances in order to meet the requirements and stringent quality standards of competitive international markets. Firms in the agro-food sector with exports targeting high-income countries tend to experience higher productivity gains compared to those that target medium- and/or low-income countries. Therefore, agro-food firms that aim to acquire the maximum gain from exporting should direct exports to high-income countries. Nevertheless, exporters to high-income countries are likely to face typically large entry costs. One possible way to circumvent this constraint is to focus on the export of goods with greater comparative advantage which may compensate firms for the large entry costs.

A third strand of our findings is the strong statistical support for the positive impact of FDI on firm efficiency, its export incentives, and innovation activities in almost all sectors and for the various clusters of firms. This suggests that there is the need for greater extension of incentives to firms having high foreign participation than to indigenous firms since there is evidence of efficiency improvements, which the study believes increases export propensity with the support of the learning by exporting hypothesis. This recommendation is debatable—it should be considered with a lot of caution, because it might go against what industrial policies of emerging economies usually recommend, notably, extending FDI given to local firms to enhance the economic development of developing countries. However, at early and intermediate stages of economic development, it might be more fruitful for these countries to first focus on efficiency considerations in order to increase gains, and then on redistribution.

6 Conclusion

This study has investigated the link between firm productivity and exporting decisions using a production-function approach to test self-selection and learning by exporting effects. To

complement the discussion, we explored the link between innovation (as a channel linking firm productivity to exporting) and exporting status. The empirical analysis was based on three firm level datasets using accounting, industrial, and exporting flow surveys conducted on 1323 Tunisian manufacturing firms from 2004 to 2006. We distinguished between two clusters of firms: (i) exporters (including fully and partially exporting firms) versus non-exporters and (ii) fully exporting firms versus others, on the basis of the quite specific structure of the Tunisian manufacturing sector (almost 70 per cent of Tunisian manufacturing exports are from firms benefiting from offshore status since 1972, the entire production of which is exported to the EU).

In the first cluster, we found no evidence of self-selection. In contrast, the evidence of learning by exporting was quite strong. However, for the second cluster, predictions were confirmed for both hypotheses. In the first cluster, and using the innovation equations, we found no evidence for either hypothesis. Innovation did not precede the decision to export, and exporting did not derive from innovation. Contrastingly, in the second cluster, we found evidence of a positive correlation between innovation and exporting in both directions.

We extended the analysis to deal with sectoral specificities. We divided the Tunisian manufacturing industry into four main sectors: (i) the textile/clothing and leather/footwear industries, (ii) the mechanical/electric and electronics industries, (iii) the agro-food industries, and (iv) all other manufacturing firms. In the textile sector, we found weak evidence of self-selection; contrastingly, there was no statistical support for learning by exporting in both clusters of firms in this sector. We found evidence for the positive impact of innovation on increasing the incentives for exporting in general, whereas the reverse relationship did not hold for partially exporting firms. Contrarily, we found no evidence for the positive impact of innovation on the likelihood of exporting in fully exporting firms. However, the results confirmed that exporting increased incentives for innovation.

We found no evidence of self-selection in partially exporting firms in the electronics sector, whereas statistical support was strong for self-selection in fully exporting ones. We found no evidence of learning by exporting in partially exporting firms in this sector, but the evidence of learning by exporting was quite strong in fully exporting ones. These findings suggest that the potential gains from learning are very likely to be higher in the electronics sector than in the textile sector. This implies that the scope for learning is less with a longer history of exporting. The link between innovation and exporting was strong in both directions for partially exporting firms because of their dependence on foreign technologies and because these firms are technological latecomers in contrast to fully exporting ones. In fully exporting firms, innovation did not precede the decision to export, whereas exporting encouraged innovation.

In the agro-food sector, there was no evidence of self-selection in partially exporting firms. Moreover, evidence of learning by exporting effects was limited to fully exporting firms. We found no correlation between innovation and exporting for either cluster of firms in either direction.

Overall, these results confirmed the dynamics of learning by exporting in all sectors examined, except for the agro-food sector (because of its very particular characteristics)—the scope for learning decreases with the length of previous exporting experience. The benefits from exporting were much stronger in the electronics sector (which is an emerging sector) than in the textile sector (in which firms have longer previous exporting experience), although fully exporting firms in both sectors are mainly composed of subcontractors benefiting from quite similar advantages. This suggests that subcontracting is very likely to be more beneficial to emerging economies in the short term. An alternative argument for the scope for learning is export destination, in that exporting to high-income countries may offer more opportunities for learning than others; this was the case for

the agro-food industries, a sector heavily dependent on climate conditions and the availability of natural resources.

Appendix A

Table A1a: Estimates of the self-selection effect (exporters versus non-exporters), marginal effects (probit estimation)

Independent variable	Textile	Electronics	Agro-food	Other sectors	All industries
PAREXP_1	0.410***	0.480**	0.807***	0.862***	0.861***
	(0.0859)	(0.236)	(0.0463)	(0.0146)	(0.0106)
OUTPUT_1	0.005	0.004	-0.004	0.000	0.0001
	(0.004)	(0.006)	(0.003)	(0.000)	(0.0001)
FIRMSIZE_1	0.150**	0.560	-0.483	-0.024	0.015
	(0.062)	(0. 347)	(0.665)	(0.025)	(0.031)
FIRMAGE_1	-0.022***	-0.003	0.009	0.013	-0.005
	(0.007)	(0.014)	(0.026)	(0.008)	(0.011)
CAPITAL_1	-4.10*	-7.84	4.33	-0.008	-0.259
	(2.16)	(7.77)	(3.43)	(0.006)	(0.119)
CAPFOREIGN_1	0.021*	-0.005	—	0.238***	0.256***
	(0.012)	(0.036)		(0.067)	(0.047)
Observations	655	96	172	1803	2728

Note: Robust standard errors are in parentheses; *, **, and *** denote variables significant at 10%, 5%, and 1%, respectively.

Source: Authors' calculations based on empirical variables of analysis.

Table A1b: Estimates of the self-selection effect (fully exporting firms versus others), marginal effects (probit estimation)

Independent variable	Textile	Electronics	Agro-food	Other sectors	All industries
TOTEXP_1	0.591***	0.746***	0.651***	0.751***	8.14
	(0.066)	(0.087)	(0.109)	(0.0804)	(17.4)
OUTPUT_1	-0.002	0.022***	-0.000	0.0001	0.001***
	(0.003)	(0.006)	(0.000)	(0.0001)	(0.0001)
FIRMSIZE_1	0.095	1.13*	-0.003	0.013**	0.121***
	(0.072)	(0.604)	(3.64e-06)	(0.006)	(0.033)
FIRMAGE_1	-0.038***	-0.064	-0.000	-0.004	-0.030**
	(0.00114)	(0.00853)	(0.000)	(0.003)	(0.014)
CAPITAL_1	-1.02	-65.2***	0	-0.223***	-3.87***
	(1.85)	(21.0)	0	(0.085)	(0.416)
CAPFOREIGN_1	0.063***	0.140	—	0.0726*	0.175**
	(0.019)	(0.171)		(0.044)	(0.069)
Observations	654	96	164	1769	2692

Note: Robust standard errors are in parentheses; *, **, and *** denote variables significant at 10%, 5%, and 1%, respectively.

Source: Authors' calculations based on empirical variables of analysis.

Table A2a: Determinants of the learning by exporting effect (exporters versus non-exporters), ordinary least squares

Independent variable	Textile	Electronics	Agro-food	Other sectors	All industries
PAREXP_1	-0.503	1.861	-0.563	2.065**	1.426***
	(0.453)	(1.796)	(0.783)	(0.841)	(0.542)
OUTPUT_1	0.989***	0.823***	1.008***	1.186***	1.184***
	(0.099)	(0.077)	(0.057)	(0.055)	(0.054)
FIRMSIZE_1	4.00	-6.22	9.25	-6.19**	-5.98**
	(2.65)	(5.08)	(6.00)	(02.75)	(2.53)

FIRMAGE_1	0.204	-0.602	-0.460**	0.153	-0.078
	(0.181)	(0.521)	(0.218)	(0.399)	(0.321)
CAPITAL_1	-346*	697**	-13.9	-7.78	-7.65
	(204)	(285)	(51.6)	(17.5)	(17.0)
CAPFOREIGN_1	-0.114	1.036	-0.307	-1.039	-0.511
	(0.231)	(1.034)	(0.795)	(1.109)	(0.565)
CONSTANT	0.416	-1.714	1.157	-0.625	-0.448
	(0.621)	(2.030)	(0.785)	(0.492)	(0.384)
Observations	654	96	174	1803	2727
R-squared	0.782	0.950	0.965	0.984	0.983

Note: Robust standard errors are in parentheses; *, **, and *** denote variables significant at 10%, 5%, and 1%, respectively.

Source: Authors' calculations based on empirical variables of analysis.

Table A2b: Determinants of the learning by exporting effect (fully exporting firms versus others), ordinary least squares

Independent variable	Textile	Electronics	Agro-food	Other sectors	All industries
TOTEXP_1	-1.111**	2.160*	2.370*	0.263	0.611
	(0.558)	(1.259)	(1.241)	(0.822)	(0.393)
OUTPUT_1	0.989***	0.828***	1.010***	1.187***	1.185***
	(0.097)	(0.077)	(0.057)	(0.055)	(0.055)
FIRMSIZE_1	4.11	-6.92	9.74	-6.14**	-5.92**
	(2.62)	(5.23)	(6.10)	(2.79)	(2.56)
FIRMAGE_1	0.113	-0.424	-0.440**	0.152	-0.013
	(0.187)	(0.565)	(0.219)	(0.405)	(0.325)
CAPITAL_1	-356.0*	728.0**	-15.6	-8.25	-8.14
	(202.0)	(296.0)	(51.8)	(17.9)	(17.4)
CAPFOREIGN_1	-0.0272	0.548	-1.625*	-0.121	-0.160
	(0.209)	(0.988)	(0.971)	(1.362)	(0.598)
CONSTANT	1.009	-1.686	0.676	-0.176	-0.0313
	(0.797)	(1.590)	(0.771)	(0.491)	(0.375)
Observations	654	96	174	1779	2703
R-squared	0.784	0.950	0.966	0.984	0.983

Note: Robust standard errors are in parentheses; *, **, and *** denote variables significant at 10%, 5%, and 1%, respectively.

Source: Authors' calculations based on empirical variables of analysis.

Table A3a: Exporting equation (exporters versus non-exporters), marginal effects

Independent variable	Textile	Electronics	Agro-food	Other sectors	All industries
PAREXP_1	0.442***	0.570***	0.807***	0.860***	0.859***
	(0.087)	(0.209)	(0.046)	(0.015)	(0.011)
INNOV_1	0.0240	-0.055	0.0111	0.0788	0.176***
	(0.043)	(0.074)	(0.163)	(0.051)	(0.062)
FIRMSIZE_1	0.148***	0.683***	-0.492	-0.033	-0.009
	(0.057)	(0.235)	(0.623)	(0.026)	(0.031)
FIRMAGE_1	-0.025***	-0.008	0.011	0.016*	0.015
	(0.007)	(0.017)	(0.027)	(0.008)	(0.011)
CAPITAL_1	-1.03	-4.11	1.19	0.001	-0.109
	(0.663)	(2.88)	(2.12)	(0.005)	(0.088)
CAPFOREIGN_1	0.022*	-0.008		0.239***	0.244***
	(0.013)	(0.053)		(0.068)	(0.049)
Observations	652	95	172	1788	2709

Note: Robust standard errors are in parentheses; *, **, and *** denote variables significant at 10%, 5%, and 1%, respectively.

Source: Authors' calculations based on empirical variables of analysis.

Table A3b: Exporting equation (fully exporting firms versus others), marginal effects

Independent variable	Textile	Electronics	Agro-food	Other sectors	All industries
TOTEXP_1	0.595***	0.732***		0.627***	0.798***
	(0.065)	(0.090)		(0.109)	(0.051)
INNOV_1	0.0302	-0.0865	-0.000	0.029	0.147***
	(0.0467)	(0.247)	(0.000)	(0.019)	(0.053)
FIRMSIZE_1	0.069	0.507	-0.004	0.009**	0.130***
	(0.058)	(0.553)	(0.008)	(0.005)	(0.032)
FIRMAGE_1	-0.036***	-0.017	-0.002	-0.331	-3.77***
	(0.012)	(0.060)	(0.005)	(0.286)	(1.36)
CAPITAL_1	-2.20	-8.23	0	-0.138	-2.75***
	(1.71)	(9.74)	0	(0.112)	(0.948)
CAPFOREIGN_1	0.057***	0.212	—	0.0708*	0.218***
	(0.019)	(0.146)		(0.041)	(0.066)
Observations	651	95	164	1755	2674

Note: Robust standard errors are in parentheses; *, **, and *** denote variables significant at 10%, 5%, and 1%, respectively.

Source: Authors' calculations based on empirical variables of analysis.

Table A4a: Innovation equation (exporters versus non-exporters), ordinary least squares

Independent variable	Textile	Electronics	Agro-food	Other sectors	All industries
PAREXP_1	-0.001	0.167*	-0.015	0.026***	0.042***
	(0.020)	(0.085)	(0.031)	(0.010)	(0.0082)
OUTPUT_1	0.275***	0.090	0.607***	0.657***	0.608***
	(0.092)	(0.098)	(0.104)	(0.028)	(0.027)
FIRMSIZE_1	0.089***	0.147*	-0.079	0.017**	0.024***
	(0.030)	(0.081)	(0.143)	(0.007)	(0.007)
FIRMAGE_1	-0.009	-0.016	-0.006	-0.006*	-0.009***
	(0.006)	(0.016)	(0.009)	(0.003)	(0.003)
CAPITAL_1	-2.59**	-1.55	0.459	-0.114***	-0.140***
	(1.10)	(1.97)	(0.577)	(0.010)	(0.010)
CAPFOREIGN_1	0.031***	-0.025	-0.046	0.034**	0.037***
	(0.010)	(0.056)	(0.085)	(0.014)	(0.009)
CONSTANT	0.666***	0.649***	0.289***	0.257***	0.299***
	(0.092)	(0.101)	(0.098)	(0.024)	(0.023)
Observations	649	95	174	1779	2697
R-squared	0.128	0.148	0.343	0.499	0.482

Note: Robust standard errors are in parentheses; *, **, and *** denote variables significant at 10%, 5%, and 1%, respectively.

Source: Authors' calculations based on empirical variables of analysis.

Table A4b: Innovation equation (fully exporting firms versus others), ordinary least squares

Independent variable	Textile	Electronics	Agro-food	Other sectors	All industries
TOTEXP_1	0.007	0.170**	-0.008	0.061***	0.068***
	(0.022)	(0.066)	(0.042)	(0.018)	(0.011)
OUTPUT_1	0.274***	0.060	0.609***	0.636***	0.582***
	(0.092)	(0.099)	(0.105)	(0.029)	(0.027)
FIRMSIZE_1	0.087***	0.108	-0.089	0.018**	0.024***
	(0.030)	(0.084)	(0.143)	(0.007)	(0.007)
FIRMAGE_1	-0.008	-0.003	-0.006	-0.005*	-0.007***
	(0.007)	(0.015)	(0.009)	(0.003)	(0.003)
CAPITAL_1	-2.51**	1.39	0.498	-0.118***	-0.142***
	(1.07)	(2.40)	(0.556)	(0.01)	(0.01)
CAPFOREIGN_1	0.030***	-0.058	-0.050	0.009	0.018*
	(0.010)	(0.060)	(0.082)	(0.018)	(0.010)
CONSTANT	0.659***	0.689***	0.282***	0.277***	0.319***

	(0.090)	(0.090)	(0.098)	(0.025)	(0.024)
Observations	649	95	174	1755	2673
R-squared	0.128	0.158	0.342	0.481	0.470

Note: Robust standard errors are in parentheses; *, **, and *** denote variables significant at 10%, 5%, and 1%, respectively.

Source: Authors' calculations based on empirical variables of analysis.

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