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Abstract

In this paper we explore the link between firms' productivity and exporting using firm level data on 1323 Tunisian manufacturing firms from 2004-06. 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 is 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 is then extended to deal with sectoral studies. The study finds, in the long run, fully exporting firms in sectors characterized by subcontracting regimes such as textile and electronics 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 agro-food industries.

JEL Classifications: F140, L63, L66, L67, O55, O140, O250

Keywords: Manufacturing industry, learning-by-exporting, self-selection, innovation, Tunisia.

ملخص

في هذه الورقة نستكشف العلاقة بين بإنتاجية الشركات المصدرة باستخدام بيانات على مستوى 1323 شركة تونسية للتصنيع 2004-06. وعلى وجه الخصوص ندرس ما إذا كانت الشركات أكثر إنتاجية يتم اختيارها ذاتيا في أسواق التصدير، واذا ما كان يحقق المصدرون إنتاجية أعلى من خلال التعلم من عماية التصدير. ثم نقوم باستكشاف الصلة بين الابتكار (كقناة تربط الإنتاجية مع التصدير) والتصدير. ويجرى التحليل على مجموعتين من الشركات. المجموعة الأولى تميز المصدرين من غير المصدرين؛ وتميز الثانية الشركات المصدرة بالكامل عن غيرها من الشركات الأخرى. وتشير النتائج إلى أن الشركات المصدرة كليا يتم اختيارها ذاتيا في كثير من الأحيان فى أسواق التصدير وبالتالي، تكون مكاسبها أقل بكثير من مكاسب التصدير لأنه من المرجح ان يكون لديها خبرة سابقة لها في هذا المجال. ثم تم توسيع التحليل للتعامل مع الدراسات القطاعية. ووجدت الدراسة، أنه على المدى الطويل، تواجه الشركات في القطاعات التي تتميز بأنظمة التعاقد من الباطن مثل المنسوجات والالكترونيات انخفاض واضح في نطاق التعلم من خلال التصدير. وعلاوة على ذلك، يمكن أيضا أن يتأثر نطاق التعلم من خلال وجهة التصدير كما هو الحال في الصناعات الغذائية الزراعية.

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 firms' efficiency, to innovation activity and to global engagement. Recent empirical research on the exporting behavior of firms has established several empirical regularities. Exporting firms are known to be superior in comparison to non-exporters in terms of productivity, capital intensity, wages, and size. The productivity premium of exporting firms has received particular attention from economists, who have sought, in particular, to test the validity of two dominant hypotheses. Productive firms are likely to self-select into export markets (this is termed as *self-selection*). Contrastingly, exporting is an important source of knowledge accumulation improving firms' capabilities (this is termed as *learning-by-exporting*). It is often argued that an export-oriented strategy increases efficiency at the firm level (Krugman 1987; Rodrik 1988; Grossman and Helpman 1991).

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, which adopt import-substitution strategies, do not compete with seasoned and more advanced firms. This reasoning suggests that the potential gains from exporting are very likely to be large in developing countries and even much higher than in the developed world. For instance, in the analysis of the causal relationship between exporting and productivity at firm level on the US economy (Bernard and Jensen 1995, 1999a, 1999b), the authors found a weak evidence of learning-by-exporting, suggesting that exporting does not offer a great scope for learning for 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 are so small that if African countries are to industrialize, 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).

Large productivity premiums of new exporters compared to non-exporters imply that the decision to start exporting is determined by factors that affect productivity of firms. This 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, while on the other hand, an increase in a firm's exporting activity, due to increased scale of sales, feeds back into its productivity by increasing process innovations.

In this paper we will explore both the link between firm productivity and the exporting decision and between innovation and exporting using a production function approach.[1] The empirical analysis will be based on three waves of firm-level dataset using accounting, industrial, and exporting flows surveys of 1323 Tunisian manufacturing firms from 2004-06.

The Tunisian government has been relatively successful in creating an attractive environment for export-oriented foreign investors. Tunisia is becoming an attractive destination for

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

European investment[2] due to geographical and cultural proximity. The offshore sector[3] represents more than 48 percent of the manufacturing sector. Almost 70% of the manufacturing exports come from firms benefiting from offshore status since 1972 whose entire production is exported to the EU. This particularity of the Tunisian manufacturing industry provided the rationale for conducting the empirical analysis on two clusters of firms, notably, exporters (including fully and partially exporting firms) versus non-exporters and fully exporting firms versus others.

As a first step of the analysis we test the various predictions for the manufacturing industries ignoring the effect of sectoral specificities. We find no evidence of self-selection 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. We also found strong evidence for learning-by-exporting in the first cluster of firms. The evidence was much weaker for the second cluster suggesting that the scope for learning from exporting is lower for fully exporting firms (mainly composed of subcontractors with relatively longer previous exporting experience and for which exporting is guaranteed).

The study provides a strong evidence for a two-way relationship between innovation and the decision to export. While innovation activity increases the probability of exporting in the current period, exporting drives innovation activity. In addition the impact of innovation on triggering the export decision is slightly lower for fully exporting firms. This suggests that fully exporting firms have less incentive to innovate than partially exporting ones because they are already ahead of technological advances (they have almost similar technological advancement as countries to which they export). This result supports the lower scope for learning-by-exporting in this cluster of firms. In contrast, the effect of exporting on innovation increases slightly for fully exporting firms meaning that this cluster of firms has a higher ability to acquire new knowledge because of firms' higher exposure to more mature markets and higher abilities to adopt best-practice technologies.

We extend the basic analysis to deal with sectoral specificities. Indeed, Tunisian exports of manufacturing products are mainly concentrated on textile and clothing, which constitute almost 70% of manufacturing products. However, a certain number of new products have emerged such as beam wires commanded by European mass-produce vehicles, electronic components, certain plastic products, essential oils and detergents, products for which foreign demand has exhibited a rapid increase. This suggests that the relations explored above are very likely to be sector specific. The study focuses on four sector groups, notably, the textile/clothing and footwear industries, the mechanical/electronics and electric industries[4], the agro-food industries[5] and all other manufacturing firms.

The study found weak evidence for self-selection for clusters of firms in the textile and clothing industry. One plausible explanation for failing to detect a direct self-selection effect is the strong persistence of firm-productivity over time, which could mask the self-selection effect. We find no statistical support for the existence of learning-by-exporting in both clusters. The fact that most firms making up this sector are seasoned subcontractors with long experience in the export markets may have reducing their scope for learning. With respect to

[2] But, even firms from the BRICs and North America are increasing their investments.

[3] The Kearney's Global Services Location Index (GSLI), ranked Tunisia as the 17th most attractive offshoring destination in the world (African Manager The latest edition of the global management consulting firm).

[4] Which represent together more than 24% of the whole industry, but 62% of exporting firms in 2007.

[5] Exports by the agrofood sector tripled between 2002 and 2007, up from 557 million dinars to 1616 million. There are more than 1000 companies in the sector that have at least 10 employees, 156 of which export their entire production and 104 of which are financed at least partially by foreign holdings.

the link between innovation and exporting decisions, the analysis provides evidence for the positive impact of previous innovation on increasing the incentives for contemporaneous exporting for partially exporting firms; in contrast, exporting does not drive innovation in the current period. As for fully exporting firms, we found no evidence for the impact of innovation on increasing the likelihood of exporting.

The study finds no evidence for self-selection for partially exporting firms in the electronics sector. In contrast, the statistical support for self-selection was strong for fully exporting firms. There was no evidence for learning by exporting for partially exporting firms. One explanation that could be put forward is that for this sector, which is known to be capital intensive, it is possible that an increase in efficiency is associated with more intensive utilization of capital in such a way as to mask the direct effect on exporting. However, the evidence about the learning effect was quite strong for fully exporting firms. This finding seems to be counterintuitive because these firms are mainly subcontractors and also specialized 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 - since the electronics sector has emerged in the country not long ago (it has emerged during the last decade), meaning that its firms have no in-depth experience in exporting activity. This suggests that the potential gains from learning are very likely to be higher than for the textile sector. In analyzing the link between innovations and exporting decision, we found evidence for the positive impact of previous innovation on increasing the incentives for exporting in the current period for partially exporting firms; while exporting, in turn, drives 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 drives innovation.

Our findings for the agro-food sector show no evidence for self-selection in partially exporting firms[6]. One possible explanation is that in this quite specific sector, it is not efficiency which drives export decision, but rather other exogenous factors including the availability of first quality agricultural products (such as olive oil and dates) and industrial policies promoting and encouraging exporting activity. There was also no evidence of learning by exporting in partially exporting firms; in contrast, the evidence is quite strong for fully exporting ones. One plausible explanation is that the scope for learning is larger when firms export to high income countries (EU) than to medium and/or low income countries (See, De Loecker 2007 who finds that the productivity gains are higher for firms exporting towards high income regions, although he 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 innovations and exporting decision, we found no evidence on the positive impact of previous innovation on increasing the incentives for exporting in the current period; we also found no evidence to support the fact that exporting might drive innovation.

Finally, the empirical analysis provided no evidence for 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 for partially exporting firms, but none for fully exporting ones. Our analysis confirms that innovation precedes the decision to export in both clusters, but the effect was slightly lower for fully exporting firms. Exporting drives innovation in both clusters, with a slightly stronger effect in fully exporting firms.

The 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, notably, exporters

[6] Here we did not say anything about the behavior of totally exporting firms for reasons explained below in the "Estimates of self-selection hypothesis for the agrofood sector" in section "Agrofood industries".

versus non-exporters and fully exporting firms versus others. We describe the dataset we use, as well as basic descriptive statistics. We present the results on self-selection and learning-by exporting for 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, notably the textile/footwear and leather industries, the electric/mechanical and electronics industries, the agro-food industries and the remaining manufacturing industries (including mining, energy and miscellaneous industries). In section 5 we give some policy recommendations. Section 6 concludes. Some tables are relegated to an 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. On the other hand, 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 causality is very demanding[7] and therefore we restrict the analysis to explore the correlation between efficiency and exporting,

We analyze 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 in prior to joining the export market. Learning-by-exporting implies that firms facing foreign competition would accumulate a stock of (external) knowledge through their relation with foreign competitors who can have information on production techniques and on the technical specifications of competing products, benefit from the technical information provided by foreign buyers, 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 waves of firm-level data using accounting, industrial, and export flow surveys on 1323 Tunisian manufacturing firms from 2004-06. These data are compiled from surveys conducted annually by the "INS" (Institut National de la Statistique) of Tunisia on all manufacturing firms. We drop from the initial dataset 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. Consequently, our balanced panel dataset is composed of 1323 firms. This unique dataset (we were the first to explore on the micro-level 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[8]. Moreover, we test for the congruent hypothesis that exporting improves a firm's productivity. This dataset also allows exploring whether exporting activity drives innovation, and, alternatively, whether innovation is indeed a prior decision to exporting.

[7] 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.

[8] Enhancing the 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 2004).

In this dataset, the percentage of partially exporting firms is equal to 13.08% in 2004, 13.26% in 2005 and 11.01% in 2006. Totally exporting firms represent, in contrast, 26.69%, 25.91% and 23.60% of total manufacturing firms, respectively in 2004, 2005 and 2006.

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 the peculiarity of the Tunisian manufacturing sector, in that almost 70% of exports come from the offshore sector 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 higher abilities to accumulate knowledge and/or more incentives to engage in innovation to bear on intense foreign competition. On the other hand, these firms might be mainly subcontractors or/and 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 their efficiency in previous periods, meaning 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 ahead of technological advances or there is no complexity in the production process requiring such investment to occur.

2.3 Estimation procedure

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

- CAPFOREIGN_1: Denotes an indicator variable for capital owning status, it is assigned a value 1 if the firm's capital is foreign during the previous year and 0 otherwise.
- CAPITAL_1: The firm's financial resources during the previous year expressed in trillion of constant (2004) US dollars.
- FIRMAGE_1: Age of the firm (decades). This is a measure of the firm's survival.
- FIRMSIZE_1: The number of the firm’s employees (thousands) in the previous year (including administrators, technicians, simple worker, etc.).
- INNOV: The proportion of engineers and technicians with different degrees of qualification in the firm's workforce during the current year.
- INNOV_1: The proportion of engineers and technicians with different degrees of qualification in the 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 Dollars.
- OUTPUT_1: Sales of the previous year - revenue from real output sold during the previous year expressed in thousands of constant (2004) US Dollars.
- PAREXP: Denotes 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: Denotes 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: Denotes 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: Denotes 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.

2.3.1 Modeling 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 models used for the first and second clusters of firms (notably, exporters versus non-exporters and fully exporting firms versus others) are respectively given by the following equations:

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

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

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, and $Z_{i,t-1}$ is a vector of lagged control variables including the firm's age, the firm's size, the capital intensity and the capital owning status; and i and t are firm and time indices, respectively.

In this model we assume export participation to depend on previous export participation, output, firm size, capital intensity, etc. Previous export participation is included in the model to 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 costs 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 FDI for which we control using the foreign 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 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 Nickell 1996; Bigsten et al. 2004; Joze et al. 2008; Keiko and Lechevalier 2010). One potential reason for dynamics of this form is that whenever the firm's behavior and characteristics are changed, this may take time for this 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.

2.3.2 Modeling learning-by-exporting

We model learning-by-exporting as a simple linear regression of firm i sales [9] 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:

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

And

[9] "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." - to use a phrase coined by Bigsten et al (2004).

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

Where $PAREXP_{i,t-1}$ and $TOTEXP_{i,t-1}$ are the lagged export status for partially exporting firms and totally exporting ones, respectively. $OUTPUT_{i,t-1}$ is lagged sales, and $Z_{i,t-1}$ is a vector of lagged control variables including the firm's age, size, capital intensity and capital owning status. α_1 is the key parameter to be estimated (it provides evidence about learning by exporting whenever it is positive and significant); and $u_{i,t}$ is a residual, assumed to be serially uncorrelated and which captures efficiency shocks.

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

2.3.3 Estimates of Self Selection

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

2.3.3.1 Exporters versus non-exporters

The first column of Table 2 shows no evidence of self-selection, although the coefficient on 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.

The firm's size measured by the number of employees is positively related to the firm's likelihood of becoming an exporter, although its coefficient is not statistically significant. The negative coefficient on 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 lower 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 or/and are more risk averse to the adoption of new technologies[10] or new ways of producing. The positive and significant coefficient on 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 that help them keep up with foreign competitors. These buffers include knowledge of foreign market characteristics, trends in consumer demand and the technological improvements, and better governance strategies.

2.3.3.2 Totally exporting firms versus others

The third column of Table 2 provides strong statistical support for self-selection. The coefficient on OUTPUT_1 is positive and highly significant consistent with findings in the literature include by Bernard and Jensen 1999; Greenaway and Kneller 2006 and others that only firms with sufficiently high productivity level export to foreign markets. Moreover, the dichotomy into fully exporting firms and others increases the marginal effect on 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.

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

Past exporters are more likely to continue exporting. This is captured by the positive and significant coefficient on 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 channeled through tax concessions). Second, fixed costs associated with exporting in the current period may be lower than costs in previous periods.

The coefficient on CAPFOREIGN_1 is positive and highly significant and is along expected lines. However, its marginal effect is lower for this cluster of firms (it falls from 0.256 to 0.175) possibly due to 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 higher foreign involvement than others).

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

2.3.4 Estimates of learning-by-exporting model

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

2.3.4.1 Exporters versus non-exporters

The first column of Table 3 provides strong evidence for learning-by-exporting; the coefficient on PAREXP_1 is positive and significant at less than 1% level of significance. The positive coefficient on OUTPUT_1 captures the persistence of the firm's efficiency over time; efficiency may have long-term effects. Exporting firms are likely to have higher ability to adjust their technology and productivity over time because of their exposure to competition. The coefficients of all control variables are either of the wrong sign and/or are statistically insignificant.

2.3.4.2 Totally exporting firms versus others

The second column of Table 3 is consistent with predictions on learning-by-exporting with the positive and almost significant coefficient on TOTEXP_1 (significant at 12.1%). This coefficient becomes significant at 10% when we substitute[11] a variable controlling for innovation in place of the one controlling for FDI. One possible explanation is that CAPITALFOREIGN_1 absorbs most of the effect on increasing the firm's efficiency so as to mask the direct effect of exporting.

The marginal effect on TOTEXP_1 is lower compared to 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 a careful exploration of learning-to export dynamics, we observe that almost all fully exporting Tunisian firms are subcontractors with relatively long exporting experience and with strict export arrangements. Therefore, the potential gains from exporting is likely to be lower in the current period compared to prior periods (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.

[11] We did not report this finding here.

The positive and significant coefficient on OUTPUT_1 captures the persistence of the firm's efficiency over time; more productive firms invest to enhance their productivity. The positive coefficient on FIRMAGE_1 is positive suggesting that older firms are more efficient at allocating resources that will allow them to converge towards technical efficiency. Engaging in innovation through equipment modernization, more 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 logINNOV-1 in the specification changes the coefficient on FIRMAGE_1. This helps differentiate old managers who are less inclined to innovate from those that have more incentives to modernize management tools.

3. Exploring the Link between Innovation and Exporting

The analysis conducted up 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 this firms heterogeneity and difference of their evolution, but they instead simply assume that productivity is exogenous to the firm. However, models of firm dynamics (See, Jovanovic 1982; Hopenhayn 1992) and their extension to international trade (See, Melitz 2003) assume that productivity is assigned to a firm by luck of the draw from a random distribution. After making a draw, there is therefore no way for a firm to change its path of its survival or demise.

Contrastingly, endogenous growth theory relates firm productivity to decisions, such as investment into research and development (R&D) and innovation. Romer (1990) argues 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 product lifecycle theory, Klepper (1996) shows that product innovation dominates the early stage of the product lifecycle, while process innovation becomes relevant in the later stages, once production volumes have increased and firm efficiency becomes increasingly important. Recently, Constantini 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.

This literature suggests that on one hand, a firm decision to enter exporting markets may be driven by its prior decision to innovate a product, which will be translated into improvement of the firm's productivity. On the other hand, an increase in the firm exporting activity, following an increased scale of sales, feeds back into its productivity by increasing process innovations. Based on 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. In turn, successful exporting may drive process innovation, which in turn affects positively its productivity growth. This suggests that the causality between innovation and exporting may run in both directions. Investigating causality is very demanding[13]; this is why in the remainder of this section we will restrict the analysis to the investigation of the correlation between innovation and exporting. We will use the same methodology as for exploring the link between productivity and exporting; we

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

[13] This is termed as process innovation.

study the link between exporting and innovation by modeling joint decisions using both probit and OLS models.

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

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. Considering a measure of human capital is necessary to account for the skills embodied in the firm's employees themselves. This human capital injects higher skills and knowledge into the organization, which is likely to enhance 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 labor force of firm *i* (total number of employees) during period *t*.

In the literature variables are often used that are very likely to capture *labor displacement*, which may account for actual innovation better than expenditure in R&D and that may or may not lead to innovation. There is potential for sunken R&D expenditures, firms may well expend on R&D, whereas they are not innovating. Notice that we do not discriminate between product and process innovations.

3.2 Modeling the 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 of the firm characteristics using a one period lag. The probit models used for the first and second clusters of firms (namely, exporters versus non-exporters and fully exporting firms versus others) are respectively given by the following equations:

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

And

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

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

3.3 Modeling the innovation activity (Innovation equation)

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

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

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 capturing shocks that may affect innovation activity.

3.4 Estimates of the exporting activity (Exporting equation)

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

3.4.1 Exporters versus non-exporters

Prior innovation activity increases the likelihood of current export status, and its coefficient is significant at less than 1% level. 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 on CAPFOREIGN_1 implies that firms with higher foreign capital share are better equipped to join export markets since they are better governed, have superior technical know-how and marketing experience. These advantages are readily translated into production scale upgrading and strengthening export capabilities.

3.4.2 Totally exporting firms versus others

There is a strong statistical support for the positive impact of lagged innovation on exporting ability. However, the marginal effect for this cluster of firms is slightly lower compared to 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 on lagged exporting is along expected lines as explained in previous sections. Moreover, the marginal effect on lagged exporting declines slightly compared to the previous setting (it falls from 0.859 to 0.797), meaning that sunk cost of exporting is very likely to be less important for fully exporting firms.

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

3.5 Estimates of the innovation activity (Innovation equation)

3.5.1 Exporters versus non-exporters

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

Firm size predicts innovation fairly well (the coefficient on FIRMSIZE_1 is positive and significant at less than 1%). This is consistent with predictions that innovation activity correlates positively with the size of the firm, indicating the importance of scale in research activity. This is in line with the findings of Love and Roper 2002; Barrios et al 2003; Damijan and Kostevc 2006. Large firms are considered to be relatively more innovative than

smaller ones, because of their capacity to spread risks over a portfolio of projects and their access to financial resources, giving them an advantage over smaller firms in investing in R&D. An alternative explanation is that larger firms may have higher absorptive capacity, so even when these firms do not innovate, they nevertheless invest in R&D activity to enhance their absorptive capacity.

As noted in previous sections, older firms may be less innovative except those, which have already invested in innovation activities. This intuition is supported by the positive coefficient on INNOV_1 and the negative coefficient on FIRMAGE_1. Based on this reasoning, larger firms may have higher absorptive capacities allowing them to benefit more from technological spillover of other firms' R&D (Cohen and Levinthal 1989). The positive and highly significant coefficient on 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.

3.5.2 Totally exporting firms versus others

In the innovation equation, the positive and significant coefficient on lagged exporting status is along expected lines as explained in the previous section. Moreover, the coefficient on this variable increases slightly in fully exporting firms in contrast to the exporters/non-exporters differentiation (it goes 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 contemporaneous innovation and 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 their technological advances.

4. Sectoral Studies

In the foregoing analysis, we have ignored the role of sectoral specificities on efficiency and exporting status and innovation and exporting. 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 sectoral specific. As a background to the analysis we provide a brief sketch of the manufacturing sector in Tunisia.

Since 1970 Tunisia pursued diversification strategies to improve competitiveness in global markets. Four decades later, the manufacturing industry is very diverse, and one dominated by the export sectors: textiles/clothing-leather/footwear, agro-food, and mechanical/electrical/electronic industries. These three sectors generate more than one billion dinars in exports each and represent 76% of industrial companies, 87% of exports, almost 62% of foreign direct investment, and more than 83% of jobs.

Tunisian exports of manufacturing products are mainly concentrated in textile and clothing, which constitute almost 70% of manufacturing products. The textiles and clothing industries sector is comprised of some 2,094 industrial enterprises employing at least 10 persons, of which 1,656 produce exclusively for the export market. The Sector comprises of 971 enterprises with foreign participation, of which 635 are wholly (100%) foreign owned. The leading foreign investors in the textile/clothing sector are Italy, Belgium, Holland, France, Algeria and the USA. 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 supplier to the European Union, as well as 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. Clothing and textile exports have reached MTND 4,420 in 2006 against MTND 4020 in 2001. The clothing sector alone represents 91% of those exports: 72% for woven garments and 19% for knitted goods. Clothing and textile exports represent 36% of the total Tunisian exports.

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 the foreign demand has rapidly increased. Thanks to integration and strong exports, the electric/electronics and mechanical sector's rate of coverage has risen considerably, up from 66% in 2000 to 114% in 2008. The European Union, one of the most competitive markets in the world, remains the favorite destination of the sector's goods. With its expertise and experience in the field of electrical & electronics industry, Tunisia is currently hosting more than 50 companies operating in manufacturing products and components for the aerospace industry (such as ANJOU ÉLECTRONIQUE, LATECOERE, SAFRAN GROUP, ZODIAC respectively produce electric and electronic components designed for AIRBUS, BOEING, EUROCOPTER, DASSAULT, EMBRAER, BOMBARDIER). The development of the electrical, electronics and household appliance sector in Tunisia is based on a two-pronged strategy:

- Manufacture of finished products for the local and African markets;
- Manufacture of sub-assemblies or components for export to Europe.

The last pillar and not the least is the agro-food sector. The sector's production in 2007 brought about 8.9 billion Tunisian Dinars, compared to 8.2 billion in 2006. Growth is led by key agro-food products, ongoing upgrading in all branches and significant development on neighboring markets. Exports have enjoyed an increase of almost 300% in the period 2002 - 2007, up from 557 million dinars to 1616 million. There are more than 1000 firms in the agro-food sector that have at least 10 employees, 156 of which export their entire production and 104 of which are financed at least partially by foreign holdings. Firms producing oils & fats and cereals and handling cold storage represent almost 70% of the overall number of businesses in this sector. Olive oil is the primary agro-food product exported by the agro-food sector, with almost 180 thousand tons a year and earnings amounting to an average 43% of agro-food exports. Olive oil is an age-old tradition in Tunisia. High volume available for export and high quality have made Tunisian olive oil well known for its sensory-pleasing characteristics, solidifying Tunisia's position in its traditional markets in the EU and opening new prospects for exports to new markets like the US, Japan and Middle Eastern countries.

In the remainder of the paper we will investigate the role of efficiency/innovation on firms export status and vice-versa in four main sectors, notably, the textile/clothing and footwear industries, the mechanical/electronics and electric industries, the agro-food industries and other manufacturing firms pooled together (results for this last sector will not be reported here because they are almost similar to those presented above).

4.1 Textile/clothing and footwear industries

A balanced panel data of 327 firms is used to explore the relationship between export status and productivity/innovation. Firms producing exclusively for the export market represent 86.4% of the sample in 2004, 84.8% in 2005 and 85.8% in 2006. In contrast, the percentage of partially exporting firms amounts to 4.9% in 2004, 5.1% in 2005 and 4.4% in 2006.

4.1.1 Exploring the link between exporting and productivity in the textile sector

4.1.1.1 Estimates of self-selection for the textile sector

Table 6a and Table 6b in the appendix below illustrate the results about self-selection for this sector.

4.1.1.1.1 Exporters versus non-exporters

We find evidence of self-selection for partially exporting firms in the second specification. In the first specification, lagged output increases the likelihood of contemporaneous exporting, although this relationship is not statistically significant. In contrast, when we eliminate the control variable CAPITALFOREIGN_1 from the first specification, the coefficient on lagged output becomes significant at 8.3%. It is possible that CAPITALFOREIGN_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, have better access to best practice technologies, and are endowed with more financial resources to invest in innovation). However, the coefficient on 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 on FIRMAGE_1 is statistically significant at less than 1%, but its sign is not along expected lines.

4.1.1.1.2 Totally exporting firms versus others

Efficiency premiums increase the likelihood of exporting, but the coefficient on lagged output is insignificant, providing little evidence about self-selection for this cluster of firms. Possibly the reason for this result is that fully exporting firms of this sector are mainly subcontractors characterized by strict export arrangements, in such a way as to mask the direct effect of efficiency in increasing exporting. The coefficient on lagged exporting is positive and significant at less than 1% (sunk cost of exporting activity); and its marginal effect is higher by one third compared to the premium for exporting firms as a whole indicating larger scale of sales in fully exporting firms. The firm's size is positively correlated to export-status, and its coefficient is significant at less than 5%. In contrast its marginal effect is slightly lower than 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 to increase the likelihood of exporting. The positive and significant coefficient on CAPFOREIGN_1 is along expected lines. Foreign owned firms have higher abilities to export, and the marginal effect in fully exporting firms is higher by two third compared to exporting firms as a whole (0.063 compared to 0.021).

4.1.1.2 Estimates of the learning-by-exporting model for the textile sector

The second columns of Table 7a and Table 7b (in the appendix) illustrate the results for the learning-by-exporting effect in the textile sector for the two clusters of firms.

4.1.1.2.1 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 seventies and therefore older firms are likely to have experienced long exporting experience lowering the scope for learning.

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

4.1.1.2.2 Totally exporting firms versus others (textile sector)

Similarly, we find 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 on lagged

output is positive and significant at less than 1%). The regime of exporting did not affect the coefficient.

4.1.2 Exploring the link between exporting and innovation in the textile sector

4.1.2.1 Estimates of export activity (Exporting equation)

The second columns of Table 8a and Table 8b (in the appendix) illustrate the results about the estimates of the export activity for this sector.

4.1.2.1.1 Exporters versus non-exporters (textile sector)

In the export equation, the coefficient on 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 signifying lower future fixed costs associated with exporting). The coefficient on FIRMSIZE_1 is significant at less than 5%, implying that larger firms are very likely to engage in large scale of production and thereby export more. The positive and strongly significant coefficient on CAPFOREIGN_1 is along expected lines.

4.1.2.1.2 Totally exporting firms versus others (textile sector)

In the export equation, the coefficient on lagged innovation is positive, though it is not significant. There is a 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 exporting/non-exporting 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 coefficients on FIRMSIZE_1 and CAPFOREIGN_1 have the expected positive signs. Although the coefficient on FIRMSIZE_1 is not significant, the one on CAPFOREIGN_1 is significant at less than 5% as expected.

4.1.2.2 Estimates of innovation activity (Innovation equation)

The second columns of Table 9a and Table 9b (in the appendix) illustrate the results about the estimates of the innovation activity for this sector.

4.1.2.2.1 Exporters versus non-exporters (textile sector)

In the innovation equation, the coefficient on lagged exporting is negative and insignificant. Prior experience at innovation increases the incentives for contemporaneous innovation due 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 on CAPFOREIGN_1 is positive and highly significant. The interpretation is similar to that given in previous sections.

4.1.2.2.2 Totally exporting firms versus others (textile sector)

The coefficient on lagged exporting is positive, but it is statistically insignificant. Prior experience in innovation increases the incentives for current innovation (sunk cost of innovation). Its coefficient is statistically significant and is similar to the exporter/non-exporter. 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 foreign direct investment predict innovation fairly well and their coefficients remain at fairly similar levels as 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, the percentage of partially exporting firms is 16.4% in 2004, 23.4% in 2005 and

20.0% in 2006. As for fully exporting firms they represent 62.7% in 2004, 53.2% in 2005 and 46.3% in 2006. The relatively small size of the sample can be a source of biases in our results.

4.2.1 Exploring the link between exporting and productivity in the electronics sector

4.2.1.1 Estimates of self-selection (electronics sector)

The third columns of Table 6a and Table 6b (in the appendix) illustrate the results about the estimates of the self-selection effect for the electronics sector.

4.2.1.1.1 Exporters versus non-exporters (electronics sector)

We find 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 on FIRMSIZE_1 is positive and significant implying that the larger fixed costs related to exporting the more likely it is that only bigger will be able to bear them.

4.2.1.1.2 Totally exporting firms versus others (electronics sector)

Contrastingly, we find strong statistical support for the self-selection hypothesis in totally exporting firms. The coefficient on lagged exporting is positive and significant at less than 1%. Moreover, its marginal effect increases from 0.480 to 0.746 compared to the comparator cluster, indicating the importance of sunk costs of exporting in fully exporting firms. Firm size predicts the firm decision to start exporting or to 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 enter export markets or helps them maintain their exporting status.

4.2.1.2 Estimates of learning-by-exporting (electronics sector)

The third columns of Table 7a and Table 7b (which appear in the appendix), illustrate the results for the learning by exporting effect for the first and second cluster of firms, respectively.

4.2.1.2.1 Exporters versus non-exporters (electronics sector)

Again, we find no evidence of learning by exporting in this sector. Several interpretations could be put forward to justify this result. It can be the case that only a small portion of these firms are partial exporters or they may have low exporting capacities meaning that they are not well exposed to international export markets and therefore exhibit lower 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 on OUTPUT_1 is along expected lines. The coefficients of the remaining control variables are insignificant.

4.2.1.2.2 Totally exporting firms versus others (electronics sector)

There is strong evidence for 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 have much more to gain from such exposure. Lagged output increases the firm's productivity and its coefficient is significant at less than 1%. Firms with a larger 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, which are endowed with better governance strategies and advanced technologies.

4.2.2 Exploring the link between exporting and innovation in the electronics sector

4.2.2.1 Estimates of export activity (Exporting equation) for the electronics sector

The third columns of Table 8a and Table 8b (in the appendix) illustrate the results about the determinants of the exporting activity in the electronics sector for the first and second cluster of firms, respectively.

4.2.2.1.1 Exporters versus non-exporters (electronics sector)

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

4.2.2.1.2 Totally exporting firms versus others (electronics sector)

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

4.2.2.2 Estimates of innovation (Innovation equation) for the electronics sector

The third columns of Table 9a and Table 9b (in the appendix) illustrate the results about the determinants of the innovation activity in the electronics sector for the first and second cluster of firms, respectively.

4.2.2.2.1 Exporters versus non-exporters (electronics sector)

In the innovation equation, the coefficient on lagged exporting is positive and significant at 5.3%. 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 innovation in the current period, though its coefficient is insignificant. The firm size is a good determinant of innovation as expected. The coefficients of all remaining control variables are insignificant.

4.2.2.2.2 Totally exporting firms versus others (electronics sector)

In the innovation equation, the positive and strongly significant coefficient on lagged exporting is along expected lines as explained in the previous section. Moreover, the coefficient increases slightly, meaning 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, though its coefficient is statistically insignificant. However, this result could be due to 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, the percentage of partially exporting firms is 37.3% in 2004, 39.9% in 2005 and 25.4% in 2006. Fully exporting firms represent 6.7% in 2004, 5.8% in 2005 and 7.8% in 2006. Similar to the previous section, the relatively small percentage of totally exporting firms can be a source of biases in our results.

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

4.3.1.1 Estimates of self-selection for the agro-food sector

The fourth columns of Table 6a and Table 6b (in the appendix) illustrate the results about estimates of self-selection in the agro-food sector for the first and second cluster of firms, respectively.

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

We find 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 which drives export decision, but rather other factors including the availability of first quality agricultural products (such as olive oil, well known for its sensory-pleasing characteristics, and dates known for their delicious and nutritional and natural qualities[14]) and industrial policies encouraging exporting either through liberalization of agriculture[15] or through policies granting priority to the export of some products (such as olive oil which integration in the world market is not by chance but rather the result of olive-growing policies held by the Tunisian government since 1962 granting an absolute priority in the exportation of olive-oil and encouraging the grain-oils and the subvention of their prices in the consumption).

The coefficient on lagged exporting is positive and significant at less than 1%, indicating the large sunk cost of previous exporting activity. CAPITAL_1 does not play a significant role in exporting status. This might be due to the fact that this sector is not capital-intensive, or to the export support 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.

Remark: We did not report results for the second cluster of firms –since they were not insightful.

4.3.1.2 Estimates of learning-by-exporting for the agro-food sector

The fourth columns of Table 7a and Table 7b (in the appendix) illustrate the results about the estimates of the learning-by-exporting effect for the first and second cluster of firms, respectively.

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

We find no evidence of learning by exporting in this cluster of firms. At the first glance, one could think about the dynamics of learning in that agro-food firms have experienced long previous exporting activity (in particular that this sector has adopted an export-oriented strategy since 1962 with policies encouraging olive oil exporting to EU), which is very likely to be the driving factor in reducing the scope for learning. However, because of the major difference of this sector as compared to the previous ones, a different explanation might be 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 low scope for learning compared to high income countries as EU countries which markets are very demanding. This finding is well supported by the higher scope for learning from exporting of fully exporting firms which exports are mainly directed to the European Union (Italy, Spain, France), USA, and Switzerland (for instance, these countries receive from 88% (2002) to 98% (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

[14] For the same reasons advanced in exploring the link between productivity and exporting (refer to footnote 4).

[15] 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)." National Institute of Statistics, 2008.

and dates which do not require large processing, reducing therefore greatly the scope for learning.

The positive and highly significant coefficient on OUTPUT_1 is along expected lines. It captures the persistence of the firm's efficiency over time. The coefficient on lagged firm size is positive but insignificant. The coefficient on FIRMAGE_1 is negative and significant at the 5% level, which refers could imply that older firms managed by seasoned managers may be rooted in traditional practices and are less receptive to innovative techniques. The coefficients of all remaining control variables are insignificant.

4.3.1.2.2 Totally exporting firms versus others (agro-food sector)

We find evidence of learning by exporting in this cluster of firms - the coefficient on lagged exporting is positive and significant at 10% level. The scope for learning is higher for fully exporting firms than for partially exporting ones, unlike in the textile sector. Possibly, the reason is that these firms export mainly to high income countries (EU) where efficiency gains from exporting is likely to be higher than to medium and/or low income countries (See, De Loecker 2007). For instance, olive oil exports in to the European Union comply fully with standards of hygiene and quality. Lagged output increases the firm's productivity and its coefficient is significant at the 1% level. The coefficient on lagged firm size is not significant. The negative coefficient on FIRMAGE_1 is negative and significant. The coefficients of other control variables are statistically insignificant.

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

4.4.1 Estimates of export activity (Exporting equation)

The fourth columns of Table 8a and Table 8b (in the appendix) illustrate our findings for this sector.

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

In the export equation, the coefficient on lagged innovation is positive as expected, but statistically insignificant, indicating that innovation is not a prior decision to exporting. Though, when interpreting carefully, one can see that investing in innovation activities is a prior decision to the creation of firms, in that this sector already employs highly skilled engineers and technicians (at reasonable wage costs). Indeed, the sector employs 25% of the country's engineers (National Institute of Statistics 2008). Moreover, this sector's firms receive "external knowledge" through the assistance of several centres as the Agro-Food Technical Center[16], technical organization serving food professionals. It works in development and promotion of food processing sector, providing assistance to various branches of this industry. This may well offset the real effect of the internal innovation undertaken by the firm. Lagged exporting is positive and highly significant (importance of sunk cost of previous exporting). The coefficients of the remaining control variables are statistically insignificant.

4.4.1.2 Totally exporting firms versus others (agro-food sector)

In the export equation, the coefficient on lagged innovation is positive, though it is not significant. There is a strong statistical support of the positive correlation between lagged exporting and the involvement in exporting in the current period (sunk cost of previous exporting). Moreover its marginal effect is stronger as compared to the previous cluster meaning that sunk costs of exporting are very likely to be more important for fully exporting

[16] 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.

firms because of the large scale of exporting. The coefficient on FIRMSIZE_1 is negative and significant at less than 1%. This may refer to the possibility of congestion, undermining labour productivity, and negatively affecting the scale of production. The coefficient on FIRMAGE_1 is also negative, but it is statistically significant at less than 5%, referring to the likely rigidity of older managing systems.

Remark: We did not report the estimates about the correlation between exporting and innovation for this sector, because no evidence about this relation has been established for either cluster of firms in either direction.

5. Policy Recommendations

The principal aim of this study was to explore the link between firm productivity and exporting decision on one hand and 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 levels. The various findings in sectoral studies have several striking features, which will constitute the cornerstones for the subsequent policy recommendations.

One strand of our findings shows lower scope for learning from exporting in fully exporting firms in the textile and clothing sector compared to the electronics sector, although fully exporting firms in both sectors are mainly composed of subcontractors that benefit from similar advantages. This begs the question: why do firms in the two sectors that share similar attributes do not learn by exporting in the same way? We attribute the differences to different dynamics of learning. While the textile sector has benefited from the subcontracting regime since the beginning of the seventies, the electronics sector emerged very recently during the last decade. Subcontracting firms with strict export agreements benefits more in the short term, but in the long-term and subsequent to reaching the peak of the learning curve, the benefits from exporting gradually decline. This suggests that industrial policies of emerging economies should consider subcontracting as an intermediary stage for the economic development in order to acquire the necessary knowledge and abilities to increase its competitiveness and reduce its technological dependency on foreign investors and then move from the beaten tracks primarily based on subcontracting to co-contracting and finally to an entirely finished product with higher added-value.

By the same token, the scope for learning by exporting in the electronics sector is bound to be short-lived. In the interim, exports of this sector to high-income countries where learning is likely to be higher than to medium and /or to low income countries are exclusively based on manufacture of sub-assemblies or components. The conjunction of the decreased scope for learning from exporting in the long-term, and the task-based feature of production (where there is no complexity even in complex industries such as the electronics sector), which undermines firms abilities and incentives to acquire the necessary knowledge on the complete production process keeping them heavily dependent on foreign investors and technologies. The electronics sector in Tunisia would benefit from abandoning the subcontracting traditions that rely exclusively on task-based production in favor 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 the early stage of their development, and then involve in innovation per se by creating new products or producing existing products in the later stages.

The second strand of findings shows that export orientation in the agro-food sector is not driven by efficiency considerations, but rather based on exogenous factors, including the availability of unique agricultural products, and industrial policies promoting exporting. We argue that the sector can expand 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 profits products towards more sophisticated and industrialized products with higher value added 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 higher 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 be faced with entry costs, which are typically large. One possible way to circumvent this constraint is to focus on the export of goods with higher comparative advantage that 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 extension of incentives given to firms having high foreign participation than to indigenous firms since there is evidence of efficiency improvements, which the study believes has heighten their export propensity with the support of learning by exporting hypothesis. This recommendation is debatable – it should be considered with a great deal 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 the early and intermediate stages of economic development, it might be more fruitful for these countries to focus on efficiency considerations in order to increase the size of the cake, and then come back to redistribution considerations.

6. Conclusion

The paper 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 waves of firm-level dataset using accounting, industrial, and exporting flow surveys, on 1323 Tunisian manufacturing firms from 2004-06. We distinguished between two clusters of firms: exporters (including fully and partially exporting firms) versus non-exporters and fully exporting firms versus others based on the quite specific structure of the Tunisian manufacturing sector. Almost 70% of the manufacturing exports come from firms benefiting from offshore status since 1972 which entire production was exported to European Union.

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 does 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 manufacturing sector into four main sectors, notably, the textile/clothing and footwear industries, the mechanical/electronics and electric industries, the agro-food industries and all other manufacturing firms. In the textile sector, we have found weak evidence of self-selection; contrastingly, there was no statistical support for learning-by-exporting in both clusters. We find evidence for a positive impact of innovation on increasing the incentives for exporting, while the reverse relation did not hold for partially exporting firms. Contrarily, we found no

evidence of a positive impact of innovation on the likelihood of exporting in fully exporting firms. However, the results confirm that exporting increases incentives for innovation.

We found no evidence of self-selection in partially exporting firms in the electronics sector while statistical support was strong for fully exporting ones. We found no evidence of learning-by-exporting in partially exporting firms in the sector, but the evidence was quite strong for fully exporting ones. These findings suggests that the potential gains from learning are very likely to be higher in the electronics sector in contrast to the textile sector. This implies that the scope for learning is lower with a longer history of exporting. The link between innovation and exporting was strong in both directions for partially exporting firms because of the dependence of the firms on foreign technologies and because partially exporting firms are technological latecomers in contrast to fully exporting ones. In fully exporting firms, innovation does not precede the decision to export, while exporting encourages 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 only. We find no correlation between innovation and exporting for either cluster of firms in either direction.

Overall these results provide a strong confirmation about the dynamics of learning from exporting except for the agro-food sector because of its very particular characteristics. The scope of 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) as compared to the textile sector which firms have longer previous exporting experience, though 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 run. An alternative argument for the scope of learning is export destination, in that exporting to high-income countries may offer more opportunities for learning than others. This was the case of agro-food industries, a particular sector depending heavily on climate conditions and the availability of natural resources.

References

Angulo, A. M., N. Mtimet, B. Dhehibi, M. Atwi, O. Ben Youssef, J. M. Gil, and M. B. Sai. 2011. "A Revisited Gravity Equation in Trade Flow Analysis: An Application to the Case of Tunisian Olive Oil Exports." *Investigations Regionales* 21:225-239.

Aw, B.Y., M.J. Roberts, and T. Winston. 2005. "The Complementary Role of Exports and R&D Investments as Sources of Productivity Growth." NBER Working Paper No.W11774.

Barrios, S., H. Görg, and E. Strobl. 2003. "Explaining Firms' Export Behavior: R&D, Spillovers and the Destination Market." *Oxford Bulletin of Economics and Statistics* 65(4): 475-496.

Bartelsman, E., and M. Doms. 2000. "Understanding Productivity: Lessons from Longitudinal Microdata." *Journal of Economic Literature* 38:569-594.

Basu, S., and J.G. Fernald. 1995. Are Apparent Productive Spillovers a Figment of Specification Error? *Journal of Monetary Economics* 36(1): 165-88.

Bigsten, A. et al. 2004. "Do African Manufacturing Firms Learn from Exporting?" *The Journal of Development Studies* 40(3): 115--141.

Cohen, W. M., and D. A. Levinthal. 1989. "Innovation and Learning: the Tow Faces of R&D." *The Economic Journal* 99(3): 569-596.

Cohen, W. M., and D. A. Levinthal. 1990. "Absorptive Capacity: A New Perspective on Learning and Innovation." *Administrative Science Quarterly* 35:128--152.

Constantini, J.A., and M.J. Melitz (ed.) 2007. *The Dynamics of Firm-Level Adjustment to Trade Liberalization*. Princeton University, Mimeo.

Damijan, J., and C. Kostevc. 2006. "Learning-by-Exporting: Continuous Productivity Improvements or Capacity Utilization Effects? Evidence from Slovenian Firms." *Review of World Economics* 142(3): 599-614.

De Loecker, J. 2007. "Do Exports Generate Higher Productivity? Evidence from Slovenia." *Journal of International Economics* 73(1): 69-98.

Greenaway, D., and R. Kneller. 2007. "Firm Heterogeneity, Exporting and Foreign Direct Investment." *Economic Journal* 117:134-161.

Griffith, R., E. Huergo, J. Mairesse, and B. Peters. 2006. "Innovation and Productivity across four European Countries." *Oxford Review of Economic Policy* 22:483-498.

Girma, S., H. Görg, and A. Hanley. 2007. "R&D and Exporting: A Comparison of British and Irish Firms." Research Paper 2007/18. University of Nottingham.

Grossman, G. M., and E. Helpman. 1991. "Endogenous Growth: Trade, Knowledge Spillovers, and Growth." *European Economic Review* 35:517-526.

Hopenhayn, H. 1992. "Entry, Exit, and Firm Dynamics in Long Run Equilibrium." *Econometrica* 60(5):1127-1150.

Jouili, M. 2011. "National Agro-Industries Survey in Tunisia." Working paper, University of Nabeul.

Klepper, S. 1996. "Entry, Exit, Growth, and Innovation over the Product Life Cycle." *American Economic Review* 86(3): 562-583.

Koundouri, P., C. Nauges, and V. Tzouvelekas. 2006. "Endogenous Technology Adoption under Production Risk: Theory and Application to Irrigation Technology." *American Journal of Agricultural Economics* 88(3): 345-369.

KRIAA, M., and V. KARRAY. 2010. "Innovation and R&D Investment of Tunisian Firms: A Two-Regime Model with Selectivity Correction." *Journal of Business Inquiry* 9(1): 1-21.

Lewis, T., and D. Sappington. 1989. "Countervailing Incentives in Agency Problems." *Journal of Economic Theory* 49(2): 294--313.

Love, J.H., and S. Roper. 2002. "Innovation and Export Performance: Evidence from the UK and German Manufacturing Plants." *Research Policy* 31(7): 1087-1102.

Melitz, M.J. 2003. "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity." *Econometrica* 71:1695-1725.

Rahmouni, M., M. Ayadi, and M. Yildizoglu. 2010. "Characteristics of Innovating Firms in Tunisia: The Essential Role of External Knowledge Sources." *Structural Change and Economic Dynamics* 21(3): 181-196.

Romer, Paul M. 1990. "Endogenous Technological Change." *Journal of Political Economy* 98(5): 71-102.

Vernon, R. 1966. "International Investment and International Trade in the Product Cycle." *Quarterly Journal of Economics* 80(2): 190-207.

Wagner, J. et al. 2007. "Exports and Productivity -Comparable Evidence for 14 Countries." Discussion paper 192. Licos.

Table 1: Summary of Descriptive Statistics

Variable	Unit of measure	Obs.	Mean	Std. Dev.	Min.	Max.
CAPFOREIGN_1	Binary variable	2736	0.1900585	0.3924188	0	1
CAPITAL_1	Trillions of constant (2004) US Dollars	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_1	Percentage	2717	0.7820502	0.2539912	0	1
INNOV	Percentage	2721	0.7846324	0.2500312	0	1
logINNOV	-	2651	-0.2939156	0.5081729	-4.867535	0
OUTPUT_1	Thousands of constant (2004) US Dollars	2736	1.50e+07	7.94e+07	0	1.75e+09
OUTPUT	Thousands of constant (2004) US Dollars	2735	1.65e+07	9.24e+07	0	2.30e+09
PAREXP_1	Binary variable	2736	0.4671053	0.499008	0	1
PAREXP	Binary variable	2736	0.4736842	0.4993983	0	1
TOTEXP_1	Binary variable	2712	0.3064159	0.4610896	0	1
TOTEXP	Binary variable	2701	0.3061829	0.460992	0	1

Table 2: Determinants of the Self-selection Effect - Probit Estimation

	Exporters vs non-exporters		Totally 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	2,728	2,728	2,692	2,692

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

Table 3: Determinants of the Learning-by-exporting Effect –Ordinary Least Squares

	Exporters vs. non-exporters	Totally exporting firms vs. others
Independent variable		
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)
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.

Table 4: Exporting Equation - Probit Estimation

	Exporters vs non-exporters		Totally 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***	-.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.

Table 5: Innovation Equation – Ordinary Least Squares

	Exporters vs. non-exporters	***Totally exporting firms vs. others***
Independent variable		
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.

Appendix

Table 6a: Estimates of the Self-selection Effect (First cluster of firms) – Marginal effects (Probit Estimation)

Exporters versus non-exporters					
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.

Table 6b: Estimates of the Self-selection Effect (Second cluster of firms) – Marginal effects (Probit Estimation)

Totally exporting firms versus others					
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.

Table7a: Determinants of the Learning-by-Exporting Effect (first cluster of firms) – Ordinary Least Squares

Exporters versus non exporters					
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	1,803	2,727
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.

Table7b: Determinants of the Learning-by-Exporting Effect (second cluster of firms) – Ordinary Least Squares

Totally exporting firms versus others					
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	1,779	2,703
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.

Table 8a: Exporting Equation (first cluster of firms) - Marginal effects

Exporters versus non-exporters					
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	-.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.

Table 8b: Exporting equation (second cluster of firms) - Marginal effects

Totally exporting firms versus others					
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	.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.

Table 9a: Innovation Equation (First cluster of firms) – Ordinary Least Squares

Exporters versus non-exporters					
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.

Table 9b: Innovation Equation (Second cluster of firms) – Ordinary Least Squares

Totally exporting firms versus others					
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.