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# Export market participation under sunk costs and firm heterogeneity.

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**Abstract**

In this paper we investigate the importance of sunk costs, firm characteristics and spillovers from nearby exporters on a firm's export participation decision. The empirical analysis involves the estimation of a non-structural, discrete choice, dynamic model with firm heterogeneity. By using new panel data for Estonian companies during 1994 through 1999 we find that: (i) both sunk costs and observable firm characteristics are important determinants of export market participation; (ii) previous history matters, in that, if a firm has been exporting the last period or the period before that it significantly increases the likelihood of the firm exporting in the current period; (iii) the conclusions are robust across all specifications; (iv) larger firms with high capital intensity and foreign owned are more likely be exporters; (v) operating in an export-oriented industry increases a firm's likelihood of exporting.

Keywords: Dynamic Panel, sunk costs, export decision.
JEL classification: L10, F10, C23, C25.

## 1. Introduction

The last decade has produced a stream of micro-econometric studies on the relationship between firm's exports and its productivity, which conclude that exporters have higher productivity, and, often, higher productivity growth, even after controlling for observed plant characteristics. Furthermore, this conclusion is not affected by previous exporting experience, since some studies show that exporting does not necessarily improve firm productivity (Bernard and Jensen, 1999). Alternatively, a series of papers, such as Roberts and Tybout (1997), Bernard and Wagner (2001), Bernard and Jensen (2001) and Campa (2004), model a firm's exporting decision as a function of previous exporting history subject to sunk entry cost, as well as firm and industry characteristics. They find that sunk entry costs are important for the current exporting decision. Yet, Roberts and Tybout (1997) find that their effect depreciates fairly quickly, that is, if the firm has been out from the export market for two years its probability of exporting again is no different from that of a plant that has never exported. These findings stress the importance of sunk entry costs, however still leaving their relative importance an open question.

In this study we investigate the relevance of sunk entry costs, firm characteristics and spillovers from nearby exporters on a firm's exporting decision. The empirical analysis involves the estimation of a non-structural, discrete choice, dynamic model with firm heterogeneity. In contrast to previous research we explicitly model for unobserved firm heterogeneity, permanent over time, as well as initial conditions in the estimation of a random dynamic probit. In addition, we employ a large and representative panel of Estonian firms over the period 1994 through 1999, which allows us to model a firm's current exporting decision as a function of its last two years exporting history and observed firm characteristics. During this period Estonia underwent major structural economic changes. For instance, soon after becoming an

independent country, Estonia started a trade liberalization policy reform. The result of this reform was the abolishment of all tariff and non-tariff barriers to trade, opening the door fully to FDIs, as well as the equal treatment of foreign and domestic investors under the national law. This led to a reorientation of Estonia's trade from Russia, as the main trade partner, to the West European countries. Although the main trade and investment reforms were undertaken unilaterally, bilateral free trade agreements with the major trading partners were signed to secure access to export markets. For a small economy, within a short time period Estonia managed to establish a high degree of trade openness, which resulted in continuous increase in exports. For instance, between 1996 and 1999, exports to Finland and Sweden (now the main trade partners) increased by 8.37% and 40%, respectively.

A very important determinant of the macro-economic stability was the currency board system the Estonian Central Bank adopted since the early transition. In 1992, the new Estonian currency, the kroon, was fixed to the D-mark, and became automatically fixed to the Euro when it became common currency in 1999. However, in advance of the expected adoption of the monetary union, the mark (and, consequently, the Estonian kroon) depreciated against the US dollar by 17% during the period 1995-1998. Furthermore, the Russian crisis of 1998 had an overall severe impact on the Estonian economy and trade. For instance, in 1998 Estonian exports to Russia fell by almost 64%. Russian crisis aside, such large fluctuations in exchange rates are likely to have a strong impact on a country's trade flows. In a series of papers, Dixit (1989) and Baldwin and Krugman (1989) argued that fluctuations in exchange rates have significant effects on the entry and exit decisions of firms in the export market. Yet, once the firm has incurred a sunk cost to enter the export market, it might prefer to stay in even though there is an exchange rate shock of a moderate magnitude, in order not to re-incur the sunk entry cost. Hence, the existence of sunk entry costs may cause

hysteresis in trade. Accordingly, there may be persistency of Estonian firms in the export market even though they might experience negative exchange rate shocks.

The rest of the paper is organized as follows. In Section 2 we introduce theoretical arguments on sunk costs hysteresis and briefly review the empirical literature on firm exporting decision with sunk entry costs. In Section 3 we lay out the determinants of a firm's exporting decision, while in Section 4 we introduce a model of export decision with sunk entry costs and discuss the econometric issues and the estimation strategy. In the following two sections we describe the data used in the empirical analysis and introduce the estimation results. Finally, in Section 7 we conclude.

## 2. Theoretical and empirical evidence on firm entry and exit under sunk cost hysteresis

An important determinant of the decision to undertake an action, such as the decision to export, to participate in the labor force, in a union or to remain in welfare programs, is state dependency. It implies that current participation in any of these activities directly affects the propensity of individuals/firms to participate in future activities. For instance, if a person has been in a welfare program for a long spell, the probability that he/she remains in welfare even in the next period is high[1]. This state dependency is referred to as "hysteresis" in international trade[2], which is defined as the failure of an effect to reverse itself when its underlying cause is reversed (Dixit, 1989). In this paper we focus on sunk cost hysteresis, where sunk costs, typically, represent the costs of setting up a distribution and service network, of establishing a brand name through advertising, or of bringing the product in conformity with health and safety regulations of the foreign country (Baldwin, 1989; Baldwin and Krugman, 1989).

[1] This is differently known as the welfare trap in labor economics literature.
[2] For more on this issue read Becker, Grossman and Murphy (1994) or Moffit (1992).

Under sunk cost hysteresis, a firm will find it advantageous to enter a foreign market once there is, for instance, a temporary exchange rate shock that leads to an appreciation of the foreign currency, which results in profits greater than zero. After the shock reverses itself the firms' profits will start dropping, but as long as profits are non-negative the firm finds it cheaper to stay in the market because of the already incurred sunk cost. If the firm were to exit and re-enter in good times, it would have to re-incur the sunk entry cost. Hence, the existence of sunk costs implies that it is cheaper to stay "in" than to get "in" a market (Baldwin, 1989). Baldwin (1989) refers to the interval between a firm's critical entry level (when profits exceed at least the sunk costs) and the critical exit level (when profits become negative) as the hysteresis band or, differently, as the no exit no entry band. In the hysteresis band, history matters. If the firm was "in" in the last period, it remains "in" and if the firm was "out" it remains "out", unless a large enough shock reverses the situation. In addition, Baldwin (1989) analytically shows that the hysteresis band tends to widen with sunk costs and that persistence in shocks has the effect of making entrenched firms more likely to exit, narrowing the band for the marginal firm. Further, Dixit (1989) finds that incorporating uncertainty in the analysis implies that the firm can do better by waiting, especially when there are large entry costs and that hysteresis emerges very rapidly even for very small entry costs. Hence, the hysteresis band increases with both sunk costs and uncertainty.

The empirical literature of firms' exporting decisions is closely linked to the development of theoretical models. Influential studies to date, that include the role of sunk costs in the export decision are Roberts and Tybout (1997), Bernard and Wagner (2001), Campa (2004), and Bernard and Jensen (2001). In each of these papers the authors employee a theoretical model of entry and exit with sunk costs, from which a non-structural dynamic discrete-choice model is developed for estimation. The results of the these papers reject the hypothesis that sunk costs are significantly different from

zero, implying that prior export market experience is important for the current decision to export. However, previous exporting experience seems to depreciate fairly quick. In contrast, Campa (2004) is not just interested on the importance of sunk cost hysteresis, but also on the possibility of hysteresis on the volume of exports. He estimates a dynamic export market participation to test the importance of hysteresis in trade and an export supply function to test for the possibility of hysteresis on the volume of exports. He finds sunk cost hysteresis in entry and exit to be an important determinant of export market participation, however, its effect on the volume of trade is quantitatively small. A 10 % depreciation of the currency, changes the export volume due to increases in the number of exporting firms by only 1.5%. This suggests that trade adjustment due to changes in the exchange rates, occurred mainly through the adjustment of export quantities of existing exporters, rather than through changes in the number of exporting firms.

A very important implication emerging from these theoretical considerations is that, in the case of no sunk costs there would be no hysteresis, and, accordingly, firms would easily enter the export markets in good times and exit in bad times, at no cost. However, due to asymmetric entry and exit condition created by the sunk entry costs there is hysteresis. None of these implications, however, is captured in the standard static empirical analysis of export decision-making. Empirically ignoring their importance when working with models that can easily accommodate longitudinal data may result in misspecification if the model is subject to hysteresis.

## 3. The Determinants of Export Market Participation.

There is ample empirical evidence that shows that exporting firms are larger, more productive, pay higher wages and survive longer than non-exporting firms. The literature has proposed two main reasons that could explain the positive correlation

between firm productivity and exporting. First, exporters can acquire knowledge and expertise on new production methods, product design, etc., from international contacts. In turn, learning-by exporting results in higher productivity of exporters versus non-exporters. Second, the positive correlation between productivity and exporting, could simply suggest that only the most productive firms can survive in a highly competitive international environment. Hence, the most efficient firms self-select into the export market. The empirical evidence of Bernard and Jensen (1999), Clerides et al. (1998), and Aw et al. (2000), clearly supports the self-selection hypothesis. In light of such information, current values of variables of firm characteristics would be endogenous to the current export decision.

The existing empirical evidence shows that firm characteristics such as firm size, age, labor quality, firm productivity and/or firm ownership structure are important determinants of export market participation. For instance, Clerides et al. (1998) and Bernard and Wagner (2001), find that plant characteristics, such as large capital stock and low average cost as well as firm size and productivity increase the probability of exporting. Furthermore, Bernard and Jensen (2001) argue that plant characteristics, especially those indicative to the past success such as firm size and labor quality, strongly increase the probability of exporting. Likewise, Roberts and Tybout (1997), find that plant size, its age and corporate ownership increase the probability of exporting[3].

Drawing from the results of previous research, we consider several firm characteristics, such as firm size, productivity, labor quality, capital intensity and ownership structure, as important determinants of a firm's exporting decision. As pointed out in most of the studies that focus on export market participation, exporting firms are larger than non-exporting firms. Accordingly, firm size, may reflect

[3] For additional evidence on the importance of firm characteristics see Aitken et al. (1997), Barrios et al. (2003), Sjöholm (1999) and Girma et al. (2002). They all confirm on the importance of firm characteristics as determinants of export market participation.

economies of scale in exporting (Krugman, 1984), that is, size may be associated with lower average costs of production, providing a way through which size affects the probability of exporting. In addition, Caves (1989) has argued that if sunk costs represent costs of setting up a distribution and service network, of establishing a brand name through advertising etc, then they should come in almost fixed amount no matter the size of the firm. This implies that small firms would face higher costs to entry in foreign markets, than large firms. Consequently, we include firm size in our specification as the logarithm of the average number of employees.

Another important determinant of the decision to export is firm level productivity, which we measure with sales per employee. We expect firm level productivity to be positively correlated with firms' probability to export, in that more productive firms are more likely to export (Clerides et al., 1998; Bernard and Wagner, 2001). In addition, we measure labor quality with firm's average labor cost. A firm that possesses qualified workers is more likely to produce high quality goods and therefore has a higher probability to become exporter (Bernard and Jensen, 2001). In addition, firm's capital intensity, is expected to account for differences in technology between exporting and non-exporting firms. Capital-intensive firms are expected to be more productive and to produce high quality goods, and, therefore, are more likely to export. Regarding firm ownership structure, Buck et al. (2000) find that managerial ownership increases the probability of exporting versus the other ownership forms. Therefore, we control for firm ownership status by including ownership dummies in the estimation.

Other than individual firm characteristics, economy wide and industry variables, such as changes in the domestic demand conditions and exchange rates, as well as export spillovers and inherent industry differences, can affect the probability of exporting. For instance, a drop in domestic demand for the firm's product can cause a firm to shift its sales effort to the foreign markets. We account for changes in the overall

domestic demand conditions by including domestic private consumption as a right hand side variable. In addition, favorable or unfavorable changes in exchange rates are expected to affect the decision to export. As in Roberts and Tybout (1997), we rely on the time dummies to account for the impact of (un)favorable changes in exchange rates on the export market participation. In order to control for permanent unobserved industry effects industry dummies are also included in the specification.

Regarding export spillovers, if MNEs' information on foreign markets could spill over to local firms, then potential exporting firms would face lower sunk costs of entering a foreign market[4]. Hence, more local firms could become exporters. For instance, direct contacts with foreign firms can provide local firms with necessary information on foreign tastes, market structure, competitors, distribution networks and transport infrastructures. This, in turn, contributes to the decrease of local firms' cost for collecting information on foreign markets. Hence, foreign exporters located nearby can improve the likelihood of exporting. We use three alternative measures to proxy for export spillovers: the total number of firms that export in an industry, the number of foreign firms that export in the industry and the share of foreign firms' exports in total industry's exports. All measures reflect the prevalence of knowledge about foreign market and technology. We expect the coefficient in front of the spillover variables to be positive and significant. However, the number of exporters in the industry approximates also the degree of competition in the export market. A negative coefficient of this variable indicates that exporting firms crowd out each other in the export market.

There are, however, two further issues that one has to account for in the estimation procedure: the identification of export spillovers and the endogeneity of the spillover variables. The former problem relates to the fact that in an export-oriented

[4] For more on export spillovers see Aitken et al. (1997), Clerides et al. (1998), Sjöholm (1999), Bernard and Jensen (2001), Greenaway et al. (2002) and Barrios et al. (2003).

industry, firms may have a higher probability to become exporters independently of the export activity of other firms in the same industry. We account for this including in the regression the share of industry's exports in the total economy's export, as a right hand side variable. The later problem, endogeneity, relates to the fact that foreign firms may locate in industries that offer more favourable conditions for exporting. Hence, there is a simultaneity issue in between the individual firms export decision, spillover variables and the share of industry's exports in the total economy's export. We address it by including industry dummies, as well as lagged values of spillover variables and of the share of industry's exports in the total economy's export, as instruments.

Finally, to avoid the endogeneity problem stemming from the self-selection of more productive firms into the export market, we employ lagged values of all firm characteristics.

**4. An Empirical Model of Export Decision with Sunk Costs.**

The empirical model to be estimated is formally derived in Roberts and Tybout (1997). For a better understanding of its suitability to the empirical analysis, a summary of the model is presented in Appendix 1. Accordingly, we estimate a discrete choice dynamic model of export participation, where current exporting decision is a function of previous exporting history, exogenous industry and economy wide variables $X_t$, as well as firm characteristics, $Z_{it}$. As such, we can test the sunk costs hysteresis by investigating the importance of export history captured by the coefficients in front of the dummy variables, $y_{i,t-1}$ and $y_{i,t-2}$, in equation (1).

$$y_{i,t} = c + \gamma_1 y_{i,t-1} + \gamma_2 y_{i,t-2} + \beta X_t + \theta_1 Z_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$\varepsilon_{i,t} = \alpha_i + u_{i,t} \quad (2)$$

where, $\alpha_i$ are unobserved, time invariant firm specific components, such as managerial expertise, output quality or foreign contacts, while $u_{i,t}$ is a standard random error. Collapsing (1) and (2) together, the equation to be estimated is:

$$y_{i,t} = c + \gamma_1 y_{i,t-1} + \gamma_2 y_{i,t-2} + \beta X_t + \theta_1 Z_{i,t} + \alpha_i + u_{i,t} \quad (3)$$

The estimation of this dynamic binary model faces two main issues: accounting for the unobserved firm characteristics, $\alpha_i$ and for the initial conditions problem.

In a dynamic framework, persistency in export market participation could be either the result of sunk costs, the true state dependency, or the result of time invariant unobserved firm characteristics, the heterogeneity across firms. Time-invariant firm characteristics are usually unobserved and their persistence will induce serial correlation in the error term $u_{i,t}$. If not controlled for, this persistency will be captured by the state dependency variables, causing the problem of "spurious state dependency" (Heckman 1981a). That is, we will mistakenly conclude that all the persistency in export status is due to sunk costs. Indeed, there might not be any "state dependency", which is caused by sunk costs hysteresis. Furthermore, the unobserved invariant firm characteristics are correlated with other firm characteristics included as regressors, for instance firm performance, hence, causing their coefficients to be inconsistently estimated[5].

To account for the firm unobserved heterogeneity, fixed over time, we follow Mundlak (1978), who models the dependency between the permanent firm

[5]We cannot control for unobserved heterogeneity ($\alpha_i$) using firm specific dummy variables, differently known as fixed effects because of the "incidental parameters" problem (Heckman, 1981b). With time fixed, as $n \to \infty$ the number of parameters to be estimated grows and the estimation becomes infeasible. However, both Bernard and Jensen (2001) and Bernard and Wagner (2001) have opted for a linear probability model to fully account for firm unobserved heterogeneity. Accordingly, they remove firm fixed effects by first-differencing the data, eliminating both the unobserved firm heterogeneity and initial conditions. This approach, however, attributes too much of the serial dependence to unobserved heterogeneity. In general, any approach that understates (overstates) the importance of unobserved heterogeneity will overstate (understate) the importance of state dependency. Hence, when using linear probability models, we expect the coefficient in front of the lagged binary variable to provide us with a lower bound of the sunk cost coefficients compared to the coefficients in the nonlinear models. However, the problem with the linear probability models is that predicted probabilities are not constrained to the unit interval, making nonlinear models more likely to provide a better fit.

characteristics, $\alpha_i$, and other firm characteristics regressors, $Z_{i,t}$, by assuming that $\alpha_i$ is linear in the means of all time-varying covariates.

$$\alpha_i = \theta_2 \bar{z}_{i,j} + \nu_i \quad (4)$$

where, $\nu_i$ is identically and normally distributed as $\nu_i$ ~N(0, $\sigma_\nu^2$) and is independent of $Z_{i,t}$ and $u_{i,t}$ for all *i* and *t*, and $\bar{z}_{i,j}$ is a vector of means of the time-varying covariates of a firm over time.

The initial conditions problem refers to the fact that we observe a firm's export status from year 1 to T, but the estimation of equation (3) does not allow modelling the first year of export decision. However, $y_{i,0}$, the export decision of the first year cannot be treated as exogenous because it depends on $\alpha_0$ which in itself is correlated with $u_{i,t}$ (Heckman, 1981b). If not accounted for, this will lead to inconsistent estimates.

Based on the work of Blundell and Smith (1991) and Orme (1997), a two-stage approach estimator can be adopted, that yields more reliable estimates than models that ignore the initial conditions. In the first stage a random effects probit for the *j* initial observations is estimated as follows:

$$y_{i,j} = \lambda' \Gamma_i + \mu_i \qquad \text{t=}j \text{ and } j\text{=1, 2} \quad (5)$$

where $\Gamma_i$ is a vector of exogenous regressors that include firm characteristics $Z_{i0, \ldots\ldots} Z_{iT}$. In addition, $\alpha_i$ and $\mu_i$ are assumed to be bivariate normal, i.e., $(\alpha_i, \mu_i)$~BVN(0,0,1,1,$\rho$), where $\rho$ is the correlation between $\alpha_i$ and the initial observations *j*. From the first stage, the probit generalized residuals are calculated as follows:

$$\hat{e}_{i,j} = (2y_{i,j} - 1)\phi(\hat{\lambda}' \Gamma_i) / \Phi((2y_{i,j} - 1)\hat{\lambda}' \Gamma_i) \quad (6)$$

where $\phi(.)$ *and* $\Phi(.)$ are the standard normal density and distribution function, respectively. Then, in the second stage, the probit generalized residuals are included as right hand side regressors.

The final equation to be estimated, which accounts for both the initial conditions and firm unobserved heterogeneity is:

$$y_{i,t} = c + \gamma_1 y_{i,t-1} + \gamma_2 \tilde{y}_{i,t-2} + \beta X_t + \theta_1 Z_{i,t} + \delta \hat{e}_{i,j} + \theta_2 \bar{z}_{i,j} + \eta_i + u_{i,t} \quad (7)$$

where $\eta_i$ are the random permanent firm characteristics. Equation (7) is estimated as a conventional random effects probit[6].

## 5. The Data

Before independence, Estonia's trade was heavily oriented towards the Soviet Union, which in 1991 accounted for 94.7% of Estonian exports. Its independence from the Soviet Union in 1991 triggered a wave of reforms such as price liberalization, a DM-backed currency board, full currency convertibility, large-scale privatization with special targeting of foreign investors, a flat 26% income tax, a zero corporate tax and strong bankruptcy laws. The economy grew fast, prices were stable and inflation was under control. Some of the main economic indicators are presented in Table 1, Appendix 1[7]. Impressive was also Estonia's speed of integration into the world economy. It reoriented its trade westwards and Finland quickly replaced Russia as its major trading partner (see Table 2). Nevertheless, Russia sill remained among the first five trade partners. In August 1998, Russia experienced a financial crisis as the Central Bank floated the currency and declared inability to pay off the debts.

[6] Robert and Tybout (1997) opt for a simulation-based estimation technique of the maximum likelihood of the random effects probit, to solve both estimation issues. However, Hyslop (1999) shows that in the presence of state-dependency, firm heterogeneity and serial correlation, simulation-based estimators can be biased if the number of simulation replications is less than 1000 replications per observation. In our study, after accounting for the initial conditions with the first two years, namely, 1994 and 1995, the total number of observations of the balanced panel reduces to 704 and as such the number of replications to achieve unbiased estimates would be "prohibitively" high.

[7] All tables regarding data and estimation results are presented in Appendix 2.

The fact that Estonia had the most open economy compared to the other Baltic countries, with exports amounting to 60% of GDP in 1998, made it vulnerable to international economic developments such as the Russian crisis. More specifically, the Russian crisis had a strong impact on the Estonian economy and trade. The depreciation of the ruble caused a reduction in domestic private consumption, which, in turn, caused a drop in Estonian exports to Russia from 12.3% in 1998 to 5.2% in 1999 (see Table 2). Consecutively, in 1998, Estonia experienced a current account deficit of 8.6% of GDP, which narrowed to 7% in 1999. Hence, the crisis substantially reduced the export growth[8]. This makes Estonia a very good conduit for testing the effect of the sunk cost hysteresis on export market participation.

The data set consists of yearly information on Estonian firms from 1994 to 1999, and it contains detailed information on financial statements, ownership structure and exports for firms from a stratified random sample chosen to represent eighteen economic branches at a 3-digit Nace classification. The data set includes firms with more than 10 employees in a given year. The ownership information comes from a survey of firms that have been fully or partially privatized (Jones and Mygind, 1999). Prior to using the data, a series of consistency checks is performed and inconsistent data is left out[9]. The final sample consists of 2335 firm observations of which 420 in 1994, 454 in 1995, 430 in 1996, 394 in 1997, 334 in 1998 and 303 firms in 1999[10]. This sample is representative in that in covers slightly more than 30% of the manufacturing

[8] However, the Russian crisis had no significant impact on the FDI flows. In 1998, Estonia received almost twice the amount of FDI than in 1997. This was mainly the result of heavy investments of Swedish investors in the two biggest Estonian banks. Furthermore, in the first quarter of 1999, FDI flows to Estonia amounted to 1.95 billion USD, an amount 21% higher than in the previous year. This makes Estonia the second leading recipient of FDI per capita among CEEC countries after Hungary.

[9] We check for inconsistencies using different criteria. For instance, a firm's capital at the beginning and end of each year should be positive; sales should be positive; labor cost in a given year should be positive; average employment per year should be positive and equal or greater than 10; investment in new machines and equipment should be non-negative; and the ownership shares should add up to 100.

[10] The different number of firms over years is the result of firms entering and exiting the sample. The reason may be bankruptcy, merger or firms choosing not to report in a given year.

employment in 1994. Variable definitions, their means and standard deviations are presented in Tables 3, and 4.

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Table 3 & 4 approximately here

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A common problem with data over time is that in any given year the data are expressed in current prices. This makes it important to control for inflation by expressing all data in real terms. Hence, all variables are deflated to 1994 prices using the appropriate two digit PPI deflators. Furthermore, we define five dominant ownership groups, namely, employee owned, manager owned, foreign owned, state owned, and outsider owned firms. A firm is dominantly owned by the group that owns the largest share. The dynamics of ownership structure, as shown in Table 5, reveals that, starting from 1995, the number of managerial, domestic and foreign owned firms increases over time, while the number of employee and state owned firms decreases over time[11].

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Table 5 & 6 approximately here

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Table 6 describes the distribution of exporters according to industry classification and over time. We observe that in 1994 exporters are located mainly in food products, textile products, wood products, furniture and wholesale trade sectors. Furthermore, the number of exporters in these sectors seems to slightly decrease over

[11]Note that the total number of observations according to the table on the dynamics of ownership structure is 2255, which is less than the total of 2335 firm observations. The reason is that for 80 observations we have no information on firm ownership structure. Consequently, we drop these observations from further analysis.

time, whereas their share (the ratio of exporters to the total number of firms in these sectors) remains quite high.

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Table 7 approximately here

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Table 7 shows the means of selected variables for exporting and non-exporting firms at the beginning and the end of the sample period. Clearly, this table shows that exporting firms are larger in size, pay higher wages and there are more than non-exporting firms. In addition, although exporting firms start as less capital intensive in 1994, in 1999 they become almost twice as capital intensive as non-exporting firms.

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Table 8 approximately here

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Table 8 shows the distribution of exporting and non-exporting firms over time. Their ratio is relatively constant over the whole sample period, with the share of exporting firms being no less than 60% of each year's sample. Due to the unbalanced nature of our sample the results in Table 8 are affected by the entry and exit of firms in the sample. Consequently, the decrease in the number of exporting firms over time cannot be interpreted as the decision of firms to exit the export market. In order to look at persistence of firms in the export market, one has to focus on the balanced panel, namely, those firms that are present over the whole period. In our sample there are 176 firms that are present each year over the period 1994 through 1999.

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Table 9 approximately here

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Table 9 illustrates export persistency, entry and exits in and from the export market over time, for the balanced panel. The results of Table 9 show that there is strong persistence of firms in the export market, with more than 90% of firms that export in a period being still exporters in the next period. Similarly, around 80% of non-exporters in each period remain non-exporters in the next period. Regarding entry in the export market we see that the number of entrants is highest in 1995-1996 and 1998-1999, with around 6% of non-exporters becoming exporters, and it slightly decreases in between. In contrast, the exit rates are much higher than the entry rates and the percentage of firms exiting the export market gradually increases over time. The exit rates can reflect either lingering benefits from exporting or the fact that sunk costs are not very significant. However, there is one more explanation. The Russian crisis of 1998 is expected to have affected export behaviour of Estonian firms in two ways: first, through changes in the volume of exports and second through changes in the decision to enter/exit the export market. However, Table 9 shows that, although exit rates increase during 1997-1998 and 1998-1999, they are still not much higher than those in the previous years. These facts suggest that the effect of the Russian crisis on Estonian firms has mainly been through the change in the volume of exports rather than on their decision to leave the market at all. This result is in line with that of Campa (2004), who finds that in Spain trade adjustment against exchange rate fluctuations occurred through the adjustment of the volume of exports rather than through changes in the number of exporting firms.

The persistence in the exporting behavior that we see in Table 9 might be caused by sunk costs, as the hysteresis models suggest, or it may be caused by the unobserved

firm characteristics. For instance, persistent differences in firm characteristics might explain why some firms export and others don't.

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Table 10 approximately here

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Attempting to discriminate between these two explanations, we turn to Table 10, which displays the firms' export sequence over time for the balanced sample. Each sequence represents the total number of times a firm is observed to participate in the export market during the sample period[12]. From this table we see that there is substantial serial persistency over time. That is, the majority of firms either export in all of the sample periods or never export. For example, 51 % of firms export the whole period, while 15.9% do not export at all. The rest of the firms display entry in and exit from the export market over time. The frequency of entry and exits depends to a large extend on the existence of sunk costs. If these costs are important for persistency, we expect to observe sequences in which export and non-export participation are clumped together. For instance, 8.53% of firms in the sample export five consecutive years with non-exporting year being either at the beginning or the end of the sample. Similarly, 3.4 % of firms export four consecutive years, and 4.5 % export three consecutive years. This information suggests that, while there is firm heterogeneity that affects export participation, persistency in the export market is also consistent with the sunk cost hysteresis.

## 6. The Estimation Results.

[12] One indicates the case when firms participate in the export market and zero when they don't.

In order to effectively account for the persistency of firms in the export market, we have carried out the estimations on the balanced panel only, first estimating a linear probability model and then the nonlinear probit model[13]. The estimation results are reported in Tables 11 and 12. In both estimation strategies, the firm's current export decision is modeled as a function of the last year's export status, the export status of two years ago, domestic private consumption as a measure of demand conditions in the country, firm characteristics such as firm size, labor productivity, capital intensity, labor quality and ownership structure, as well as the export spillover variable. In the linear probit estimation, we estimate three different specifications according to the three spillover variables defined earlier, while in the random effects probit estimation we consider two additional models, namely, with and without the initial conditions.

The results in Table 12 show that across all models the coefficients of the sunk costs are positive and significant, providing thus strong support for the sunk cost hypothesis. That is, having exported last a year ago or two years ago significantly increases the probability of exporting in the current period. This is largely consistent with the sunk costs hypothesis. Model 1 estimates equation (7) forgoing the initial conditions. Not accounting for the initial conditions results in upward biased coefficient estimates of the sunk costs variables $y_{i,t-1}$ and $y_{i,t-2}$. Indeed, the sunk costs coefficients are much larger in Model 1 than in all other estimations, namely, Model 2 through Model 5. The coefficient estimates of sunk costs through the five different models run between 2.48-1.05 if the firm exported last a year ago and between 0.95-1.44 if the firm exported last two years ago. Furthermore, as predicted, these coefficients are larger in comparison to the sunk cost coefficients of the linear probit estimation (Table 11). The reason is that by first differencing the data we eliminate the unobserved heterogeneity,

[13] We estimate the linear probability model by taking first-differences to eliminate fixed effects and initial conditions, inherent in equation (3), and obtain consistent estimates by instrumenting $\Delta y_{i,t-1}$ with $y_{i,t-2}$ and $Z_{i,t-2}$.

fixed over time, as well as the initial conditions. As such, the sunk costs coefficients of the linear estimation provide a lower bound of the importance of sunk costs. These sunk cost coefficient estimates range between 0.17-0.19 if the firm has exported last a year ago and between 0.146-0.147 if it has exported last two yeas ago. These coefficient estimates are comparable with those of Bernard and Jensen (2001) and Bernard and Wagner (2001), who find coefficient estimates between 0.52 -0.36 when the firm exported last a year ago and 0.18-0.105 when the firm exported last two years ago.

Regarding the domestic private consumption, both the linear probability and random effects estimation show that it significantly affects the decision to export. Its coefficient is negative and significant across the three specifications of the linear probability estimation, but significant only for Models 1 and Model 3 of the random effects estimation. These results imply that, as expected, a decrease in domestic demand for the firms' product pushes local firms to shift their output to foreign markets.

With respect to firm characteristics, we find that they are mostly significant at the random effects probit estimation. Among firm characteristics, we see that the larger and the more capital intensive a firm is, the higher its probability of exporting. These results are supported from the argument that large firms can spread their fixed costs of entering a foreign market over more units of production. In addition, as capital intensity is expected to account for differences in technology between exporting and non-exporting firms, capital-intensive firms are expected to have high quality goods, therefore, higher probability of export market participation. Furthermore, ownership structure is an important determinant of firm's decision to export. We find that a firm dominantly owned by foreigners, managers and employees is significantly more likely to export than a state owned firm. Likewise, Bernard and Jensen (2001), Buck et al. (2000) and Roberts and Tybout (1997) find that firm characteristics such as firm size, its

age, average labor cost as well as its ownership type increase the probability of exporting for the U.S and Colombian firms.

In order to account for the possibility of export spillovers, we have included in the regression three spillover variables as well as a control variable for the importance of an industry's exports in total exports. We find that the control variable, the share of industry's export activity to the overall exports of the economy, is significant across all specifications in Table 11, and only in Models 4 and 5 in Table12. The implication of such finding is that firms belonging to export-oriented industries have a higher probability to become exporters, while firms that intend to become exporters should consider locating in export oriented industries. Among the three spillover variables, spillovers from MNEs are significant only in the linear probit estimation. That is, the presence of foreign exporting firms in the industry increases the probability of local firms to export. Hence, firms that intend to become exporters will tend to locate near multinational firms. This finding is similar to Aitken et al. (1997) who also find that export spillovers are associated to multinational activity. Furthermore, the impact of MNEs spillovers on other foreign firms (the interaction of the spillover variables with the foreign dummy) is insignificant. This finding is not surprising given that foreign firms are already export oriented, hence, they have the knowledge about foreign markets and foreign tastes and as such their export decision is not influenced by the exporting activity of the other foreign exporting firms. Indeed, 91.34% of the foreign firms in our sample export the whole period. In the nonlinear probit estimation, out of the three spillover measures, only one, the number of exporters in the industry is significant, however, negative. This indicates that there may be tough competition in the export market, with exporting firms crowding out domestic firms from the export market. In contrast, we find no significant effect of the interaction variables, which suggests that foreign firms do not benefit from export spillovers.

In conclusion, we find strong support for the sunk costs hypothesis. A firm that was exporting a year ago is more likely to keep exporting the current year and although this effect depreciates for the firm that was last seen exporting two years ago, it still remains significant and positive. Furthermore, firm characteristics, such as labor productivity, capital intensity, firm size and ownership structure also increase a firm's probability to export. In addition, we find evidence that operating in an export-oriented industry increases the probability to become exporter. Finally, there is some evidence on export spillovers as spillovers from MNEs significantly increase local firms' probability to export, while the number of other exporters in the industry negatively affects export market participation, indicating some crowding out of domestic firms from the export market.

The non-linearity of the probit specification makes the economic interpretation of the coefficients difficult. Therefore, we also compute the marginal effects of a change in the independent variables on the probability of exporting. The marginal effects of a regressor on the probability of the dependent variable are calculated as follows:

$$\frac{\partial P(y=1)}{\partial x_i} = \frac{\partial F(x'\beta)}{\partial x_i} = f(x'\beta) * \beta$$

where f(.) is the normal density function calculated at the regressors' sample mean ($\bar{x}$).

Marginal effects, reported in Table 13, are calculated for five different groups of firms: a) for all the firms (exporting and non-exporting), b) for firms with past exporting experience, c) for firms with no past exporting experience, d) for firms with exporting experience last two years ago and finally e) for firms with no exporting experience in the last two years. The last row in Table 13 shows that the average predicted probability of exporting for the whole sample is 98.6%, it increases to 99.9% for firms with past exporting experience and drops to 5,6% for firms with no past exporting experience.

Furthermore, the estimated probability of exporting is 55.4 % for firms that have exported last two years ago and drops to 2.45% for firms that haven't been exporting in the last two years. Hence, the probability to export for a firm that hasn't been in the export market during the last two years is very low.

The marginal effect of capital intensity shows that if capital intensity increases by 10%, the probability of exporting increases by 0.13% for all firms, by 0.0018% for firms with past exporting experience, by 0.48% for firms with no past exporting experience and by 1.7% for firms that have been exporting last two years ago. Similarly, if firm size increases by 10 employees, the probability of exporting increases by 0.16% for all firms, by 0.0022% for firms with past exporting experience and by 2.11% for firms that have been exporting last two years ago. The marginal effects of ownership reveal that, for instance, if foreign ownership increases by 10%, the probability of exporting increases by 0.19% for all the sample of firms, by 0.0029% for firms with past exporting experience and by 3.84 % for firms that have exported last two years ago. Similarly, the changes in the probability of exporting for 10% increase in managerial and employee ownership are 0.16% and 0.17% for all firms, 0.002% and 0.0018% for those with past exporting experience and 3.15% and 3.67% for firms that exported last two years ago. Hence, the longer the firm has been in the exporting market, the higher the marginal effect/elasticity of its firm characteristics on its probability to export.

Finally, an increase in the number of other exporters in the industry reduces the probability of exporting by 0.09% for all the firms, by 0.0056% for firms with past exporting experience and by 0.46% for firms that have been exporting last two years ago. Obviously, the impact is stronger for firms that have been exporting longer. This supports our argument that as new exporters enter the export market they may steal away market shares from existing exporters.

## 7. Conclusions

In this paper we investigate the importance of sunk costs, firm characteristics and spillovers on a firm's decision to export. Empirical analysis involves the estimation of a non-structural, discrete choice, dynamic model with firm heterogeneity and is carried out using a panel of data of Estonian firms over the period 1994-1999. The findings provide strong evidence of the importance of sunk costs in the export market participation. That is, a firm's exporting history significantly affects the likelihood of remaining in the export market. This conclusion is robust across all specifications. In addition, the average predicted probability of exporting is highest for firms with past exporting experience and is more than 50% for firms that have been observed exporting last two years ago. In contrast, the probability of exporting for firms that haven't been in the export market during the last two years is very low.

While there is strong evidence that sunk costs are a significant source of export market persistence, observable firm characteristics also contribute to a firm's exporting decision. For instance, larger firms and with higher capital intensity are more likely to export. Furthermore, a firm owned by foreigners, managers and employees is more likely to export than a state owned firm.

The results on export spillovers are less conclusive. We find some evidence of spillovers in the linear estimation, but no evidence of spillovers in the nonlinear estimation. In the later case, we even find that one of the spillover variables, measured by the number of exporters in the industry, is negative and significant. This suggests that there is evidence of crowding out of firms in the export market. Nevertheless, both sets of results reveal that operating in an export-oriented industry increases the likelihood of exporting.

One important implication of the results of this paper is that export-promoting policies undertaken by the government in Estonia should distinguish between policies

that aim at expanding the export volume of existing exporters and those policies that promote entry of new firms into the export market. The entry of new firms into the export market can be promoted by reducing the sunk costs and uncertainty in accessing the export market. This would be possible if the government divulges information about potential export markets and developing the export infrastructure. Furthermore, if when entering the export market firms find it possible to expand their export volume, then promoting the entry of new firms in the export market is a more effective policy than the one aiming at expanding the export volume through subsidies. Finally, given that operating in the export-oriented industries increases the likelihood for exporting, the government should promote these industries as possible supporters of economic growth.

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## Appendix 1

In a static model without sunk costs a firm will enter the export market only if the profit from exporting is positive. In a multi-period case the firm will decide to export only when the expected current and discounted future profits are positive. If firm's revenues and profits do not depend on previous choices, then the multi-period solution would be a sequence of static optimal decision-makings.

In introducing sunk costs into the model it is usually assumed that the firm incurs $F_i^0$ in costs in the first year of entry in the export market. The corresponding earnings from export activity become $\pi_{it} - F_i^0$. If the firm exits the export market, in re-entry it will face the sunk cost, $F_i^j$ and consequently it will earn $\pi_{it} - F_i^j$. Given that the sunk costs are start up costs of setting up a distribution and service network or of establishing a brand name through advertising, then it is common sense to assume that the re-entry cost, $F_i^j$, is lower than the sunk cost the firm incurs when it enters the market for the first time. Finally, if the firm exits the market it will suffer the exit cost $N_i$ and if it stays in it will earn the profit $\pi_{it}$. This information can be collapsed together in a single expression, where the firm's current profits given its previous exporting history, and net of entry and exit sunk costs are:

$$\tilde{\pi}_{i,t} = y_{i,t}[\pi_{i,t} - F_i^0(1 - y_{i,t-1}) - \sum_{j=2}^{J_i}(F_i^j - F_i^0)y_{i,t-j}] - N_i(1 - y_{i,t}) * y_{i,t-1} \quad (1)$$

where $j$=2….$J_i$ and $y_{i,t-j}$ summarizes a firm's most recent exporting experience. For instance, $y_{i,t-2}$=1 if the firm was last seen exporting two years ago.

The Bellman equation for equation (1) is the following:

$$V_{i,t}(y_{it-j}) = \max_{y_{it}\in\{0,1\}}[\tilde{\pi}_{i,t}(y_{i,t-j}) + \delta E_t(V_{i,t+1}(y_{it})] \quad (2)$$

According to equation (2), a firm will export if the current and discounted future stream of profits from exporting is greater than the discounted future stream of profits from non-exporting. That is, $y_{i,t}$=1 if:

$$\pi_{i,t} + \delta[E_t(V_{i,t+1}(y_{i,t}=1)) - E_t(V_{i,t+1}(y_{i,t}=0))] \geq F_i^0 - (F_i^0 + N_i) * y_{i,t-1} + \sum_{j=2}^{J_{ii}} (F_i^0 - F_i^j) y_{i,t-j} \quad (3)$$

As in Dixit (1989), the sum of entry and exit sunk costs for current exporters, -($F_i^0 + N_i$), is differently known as the band of hysteresis.

The estimable equation of export market participation is based on condition (3), where the sum of current profits and the discounted increment in exporting activity is denoted as follows:

$$\pi_{i,t} + \delta\,[\,E_t(V_{i,t+1}(y_{i,t}=1)) - E_t(V_{i,t+1}(y_{i,t}=0))\,] = R_{i,t} \quad (4)$$

Finally, one can rewrite (3) as follows:

$$y_{i,t} = \begin{cases} =1 \quad if \quad R_{i,t} - F_i^0 + (F_i^0 + N_i) * y_{i,t-1} + \sum_{j=2}^{J_{ii}} (F_i^0 - F_i^j) y_{i,t-j} \geq 0 \\ =0 \quad otherwise \end{cases} \quad (5)$$

Equation (5) is then estimated employing a non-structural equation approach. Accordingly, one can assume that fluctuations in profits after entering the export market, namely, $R_{i,t} - F_i^0$ are a function of previous market participation ($y_{i,t-1}$, $y_{i,t-2}$), exogenous industry and economy wide variables $X_t$, and firm characteristics, $Z_{it}$. The empirical model to estimate, is:

$$y_{i,t} = c + \gamma_1\, y_{i,t-1} + \gamma_2 y_{i,t-2} + \beta\, X_t + \theta_1\, Z_{i,t} + \varepsilon_{i,t} \quad (6)$$

Where, $\varepsilon_{i,t} = \alpha_i + u_{i,t}$

# Appendix 2

## Table 1: Estonian economic indicators

| Economic Indicators | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|
| GDP growth, % | -2 | 4.3 | 3.9 | 10.6 | 4.7 | -1.1 |
| Inflation, % end of year | 41.7 | 28.9 | 14.8 | 12.5 | 6.5 | 3.9 |
| Unemployment, end of period | 5.1 | 5 | 5.5 | 4.6 | 5.1 | 6.5 |
| Exports, USD million | 1211 | 1660 | 1764 | 2275 | 2674 | 2439 |
| Imports, USD million | 1557 | 2398 | 2876 | 3516 | 3928 | 3430 |
| Current account balance, % of GDP | -7.2 | -4.4 | -9.2 | -12.1 | -9.2 | -5.8 |

Source: Estonian Statistical Office, Bank of Estonia.

## Table 2: The main trade partners in Estonian exports (% of total)

| Country | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|
| Exports to: | | | | | |
| Finland | 23.5 | 20.8 | 18.9 | 22.1 | 22.7 |
| Sweden | 11.8 | 13.2 | 17 | 19.5 | 22 |
| Germany | 7.3 | 7.3 | 6.5 | 6.1 | 8.3 |
| Latvia | 7.5 | 8.2 | 8.3 | 8.3 | 8 |
| Russia | 16.3 | 14.1 | 16.3 | 12.3 | 5.2 |

Source: Bank of Estonia

## Table 3: Variable Definition

| Variables | Definition |
|---|---|
| Export market participation | The dependant variable is a dummy equal 1 for all firms with positive exports, and 0 otherwise. |
| Exported last period | Is the first lag of the dependent variable. |
| Exported last two periods ago | Is a dummy variable equal to 1 if the firm was seen exporting last two periods ago, and zero otherwise. |
| Employment | Firm's average number of employees per year. Available at firm level. |
| Firm size | Is constructed as the logarithm of firm's average number of employees per year. Available at firm level. |
| Capital | Capital is calculated as the average of fixed assets at the beginning and end of year. Expressed in thousands of kroons. Available at firm level. |
| Capital/Labor | The ratio of Capital to Employment, measures firms' capital intensity. Available at firm level. |
| Dominant Ownership | This is a dummy equal to 1 if the share in equity owned by a group for that year is greater than the share in equity owned by any other group. |
| Average Labor Cost | Used to proxy labor quality. Expressed in thousands of kroons. Available at firm level. |
| Sales | Net sales are expressed in thousands of koorun. Available at firm level. |
| Sales/L | The ratio of net sales is used to proxy for labor productivity. Available at firm level. |
| Exports | Are the value of exports. Expressed in thousands of kroons Available at firm level. |
| *Spillover Variables (a, b, c)* | |
| a) Nr. of exporters in the industry | The overall number of exporters in each industry. This variable is constructed at the *Industry Level*, and is a proxy for export spillovers from nearby exporters in the sector. |
| b) The nr. of foreign exporters in the industry. | The number of foreign exporters in each industry. This variable is constructed at the *Industry Level*, and is a proxy for export spillovers from nearby exporters in the sector. |
| c) MNE Export Spillovers | The share of foreign firms' exports to the industries' exports. This variable is constructed at the *Industry Level*, and, again, proxies for export spillovers from nearby exporters in the sector. It is calculated as below: $MNE\ Export\ spillover_{j,t} = \sum_j E_{f,t-1} / (\sum_j E_{d,t-1} + \sum_j E_{f,t-1})$ |
| Private Consumption | Is the consumers consumption after subtracting the government consumption, net value of export and import and fixed investment from the gross domestic product. |
| $d_t$ | Time dummies: Included to account for economy wide shocks. |
| $d_j$ | Industry dummy, constructed on a two-digit level ISIC/NACE industry classification |

Note: Except for a), b), c) and d) all other variables are available at the firm level.

**Table 4: Mean and standard deviation of main variables.**

| Variable | Nr. Obs | Mean | St. Dev |
|---|---|---|---|
| Employment | 2332 | 153.5858 | 415.281 |
| Net Sales | 2335 | 25595.41 | 65418.32 |
| Value Added | 2335 | 5174.043 | 15160.65 |
| Exports | 2335 | 7922.083 | 25204.57 |
| Capital/Labor | 2332 | 56.34414 | 185.8232 |
| Avg. Labor Cost | 2332 | 26.58465 | 26.83318 |
| Nr. Of Foreign Exporters | 2335 | 4.59743 | 3.448208 |
| Foreign Firms' share in Exports | 2311 | 0.233603 | 0.279102 |

Note: All variables are deflated to the 1993 prices.

**Table 5: The Dynamics of the Dominant Ownership Structure**

| Year | Domestic Outsider | Employees | Foreign | Managers | State | Total |
|---|---|---|---|---|---|---|
| 94 | 84 | 49 | 52 | 38 | 152 | 375 |
| 95 | 91 | 47 | 51 | 47 | 218 | 454 |
| 96 | 111 | 47 | 59 | 56 | 156 | 429 |
| 97 | 93 | 32 | 64 | 60 | 136 | 385 |
| 98 | 86 | 27 | 57 | 52 | 106 | 328 |
| 99 | 114 | 33 | 70 | 64 | 3 | 284 |
| Total | 579 | 235 | 353 | 317 | 771 | 2,255 |

**Table 6: Sample distribution of Exporters and overall firms according to industry classification.**

| Year | 94 | | 95 | | 96 | | 97 | | 98 | | 99 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Industry | **Export** | **Total** | **Export** | **Total** | **Export** | **Total** | **Export** | **Total** | **Export** | **Total** | **Export** | **Total** |
| Agriculture, Forestry, Fishing | 13 | 38 | 12 | 29 | 7 | 23 | 11 | 24 | 9 | 21 | 6 | 16 |
| Mining&Quarrying | 10 | 14 | 12 | 17 | 8 | 13 | 10 | 15 | 8 | 13 | 8 | 13 |
| Manufacturing | | | | | | | | | | | | |
| food products | 24 | 38 | 38 | 55 | 37 | 55 | 33 | 50 | 31 | 44 | 25 | 39 |
| textile products | 17 | 21 | 26 | 30 | 24 | 27 | 23 | 26 | 19 | 20 | 17 | 19 |
| leather products | 6 | 7 | 6 | 8 | 7 | 7 | 5 | 6 | 6 | 6 | 6 | 6 |
| Wood products | 18 | 24 | 23 | 25 | 18 | 21 | 15 | 17 | 14 | 16 | 11 | 13 |
| Pulp & paper | 13 | 24 | 9 | 18 | 10 | 19 | 9 | 16 | 6 | 13 | 9 | 14 |
| coke, petroleum products & nuclear fuel | 0 | 1 | 1 | 2 | 1 | 2 | 0 | 2 | 0 | 1 | | |
| chemical products | 11 | 11 | 10 | 10 | 10 | 10 | 10 | 11 | 8 | 8 | 8 | 8 |
| rubber and plastic products | 9 | 11 | 8 | 8 | 7 | 7 | 7 | 7 | 6 | 6 | 4 | 6 |
| other non-metallic products | 13 | 15 | 16 | 19 | 16 | 18 | 16 | 18 | 14 | 17 | 13 | 15 |
| basic metal products | 12 | 15 | 15 | 19 | 18 | 21 | 13 | 18 | 13 | 16 | 11 | 14 |
| machinery & equipment | 12 | 21 | 15 | 22 | 15 | 21 | 14 | 18 | 11 | 15 | 13 | 16 |
| electrical and optical equipment | 16 | 19 | 16 | 17 | 19 | 22 | 18 | 20 | 14 | 16 | 13 | 14 |
| transport equipment | 11 | 11 | 10 | 10 | 10 | 11 | 9 | 10 | 7 | 9 | 4 | 6 |
| Furniture | 28 | 31 | 18 | 23 | 16 | 19 | 15 | 17 | 12 | 14 | 13 | 13 |
| Electricity, Gas and Water supply | 1 | 15 | 1 | 17 | 0 | 15 | 1 | 9 | 0 | 5 | 1 | 3 |
| Construction | 15 | 37 | 18 | 44 | 19 | 45 | 17 | 45 | 17 | 40 | 15 | 35 |
| Wholesale Trade | 34 | 42 | 29 | 47 | 28 | 44 | 24 | 39 | 22 | 33 | 19 | 30 |
| Retail Trade | 5 | 25 | 10 | 34 | 9 | 30 | 8 | 26 | 5 | 21 | 6 | 23 |
| Total | 268 | **420** | 293 | **454** | 279 | **430** | 258 | **394** | 222 | **334** | 202 | **303** |

## Table 7. Means of Selected Variables for Exporters and Non-exporters at the Beginning and the End of the Period

| Year | 1994 | | 1999 | |
|---|---|---|---|---|
| Variables | Exporters | Non-exporters | Exporters | Non-exporters |
| Employment | 225 | 54 | 150 | 61 |
| Wage Salary | 4113.876 | 908.3865 | 4333.934 | 1373.988 |
| Productivity (Sales/L) | 219.364 | 85.39755 | 273.1146 | 146.8218 |
| VA/L | 36.59811 | 10.70839 | 55.06947 | 7.834387 |
| K/L | 46.7814 | 54.05512 | 93.79471 | 46.97879 |
| Maximum Number of Observations | 268 | 152 | 202 | 101 |

## Table 8. Number of Exporting and Non-exporting Firms Over Time

| Year | Exporting | Non exporting | Total |
|---|---|---|---|
| 1994 | 268 | 152 | 420 |
| 1995 | 293 | 161 | 454 |
| 1996 | 279 | 151 | 430 |
| 1997 | 258 | 136 | 394 |
| 1998 | 222 | 112 | 334 |
| 1999 | 202 | 101 | 303 |

## Table 9: Export Persistence, Entrants and Exits from the Export market.

**(Balanced panel)**

| **T** | **t+1** | **94-95** | **95-96** | **96-97** | **97-98** | **98-99** |
|---|---|---|---|---|---|---|
| Non-Exp | Non-Exp | 84.78 | 82.61 | 82.98 | 80.77 | 80 |
| | Export (Entrants) | 3.85 | 6.15 | 5.43 | 4.03 | 6.61 |
| Exporters | Non-Exp (Exits) | 15.22 | 17.39 | 17.02 | 19.23 | 20 |
| | Export | 96.15 | 93.85 | 94.57 | 95.97 | 93.39 |

## Table 10: Export Transitions over Time.

| Sequences | Freq. | Percentage |
|---|---|---|
| 000000 | 28 | 15.90909 |
| 000001 | 1 | 0.568182 |
| 000010 | 2 | 1.136364 |
| 000100 | 1 | 0.568182 |
| 001000 | 2 | 1.136364 |
| 010000 | 3 | 1.704545 |
| 100000 | 1 | 0.568182 |
| | | |
| 000011 | 2 | 1.136364 |
| 000110 | 1 | 0.568182 |
| 011000 | 1 | 0.568182 |
| 110000 | 2 | 1.136364 |
| 100001 | 1 | 0.568182 |
| | | |
| 000111 | 4 | 2.272727 |
| 001101 | 1 | 0.568182 |
| 101100 | 1 | 0.568182 |
| 111000 | 4 | 2.272727 |
| | | |
| 111010 | 1 | 0.568182 |
| 101011 | 1 | 0.568182 |
| 101101 | 1 | 0.568182 |
| 101110 | 1 | 0.568182 |
| 110101 | 2 | 1.136364 |
| 111001 | 1 | 0.568182 |
| 111100 | 6 | 3.409091 |
| | | |
| 011111 | 7 | 3.977273 |
| 101111 | 1 | 0.568182 |
| 110111 | 1 | 0.568182 |
| 111101 | 1 | 0.568182 |
| 111110 | 8 | 4.545455 |
| | | |
| 111111 | 90 | 51.13636 |
| Total | 176 | 100 |

**Table 11: Balanced Panel Linear Probability Estimation with Instrumental Variables.**

| **Variables** | **Model 1** | **Model 2** | **Model 3** |
|---|---|---|---|
| Exported Last period | 0.18** | 0.17** | 0.19** |
| | (2.53) | (2.43) | (2.56) |
| Exported Last two periods ago | 0.147* | 0.146* | 0.146* |
| | (4.57) | (4.61) | (4.74) |
| Private Consumption $_t$ | -0.69** | -0.62** | -0.6** |
| | (-2.54) | (-2.38) | (-2.37) |
| Average Labor cost$_{t-1}$ | 0.048 | 0.053 | 0.049 |
| | (1.26) | (1.37) | (1.29) |
| Labor Productivity$_{t-1}$ | 0.044 | 0.042 | 0.04 |
| | (1.36) | (1.31) | (1.21) |
| Capital Intensity$_{t-1}$ | 0.0074 | 0.0067 | 0.0094 |
| | (0.34) | (0.32) | (0.44) |
| Firm Size$_{t-1}$ | 0.084*** | 0.084*** | 0.083*** |
| | (1.65) | (1.66) | (1.67) |
| Dummy Foreign$_{t-1}$ | 0.072 | 0.15*** | 0.14*** |
| | (0.73) | (1.78) | (1.68) |
| Dummy Manager$_{t-1}$ | 0.0061 | -0.0024 | 0.0029 |
| | (0.11) | (-0.04) | (0.05) |
| Dummy Employee$_{t-1}$ | 0.074 | 0.065 | 0.066 |
| | (1.43) | (1.31) | (1.34) |
| Dummy Domestic$_{t-1}$ | 0.0066 | -0.00061 | -0.0041 |
| | (0.16) | (-0.02) | (-0.11) |
| Nr. of Exporters$_{t-1}$ | 0.0022 | | |
| | (0.69) | | |
| Nr. of Exporters * | -0.00105 | | |
| Dummy Foreign | (-0.21) | | |
| Nr. of Foreign Exporters$_{t-1}$ | | 0.0037 | |
| | | (0.56) | |
| Nr. of Foreign Exporters * | | 0.017 | |
| Dummy Foreign | | (1.38) | |
| MNE Spillover$_{t-1}$ | | | 0.12*** |
| | | | (1.91) |
| MNE Spillover$_{t-1}$* | | | 0.086 |
| Dummy Foreign | | | (0.51) |
| Share of Export Activity $_{t-1}$ | 1.86** | 1.72** | 1.36*** |
| | (2.26) | (2.09) | (1.65) |
| **Time Dummies** | Yes | Yes | Yes |
| **Number of Observations** | 704 | 704 | 704 |
| **F-Test** | 1.78** | 1.69** | 2.2* |
| (joint significance of coefficients) | (0.031) | (0.045) | (0.0048) |

Note: * is significant at 1%, ** is significant at 5% and *** significant at 10% significance level

**Table 12: Balanced Panel Random Effects Probit Estimation Accounting for Firm Heterogeneity and Initial Conditions.**

| Variables | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|---|---|---|---|---|---|
| Exported Last period | 2.48* | 1.22* | 1.99* | 1.055** | 1.05** |
| | (12.09) | (2.57) | (7.5) | (2.07) | (2.11) |
| Exported Last two periods ago | 1.44* | 0.97** | 1.23* | 0.95** | 0.96** |
| | (4.68) | (2.41) | (3.8) | (2.2) | (2.2) |
| Private Consumption $_t$ | -6.97** | -7.15 | -10.34** | -8.81 | -9.01 |
| | (-1.6) | (-1.32) | (-2.17) | (-1.53) | (-1.56) |
| Average Labor cost$_{t-1}$ | -0.25 | -0.24 | -0.35 | -0.36 | -0.35 |
| | (-1.01) | (-0.7) | (-1.35) | (-0.93) | (-0.91) |
| Sales per Employee$_{t-1}$ | -0.026 | -0.0086 | -0.017 | 0.03 | 0.025 |
| | (-0.14) | (-0.03) | (-0.08) | (0.1) | (0.08) |
| Capital Intensity$_{t-1}$ | 0.27*** | 0.43** | 0.30** | 0.44** | 0.438** |
| | (1.91) | (2.24) | (2.08) | (2.16) | (2.13) |
| Firm Size$_{t-1}$ | 0.32*** | 0.53*** | 0.28 | 0.56*** | 0.55*** |
| | (1.77) | (1.77) | (1.5) | (1.74) | (1.71) |
| Dummy Foreign$_{t-1}$ | 0.82** | 1.11*** | 1.048** | 1.05 | 1.16*** |
| | (2.07) | (1.82) | (2.14) | (1.4) | (1.68) |
| Dummy Manager$_{t-1}$ | 0.57*** | 0.86*** | 0.63*** | 0.95*** | 1.01*** |
| | (1.81) | (1.8) | (1.89) | (1.78) | (1.87) |
| Dummy Employee$_{t-1}$ | 0.77** | 1.14** | 0.92** | 1.25** | 1.29** |
| | (2.19) | (2.14) | (2.41) | (2.11) | (2.18) |
| Dummy Domestic$_{t-1}$ | 0.22 | 0.16 | 0.15 | 0.16 | 0.19 |
| | (0.74) | (0.37) | (0.5) | (0.36) | (0.41) |
| Nr. of Exporters$_{t-1}$ | | | -0.12* | | |
| | | | (-2.65) | | |
| (Nr. of Exporters * Dummy Foreign) $_{t-1}$ | | | -0.0058 | | |
| | | | (-0.33) | | |
| Nr. of Foreign Exporters$_{t-1}$ | | | | -0.023 | |
| | | | | (-0.27) | |
| (Nr. of Foreign Exporters * Dummy Foreign) $_{t-1}$ | | | | 0.041 | |
| | | | | (0.34) | |
| MNE Spillover$_{t-1}$ | | | | | 0.063 |
| | | | | | (0.12) |
| (MNE Spillover * Dummy Foreign) $_{t-1}$ | | | | | 0.17 |
| | | | | | (0.25) |
| Share of Export Activity $_{t-1}$ | | | 17.16 | 27.1*** | 26.7*** |
| | | | (1.4) | (1.67) | (1.65) |
| Initial Condition ( $\eta_0$ ) | - | 1.32* | 0.58* | 1.58* | 1.59* |
| | | (2.6) | (3.74) | (2.62) | (2.66) |
| **Industry Dummies** | Yes | Yes | Yes | Yes | Yes |
| **Time Dummies** | Yes | Yes | Yes | Yes | Yes |
| **Number of Observations** | 704 | 704 | 704 | 704 | 704 |
| $\chi^2$ **-test** (joint significance of coefficients) | 222.63 (0.000) | 89.71 (0.000) | 82.6 (0.000) | 73.13 (0.000) | 71.84 (0.000) |

*Note:* A constant and mean –firm level characteristics are included in all estimations.
*, **, *** significant at 1%, 5% and 10%, respectively.
z-statistics in parenthesis

## Table 13: The Marginal Effects.

| **Variables** | All Firms | With Past Export Experience ($y_{i,t-1}=1$) | With No Past Export Experience ($y_{i,t-1}=0$) | With Exporting Experience of last, two years ago ($\tilde{y}_{i,t-2}=1/\ y_{i,t-1}=0$) | Have Not Exported in the last two years ($\tilde{y}_{i,t-2}=0/\ y_{i,t-1}=0$) |
|---|---|---|---|---|---|
| Private Consumption $_t$ | -0.2170 | -0.00295 | -0.8037 | -2.828 | -0.4239 |
| Average Labor cost$_{t-1}$ | -0.0075 | -0.00010 | -0.0276 | -0.097 | -0.0146 |
| Labor Productivity$_{t-1}$ | -0.0003 | 0.00000 | -0.0010 | -0.003 | -0.0005 |
| Capital Intensity$_{t-1}$ | 0.0131 | 0.00018 | 0.0484 | 0.170 | 0.0255 |
| Firm Size$_{t-1}$ | 0.0162 | 0.00022 | 0.0600 | 0.211 | 0.0316 |
| Dummy Foreign$_{t-1}$ | 0.019 | 0.00029 | 0.2441 | 0.384 | 0.168 |
| Dummy Manager$_{t-1}$ | 0.0168 | 0.0002 | 0.144 | 0.3151 | 0.084 |
| Dummy Employee$_{t-1}$ | 0.0176 | 0.00018 | 0.2 | 0.367 | 0.1165 |
| Dummy Domestic$_{t-1}$ | 0.0045 | 0.00006 | 0.0186 | 0.0622 | 0.0099 |
| **The Spillover Variables**[14] | | | | | |
| Nr. of Exporters$_{t-1}$ | -0.0099 | -0.00056 | -0.014 | -0.046 | -0.0088 |
| Nr. of Exporters * Dummy Foreign | -0.0005 | -0.000028 | -0.00073 | -0.00231 | -0.00044 |
| Share of Export Activity $_{t-1}$ | 1.470 | 0.08222 | 2.145 | 6.813 | 1.3035 |
| Nr. of Foreign Exporters$_{t-1}$ | -0.00031 | -1.37E-06 | -0.0023 | -0.009 | -0.0011 |
| Nr. of Foreign Exporters * Dummy Foreign | 0.00055 | 2.43E-06 | 0.004 | 0.0159 | 0.00194 |
| Share of Export Activity $_{t-1}$ | 0.3624 | 0.00161 | 2.698 | 10.562 | 1.2876 |
| MNE Spillover$_{t-1}$ | 0.00098 | 5.24E-06 | 0.006 | 0.0243 | 0.0029 |
| MNE Spillover$_{t-1}$* Dummy Foreign | 0.0028 | 0.000015 | 0.0171 | 0.068 | 0.00812 |
| Share of Export Activity $_{t-1}$ | 0.42 | 0.0022 | 2.61 | 10.41 | 1.2387 |
| **The Predicted probability of Exporting** ($\bar{x}'\beta$) | 0.986 | 0.999 | 0.056 | 0.554 | 0.0245 |

[14] The marginal effects for the spillover variables are estimated from the respective estimated equations of Table 12, Models 3-4-5.

# Export market participation with sunk costs and firm heterogeneity

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**Abstract**

In this paper we investigate the importance of sunk costs, firm characteristics and spillovers from nearby exporters on a firm's decision to participate in exporting. The empirical analysis involves the estimation of a non-structural, discrete choice, dynamic model with firm heterogeneity. By using panel data for Estonian companies from 1994 to 1999 we find that: (i) both sunk costs and observable firm characteristics are important determinants of export market participation; (ii) previous history matters, in that, if a firm has been exporting the previous period or the period before, it significantly increases the likelihood of the firm exporting in the current period; (iii) larger firms with high capital intensity and foreign ownership are more likely to be exporters; (iv) operating in an export-oriented industry increases a firm's likelihood of exporting.

Keywords: dynamic panel, sunk costs, export decision.
JEL classification: L10, F10, C23, C25.

## I. Introduction

The analysis of the causes and impacts of a firm's exporting activity has long been the focus of both theoretical and empirical work. For instance, the last decade has produced a stream of micro-econometric studies on the relationship between a firm's exports and productivity. The studies conclude that, on average, exporters display higher productivity, and, often, higher productivity growth, even after controlling for observed plant characteristics. Furthermore, these conclusions are not affected by previous exporting experience, since exporting does not necessarily improve a firm's productivity (Bernard and Jensen, 1999). Alternatively, Roberts and Tybout (1997), Bernard and Wagner (2001), Bernard and Jensen (2001) and Campa (2004) focus on the determinants of exporting activity. They model a firm's exporting decision as a function of its previous exporting history subject to sunk entry costs[1], as well as firm and industry characteristics. They find that sunk entry costs are important for the current exporting decision. Yet, their effect depreciates fairly quickly, in that, if a firm has been out from the export market for two years, the probability of it exporting again is no different from that of a firm that has never exported (Roberts and Tybout, 1997). Similarly, Rosenbaum and Lamort (1992) and Höltz (2005) investigate the importance of sunk costs on entry and exit rates. They find that in markets where sunk costs are negligible, exit rates are much higher and that sunk costs are important determinants of industry dynamics. These findings further underline the importance of sunk costs on export market participation. On the other hand, Dixit (1989) and Baldwin and Krugman (1989) stress the significant impact of fluctuations in exchange rates on the entry and exit decisions of firms in the export market. Yet, once the firm has incurred a sunk cost to enter the export market, it might prefer to stay in even if there is an exchange rate shock of a moderate magnitude, in order not to re-incur the sunk entry cost. Hence, the existence of sunk entry costs may have a hysteresis effect on trade.

[1] Sunk costs, typically, represent the costs of setting up a distribution and service network, of establishing a brand name through advertising, or of bringing the product into conformity with health and safety regulations of the foreign country (Baldwin, 1989; Baldwin and Krugman, 1989).

Overall, these findings stress the importance of sunk entry costs in a firm's exporting decision, but leave their relative importance an open question.

In this paper we investigate the importance of sunk cost hysteresis and firm characteristics as determinants of a firm's participation in the export market. The data we use is exceptionally good for modelling of sunk costs and firm heterogeneity in a dynamic setting. We employ a representative sample of Estonian firms over the period 1994 to 1999, during which time the country underwent major structural economic changes that make this data and the country an excellent case for studying the relevance of sunk entry cost hysteresis.

Before independence, Estonia's trade was heavily oriented towards the Soviet Union. Its independence from the Soviet Union in 1991 triggered a wave of reforms such as price liberalization, a Deutschemark backed currency board, large-scale privatization, a flat 26% income tax, a zero corporate tax and strong bankruptcy laws. The economy grew fast, prices were stable and inflation was under control. Estonia's speed of integration into the world economy was impressive. It reoriented its trade westwards, towards Finland and Sweden and quickly replaced Russia as its major trading partner, although it sill remained among its first five trade partners (EBRD Transition Report, 2003). In 1992, the new Estonian currency, the Kroon, was fixed to the Deutschemark, and became automatically fixed to the Euro when it became common currency in 1999. However, in advance of the expected adoption of the monetary union, the Deutschemark (and, consequently, the Estonian Kroon) depreciated against the US dollar by 17% during the period 1995 to 1998. In addition, in August 1998, Russia experienced a financial crisis as its Central Bank floated the currency and declared its inability to pay off debts. The following depreciation of the Ruble caused a reduction in domestic private consumption, which, in turn, caused a drop in Estonian exports to Russia from 12.3% in 1998 to 5.2% in 1999 (EBRD Transition Report, 2002). Consequently, in 1998, Estonia experienced a current account deficit of 8.6% of GDP, which

narrowed to 7% in 1999 (EBRD Transition Report, 2002). The Russian crisis aside, such large fluctuations in exchange rates are likely to have a strong impact on a country's trade flows (Dixit, 1989; Baldwin and Krugman, 1989). This makes Estonia a very good case for testing the effect of the sunk cost hysteresis on export market participation.

Our contribution to the literature is fourfold: first, we model a firm's current exporting decision as a function of its last two years exporting history, while earlier research takes into account only last year exporting history for a firm. This makes it possible to construct a non-structural, discrete choice dynamic model with firm heterogeneity. Second, we explicitly model for the unobserved firm heterogeneity, constant over time, as well as initial conditions. Third, we estimate a random dynamic probit model, rather than a linear model, in the estimation of the discrete choice dynamic model. Finally, we allow for changes in domestic demand conditions as well as spillovers from nearby exporters as a source of a firm's exporting decision.

The paper is organized as follows. The next section reviews theoretical arguments on sunk costs hysteresis and the determinants of a firm's exporting decision. After this we present a model of the export decision with sunk entry costs, discuss estimation issues and present the data used in the empirical analysis. This is followed by the reporting and discussion of our findings. The final section presents concluding thoughts.

## II. Theoretical Considerations

An important determinant of the decision to undertake an action, such as the decision to export, to participate in the labour force, in a union or to remain in welfare programmes, is state dependency. State dependency, also referred to as 'hysteresis', is defined as the failure of an effect to reverse itself when its underlying cause is reversed (Dixit, 1989). Under sunk cost hysteresis, a firm will find it advantageous to enter a foreign market once there is, for instance, a temporary exchange rate shock that leads to an appreciation of the foreign currency, which results in profits

greater than zero. After the shock reverses itself the firm's profits will start dropping, but as long as profits are non-negative the firm finds it cheaper to stay in the market because of the already incurred sunk cost. If the firm were to exit and re-enter in good times, it would have to re-incur the sunk entry cost. Hence, the existence of sunk costs implies that it is cheaper to stay 'in' than to get 'in' a market (Baldwin, 1989). Baldwin (1989) refers to the interval between a firm's critical entry level (when profits at least exceed the sunk costs) and the critical exit level (when profits become negative) as the hysteresis band or, alternatively, as the no exit no entry band. In the hysteresis band, history matters. If the firm was 'in' in the previous period, it remains 'in' and if the firm was 'out' it remains 'out', unless a large enough shock reverses the situation. Similarly, Ansic and Pugh (1999) show that under uncertainty, sunk costs motivate firms to 'wait and see', and that the propensity to 'wait and see' increases with sunk costs.

Along with sunk entry costs there is a host of firm characteristics, such as firm size, productivity, labour quality, capital intensity and ownership structure, which are important determinants of a firm's exporting decision (Clerides et al., 1998; Bernard and Wagner, 2001; Bernard and Jensen 2001; Roberts and Tybout, 1997). Empirical evidence shows that exporting firms are larger than non-exporting firms. Firm size may reflect economies of scale in exporting (Krugman, 1984). That is, size may be associated with lower average costs of production, providing a way through which size positively affects the probability of exporting. Another important determinant of the decision to export is firm productivity. We expect firm productivity to be positively correlated with a firm's probability of exporting, in that more productive firms are more likely to export (Clerides et al., 1998; Bernard and Wagner, 2001). Likewise, a firm that possesses qualified workers is more likely to produce high quality goods and therefore has a higher probability of becoming an exporter (Bernard and Jensen, 2001). In addition, a firm's capital intensity is expected to account for differences in technology between exporting and non-exporting

firms. Hence, capital-intensive firms are expected to be more productive and to produce higher quality goods, and, therefore, are more likely to export. Finally, regarding firm ownership structure, Buck et al. (2000) stress that it can serve as an indicator of the underlying incentives of owners to restructure, cut costs, innovate and raise productivity, which will, in turn, affect the likelihood of exporting. Differences in incentives across owner categories will translate into differences in the propensity to export. In their study Buck et al. (2000) found that managerial ownership increased the probability of exporting compared with other ownership forms.

Other than firm characteristics, economy- and industry-wide variables, such as domestic demand conditions and export spillovers, affect the probability of exporting. For instance, when domestic demand decreases, local producers can shift sales from domestic to foreign markets (Moreno, 1997). Regarding export spillovers, if the information held by multinational enterprises (MNEs) foreign markets could spill over to local firms, then potential exporting firms would face lower sunk costs when entering a foreign market. Hence, more local firms could become exporters. For instance, direct contacts with foreign firms can provide local firms with the necessary information on foreign tastes, market structure, competitors, distribution networks and transport infrastructures. This, in turn, contributes to the decrease in the costs incurred by local firms to collect information on foreign markets. Hence, foreign exporters located nearby can improve the likelihood of local firms exporting (Aitken et. al., 1997).

The existence of sunk entry costs has important implications on the conduct of empirical work on export market participation. The message emerging from above arguments is that, in the case where there are no sunk costs there would be no hysteresis, and, accordingly, firms would easily enter the export markets in good times and exit in bad times at no cost. However, due to asymmetric entry and exit condition created by the sunk entry costs there is hysteresis. None of these implications, however, is captured in the standard static empirical analysis of export decision-

making. Ignoring the importance of sunk costs when working empirically with models that can easily accommodate longitudinal data may result in misspecification if the model is subject to hysteresis.

## III. The Empirical Model and Data

In investigating a firm's export market participation decision we set up and estimate a discrete choice dynamic model, where the current exporting decision is a function of previous exporting history, exogenous industry- and economy-wide variables $X_t$, as well as firm characteristics, $Z_{it}$ (Roberts and Tybout, 1997). We can test the sunk costs hysteresis hypothesis by investigating the importance of export history captured by the coefficients for the variables, $y_{i,t-1}$ and $y_{i,t-2}$, in the following equation:

$$y_{i,t} = c + \gamma_1 y_{i,t-1} + \gamma_2 y_{i,t-2} + \theta_1 Z_{i,t} + \beta X_t + \alpha_i + u_{i,t} \quad (1)$$

where $\alpha_i$ are unobserved, time invariant, firm specific components, such as managerial expertise, output quality or foreign contacts, while $u_{i,t}$ is a standard random error.

The estimation of this dynamic binary model faces two main issues: the unobserved firm characteristics, $\alpha_i$ and the initial conditions problem. In a dynamic framework, persistency in export market participation could either be the result of sunk costs (true state dependency) or the result of time invariant unobserved firm characteristics, i.e. the heterogeneity across firms. Time-invariant firm characteristics are usually unobserved and their persistence will induce serial correlation in the error term $u_{i,t}$. If not controlled for, this persistency will be captured by the state dependency variables, causing the problem of 'spurious state dependency' (Heckman 1981a). Furthermore, the unobserved invariant firm characteristics may be correlated with other firm characteristics included

as regressors, such as firm performance, and this may lead to the coefficients of those variables to be inconsistently estimated.

To account for the firm unobserved heterogeneity, fixed over time, we follow Mundlak (1978), who models the dependency between the time invariant firm characteristics, $\alpha_i$, and other firm characteristics, $Z_{i,t}$, by assuming that $\alpha_i$ is linear in the means of all time-varying covariates.

$$\alpha_i = \theta_2 \bar{z}_{i,j} + \nu_i \quad (2)$$

where, $\nu_i$ is identically and normally distributed as $\nu_i$ ~N(0, $\sigma_\nu^2$) and is independent of $Z_{i,t}$ and $u_{i,t}$ for all *i* and *t*, and $\bar{z}_{i,j}$ is a vector of means of the time-varying covariates of a firm over time.

The initial conditions problem relates to the fact that we observe a firm's export status from year 1 to year T, but the estimation of equation (1) does not allow modelling the first year of export decision. However, $y_{i,0}$, the export decision of the first year, cannot be treated as exogenous because it depends on $\alpha_0$ which in itself is correlated with $u_{i,t}$ (Heckman, 1981b). If not accounted for, this will lead to inconsistent estimates.

Based on the work of Blundell and Smith (1991) and Orme (1997), a two-stage estimating approach can be adopted, which yields more reliable estimates than models that ignore the initial conditions. In the first stage a random effects probit for the *j* initial observations is estimated as follows:

$$y_{i,j} = \lambda' \Gamma_i + \mu_i \qquad \text{t=}j \text{ and } j\text{=1, 2} \quad (3)$$

where $\Gamma_i$ is a vector of exogenous regressors that include firm characteristics $Z_{i0,}$ .....$Z_{iT}$. In addition, $\alpha_i$ and $\mu_i$ are assumed to be bivariate normal (BVN), i.e. $(\alpha_i, \mu_i)$~BVN(0,0,1,1,$\rho$), where $\rho$ is the correlation between $\alpha_i$ and the initial observations *j*. From the first stage, the probit generalized residuals are calculated as follows:

$$\hat{e}_{i,j} = (2y_{i,j} - 1)\phi(\hat{\lambda}'\Gamma_i) / \Phi((2y_{i,j} - 1)\hat{\lambda}'\Gamma_i) \quad (4)$$

where $\phi(.)$ *and* $\Phi(.)$ are the standard normal density and distribution function, respectively. Then, in the second stage, the probit generalized residuals are included as right hand side regressors in equation (1).

The equation to be estimated, which accounts for both the initial conditions and firm unobserved heterogeneity, becomes the following:

$$y_{i,t} = c + \gamma_1 y_{i,t-1} + \gamma_2 \tilde{y}_{i,t-2} + \theta_1 Z_{i,t} + \beta X_t + \delta \hat{e}_{i,j} + \theta_2 \bar{z}_{i,j} + \eta_i + u_{i,t} \quad (5)$$

where $y_{i,t}$ is an indicator variable taking the value of one if the firm exports in the current period and zero otherwise, $y_{i,t-1}$ is an indicator variable taking the value of one if the firm exported last year or zero otherwise, $y_{i,t-2}$ is an indicator variable taking the value of one if the firm did not export last year but did export two years ago and zero otherwise, $Z_{it}$ are observable firm characteristics such as firm size, firm productivity, labour quality, capital intensity and ownership structure, $X_t$ are economy and industry wide variables, such as changes in the domestic demand conditions and exchange rates, as well as export spillovers and inherent industry differences and $\eta_i$ are the random, permanent firm characteristics. We account for changes in the overall domestic demand conditions with domestic private consumption, while, following the method of Roberts and Tybout (1997), we rely on the time dummies to account for the impact of (un)favorable changes in exchange rates on export market participation. In order to control for permanent unobserved industry effects, industry dummies are also included in the specification.

Even taking these measures, the estimation of equation (5) faces one more challenge, namely the endogeneity of firm characteristics as well as the identification of export spillovers and the endogeneity of the spillover variable. There is ample empirical evidence that shows that

exporting firms are larger, more productive, pay higher wages and survive longer than non-exporting firms. Nevertheless, exporting experience does not necessarily improve firm productivity (Bernard and Jensen, 1999). Conversely, the positive correlation between productivity and exporting could simply suggest that only the most productive firms can survive in a highly competitive international environment. Hence, the most efficient firms self-select into the export market (Bernard and Jensen, 1999; Aw et al., 2000). In such a situation, current values of variables of firm characteristics would be endogenous to the current export decision. We employ lagged values of all firm characteristics to avoid this issue.

Export spillovers are subject to an identification problem, especially since firms in export-oriented industries may have a higher probability of becoming exporters independently of the export activity of other firms in the same industry. We account for this by including in the regression the share of the total economy's exports accounted for by a specific industry. The endogeneity of the spillover variable relates to the fact that foreign firms may locate in industries that offer more favourable conditions for exporting. Hence, there is a simultaneity issue between the individual firm's current export decision, the spillover variable and the share of the total economy's exports accounted for by a specific industry. We address this by including lagged values of spillover variables and of the industry's share of exports, as instruments.

The data set used in the estimation consists of annual information on Estonian firms from 1994 to 1999, and it contains detailed information on financial statements, ownership structure and exports for firms from a stratified random sample chosen to represent eighteen economic branches at the level of a 3-digit NACE classification. The data set includes firms with more than 10 employees in a given year. We constructed five ownership groups, namely, employee owned, manager owned, foreign owned, state owned, and outsider owned firms. Prior to using the data, a

series of consistency checks was performed and inconsistent data was left out[2]. The final sample consists of 2,335 firm observations and it is representative in that in covers slightly more than 30% of the manufacturing employment in 1994[3]. All variable definitions are presented in Table 1, while the means and standard deviations of the main variables are reported in Table 2[4]. All variables are deflated to 1994 prices using the appropriate two digit PPI deflators.

***

Table 1 & 2 approximately here

***

In order to look at persistence of firms in the export market, one has to focus on the balanced panel. In our sample there are 176 firms that are present each year over the period 1994 through 1999. Table 3 illustrates export persistency, entry into and exit from the export market over time, for the balanced panel.

***

Table 3 approximately here

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The results show strong persistence of firms in the export market, with more than 90% of firms that export in a given period still being exporters in the following period. Similarly, around 80% of non-exporters in each period remain non-exporters in the next period. The number of entrants is highest in 1995-1996 and 1998-1999, with around 6% of non-exporters becoming exporters, and it slightly decreases in between. In contrast, the exit rates are much higher than the

[2]We checked for inconsistencies using different criteria. For instance, a firm's capital at the beginning and end of each year should be positive; sales should be positive; labour cost in a given year should be positive; average employment per year should be positive and equal to or greater than 10; investment in new machines and equipment should be non-negative; and the ownership shares should add up to 100.

[3] Out of this sample, the balanced panel consists of 1,056 observations. However, after accounting for initial conditions and the use of lagged variables, the total number of observations of the balanced panel used in the estimation drops to 704.

[4] To check for potential multicollinearity between variables employed in this study, we examine the table of variable correlations which shows no problem across the variables. This table is available upon request.

entry rates and the percentage of firms exiting the export market gradually increases over time. The exit rates can reflect either lingering benefits from exporting or that sunk costs are not very significant. One particular event that could have had an impact on Estonian firms' exporting behaviour during this period is the Russian crisis of 1998. Its effect is expected to have materialised in two ways: first, through changes in the volume of exports and second through changes in the decision to enter/exit the export market. Looking at exit rates we observe that, although they increase during 1997-1998 and 1998-1999 they are still not much higher than those in the previous years. These facts suggest that the effect of the Russian crisis on Estonian firms has mainly been through changes in the volume of exports rather than on the decision to leave the market altogether. This finding is consistent with that of Campa (2004) who found that in Spain trade adjustment against exchange rate fluctuations occurred through the adjustment of the volume of exports rather than through changes in the number of exporting firms.

The observed persistence in exporting behaviour might be caused by sunk cost hysteresis or by the unobserved firm characteristics. For instance, persistent differences in firm characteristics might explain why some firms export and others do not.

***

Table 4 approximately here

***

Attempting to discriminate between these two explanations, we develop firm export sequences over time, reported in Table 4. Each sequence represents the total number of times a firm is observed to participate in the export market during the sample period[5]. We notice substantial serial persistency over time. That is, the majority of firms either exports in all of the sample periods or never exports. For example, 51 % of firms export for the whole period, while 15.9% do not

[5] One indicates the case when firms participate in the export market and zero when they do not.

export at all. The rest of the firms display entry into and exit from the export market over time. The frequency of entry and exit depends to a large extent on the existence of sunk costs. If these costs are important for persistency, we expect to observe sequences in which export and non-export participation are clumped together. The data do provide some support for this conjecture with, for instance, 8.53% of firms in the sample exporting five consecutive years with a non-exporting year either at the beginning or the end of the sample. Similarly, 3.4 % of firms export four consecutive years, and 4.5 % export three consecutive years. This evidence suggests that, while there is firm heterogeneity that affects export participation, persistency in the export market is also consistent with the sunk cost hysteresis[6].

**IV. The Estimation Results.**

This section reports the estimates of equation (5) carried out using conventional random effects probit in Stata 9, and related discussion. To account for the persistency of firms in the export market effectively we carry out the estimations on the balanced panel, modelling a firm's current export decision as a function of the last year's export status, the export status of two years ago, firm characteristics such as firm size, labour productivity, capital intensity, labour quality and ownership structure, as well as economy- and industry-wide variables such as domestic private consumption and export spillovers. The estimation results are reported in Table 5. Columns two through five present estimates of five different models. The first two models report estimates of the basic equation without accounting for the spillover effects, and with and without the initial conditions. The last three models include in the specification, one at a time, of the three different spillover variables explained below.

[6] More extended descriptive statistics also show that exporting firms are larger, pay higher wages and are more capital intensive than non-exporting firms. These results are available upon request.

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Table 5 approximately here

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The results reveal that across all models the coefficients of the sunk costs variables are positive and significant, thus providing strong support for the sunk cost hysteresis hypothesis. That is, having exported last year ( $y_{i,t-1}$ ) or having last exported two years ago ( $y_{i,t-2}$ ) significantly increases the probability of exporting in the current period, which is largely consistent with the sunk costs hypothesis. Model 1 estimates equation (5) ignoring the initial conditions. As discussed earlier, not accounting for the initial conditions results in upward biased coefficient estimates of the sunk costs variables $y_{i,t-1}$ and $y_{i,t-2}$. Indeed, the sunk costs coefficients are much larger in Model 1 than in all other estimations, namely, Model 2 through Model 5. The coefficient estimates of sunk costs through the five different models range between 2.48 and 1.05 if the firm exported last year and between 0.95 and 1.44 if the firm last exported two years ago[7].

Turning to coefficient estimates of firm characteristics, we find that they are mostly significant, largely confirming the hypotheses set forth in the second section. Among firm characteristics, we see that the larger and the more capital intensive a firm is, the higher its probability of exporting. These results provide support for the argument that large firms find it cheaper to enter foreign markets as they can spread the fixed costs of entering over more units of

[7] We also estimated the linear probability model by taking first-differences to eliminate fixed effects and initial conditions, inherent in equation (1), and obtained consistent estimates by instrumenting $\Delta y_{i,t-1}$ with $y_{i,t-2}$ and $Z_{i,t-2}$. This approach, however, attributes too much of the serial dependence to unobserved heterogeneity. In general, any approach that understates (overstates) the importance of unobserved heterogeneity will overstate (understate) the importance of state dependency. Hence, when using linear probability models, we expect the coefficient of the lagged binary variable to provide us with a lower bound of the sunk cost coefficients compared to the coefficients in the nonlinear models. Indeed, the sunk cost coefficients from the estimated random dynamic probit are larger in comparison to the sunk cost coefficients of the linear probit estimation. These results are available upon request. A further problem with the linear probability models is that predicted probabilities are not constrained to the unit interval, making nonlinear models more likely to provide a better fit.

production. In addition, as capital intensity is expected to account for differences in technology between exporting and non-exporting firms, capital-intensive firms are expected to produce higher quality goods, and have, therefore, higher probability of export market participation. A further significant determinant of a firm's decision to export is a firm's ownership structure. The results show that a firm owned by foreigners, managers and employees is significantly more likely to export than a state owned firm. Overall our results are in line with those of the previous literature. For instance, Bernard and Jensen (2001) and Roberts and Tybout (1997) found that firm characteristics such as firm size, its age and average labour cost, as well as its ownership type, increased the probability of exporting for U.S and Colombian firms.

The estimation results also provide evidence of the importance of economy- and industry-wide variables in the likelihood of export participation. Although not consistently significant, the results show that domestic private consumption does influence the decision to export. Its coefficient is negative and significant only for Model 1 and Model 3. These results imply that, as expected, a decrease in domestic demand for the firm's product pushes local firms to shift their output to foreign markets.

To account for the possibility of export spillovers, we included in the regression a control variable for the identification of spillovers, namely, the share of the total economy's exports accounted for by a specific industry, as well as three spillover variables. The three alternative measures that proxy for export spillovers are the total number of firms that export in an industry, the number of foreign firms that export in the industry and the proportion of exports by foreign firms in the total exports of that industry. All these measures reflect the prevalence of knowledge about foreign markets and technology. As long as this knowledge spills over to local firms and influences their export decision we expect the coefficient of the spillover variables to be positive and significant. However, the number of exporters in the industry also approximates the degree of

competition in the export market. A negative coefficient of this variable indicates that exporting firms crowd each other out of the export market. Finally, to separate the spillover effect on domestic firms from that on foreign firms we introduced interaction terms of the spillover variables with the dummy denoting foreign ownership.

We found that the control variable, namely, the share of the total economy's exports accounted for by a specific industry, is significant in Model 4 and Model 5. The implication of such a finding is that firms belonging to export-oriented industries have a higher probability of becoming exporters, while firms that intend to become exporters should consider locating in export oriented industries. This finding is consistent with Aitken et al. (1997). Among the three spillover variables only one, the number of exporters in the industry, is significant, but negative. This indicates that there may be tough competition in the export market, with exporting firms crowding out domestic firms from the export market. In contrast, we found no significant effect of spillovers on other foreign firms, measured by the coefficient of the interaction of the spillover variable with the foreign firm dummy, which suggests that foreign firms do not benefit from export spillovers. This finding is not surprising given that foreign firms are already export oriented, hence they have the knowledge about foreign markets and foreign tastes and as such their export decision is not influenced by the exporting activity of the other foreign exporting firms. Indeed, 91.34% of the foreign firms in our sample exported throughout the whole period.

Overall, we found strong support for the sunk costs hypothesis. A firm that exported last year is more likely to keep exporting in the current year and although this effect depreciates for the firm that last exported two years ago, it still remains significant and positive. Furthermore, firm characteristics, such as capital intensity, firm size and ownership structure also increase a firm's probability of exporting. In addition, we found evidence that operating in an export-oriented industry increases the probability of becoming an exporter and that the number of other exporters in

the industry negatively affects export market participation, indicating crowding out of domestic firms from the export market.

***

Table 6 approximately here

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The non-linearity of the probit specification makes the economic interpretation of the coefficients difficult. Therefore, we also computed the marginal effects of a change in the independent variables on the probability of exporting. These effects, reported in Table 6, are calculated for five different groups of firms: a) for all the firms (exporting and non-exporting), b) for firms with past exporting experience, c) for firms without past exporting experience, d) for firms that last exported two years ago and e) for firms without exporting experience in the last two years. The last row in Table 6 shows that the average predicted probability of exporting for the whole sample is 98.6%; it increases to 99.9% for firms with past exporting experience and drops to 5.6% for firms without past exporting experience. Furthermore, the estimated probability of exporting is 55.4 % for firms that last exported two years ago and drops to 2.45% for firms that did not export in the last two years. Hence, the probability of exporting for a firm that has not been in the export market during the last two years is very low.

The marginal effect of capital intensity shows that if capital intensity increases by 10%, the probability of exporting increases by 0.13% for all firms, by 0.0018% for firms with past exporting experience, by 0.48% for firms without past exporting experience and by 1.7% for firms that last exported two years ago. Similarly, if firm size increases by 10 employees, the probability of exporting increases by 0.16% for all firms, by 0.0022% for firms with past exporting experience

and by 2.11% for firms that last exported two years ago. The marginal effects of ownership variables reveal that, for instance, if foreign ownership increases by 10%, the probability of exporting increases by 0.19% for all the sample of firms, by 0.0029% for firms with past exporting experience and by 3.84 % for firms that last exported two years ago. Similarly, the changes in the probability of exporting for a 10% increase in managerial and employee ownership are 0.16% and 0.17% for all firms, 0.002% and 0.0018% for those with past exporting experience and 3.15% and 3.67% for firms that last exported two years ago. Hence, the longer the firm has been in the export market, the higher the marginal effect/elasticity of its firm characteristics on its probability of exporting.

Finally, an increase in the number of other exporters in the industry reduces the probability of exporting by 0.09% for all the firms, by 0.0056% for firms with past exporting experience and by 0.46% for firms that last exported two years ago. Obviously, the impact is stronger for firms that have been exporting longer. This supports our argument that as new exporters enter the export market they may steal away market share from existing exporters.

## V. Concluding Remarks

In this paper we have investigated the importance of sunk costs, firm, economy and industry characteristics, and spillovers on a firm's decision to export. We have done so through the estimation of a non-structural, discrete choice, dynamic model with firm heterogeneity. In the empirical modelling we have explicitly accounted for two common shortcomings of the empirical work, i.e. the unobserved time-invariant firm heterogeneity and the initial conditions problem. The analysis was carried out using a panel of data of Estonian firms over the period 1994 to1999.

The findings provide strong evidence of the importance of sunk costs in export market participation. That is, a firm's exporting history significantly affects the likelihood of remaining in

the export market. This conclusion is robust across all specifications. In addition, the average predicted probability of exporting is highest for firms with past exporting experience and is more than 50% for firms that have last exported two years ago. In contrast, the probability of exporting for firms that have not been in the export market during the last two years is very low.

While there is strong evidence that sunk costs are a significant source of export market persistence, observable firm characteristics also contribute to a firm's exporting decision. For instance, larger firms and those with higher capital intensity are more likely to export. Furthermore, a firm owned by foreigners, managers and employees is more likely to export than a state owned firm.

The results on export spillovers are less conclusive. We find that the spillover variable measured by the number of exporters in the industry is negative and significant. This suggests that there is evidence of crowding out of firms in the export market. Nevertheless, operating in an export-oriented industry increases the likelihood of exporting.

One important implication of the results of this paper is that export-promoting policies undertaken by the government in Estonia should distinguish between policies that aim at expanding the export volume of existing exporters and those policies that promote entry of new firms into the export market. The entry of new firms into the export market can be promoted by reducing the sunk costs and uncertainty in accessing the export market. This would be possible if the government disseminates information about potential export markets and develops the export infrastructure. Furthermore, if, when entering the export market, firms find it possible to expand their export volume, then promoting the entry of new firms in the export market is a more effective policy than one aiming at expanding the export volume through subsidies. Finally, given that operating in export-oriented industries increases the likelihood of exporting, the government should promote these industries as possible supporters of economic growth.

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## Table 1: Variable Definition

| Variables | Definition |
|---|---|
| Sales | Net sales are expressed in thousands of Kroons. Available at firm level. |
| Capital | Capital is calculated as the average of fixed assets at the beginning and end of year. Expressed in thousands of Kroons. Available at firm level. |
| Number of Employees | Firm's average number of employees per year. Available at firm level. |
| Exports | The value of exports in thousands of Kroons Available at firm level. |
| Export market participation | The dependent variable is a dummy equal to 1 if the firm is exporting in the current period and 0 otherwise. |
| Exported last year | Is a dummy variable equal to 1 if the firm exported last year and zero otherwise. |
| Exported last two years ago | Is a dummy variable equal to 1 if the firm did not export last year but did export two years ago and zero otherwise. |
| Firm size | Is the logarithm of the number of employees per year. Available at firm level. |
| Capital Intensity | The ratio of capital to the number of employees. Available at firm level. |
| Labour Quality | Is the average labour cost in thousands of Kroons. Available at firm level. |
| Labour Productivity | The ratio of net sales to the number of employees. Available at firm level. |
| Ownership Dummy | Is equal to 1 if the firm is owned by foreigners, managers, employees, domestic outsiders, and state and is equal to zero otherwise. |
| *Spillover Variables (a, b, c)* | |
| a) Number of exporters in the industry | The overall number of exporters in each industry. This variable is constructed at the *Industry Level*, and is a proxy for export spillovers from nearby exporters in the sector. |
| b) Number of foreign exporters in the industry. | The number of foreign exporters in each industry. This variable is constructed at the *Industry Level*, and is a proxy for export spillovers from nearby exporters in the sector. |
| c) MNE Spillovers | The proportion of foreign firms' exports to the industry's exports. This variable is constructed at the *Industry Level*, and, again, proxies for export spillovers from nearby exporters in the sector. It is calculated as below: $MNE\ Export\ spillover_{j,t} = \sum_j E_{f,t-1} / (\sum_j E_{d,t-1} + \sum_j E_{f,t-1})$ |
| d) Share of Industry's Exports | The share of the total economy's exports accounted for by a specific industry. |
| e) Private Consumption | Consumers consumption after subtracting government consumption, net value of export and import and fixed investment from the gross domestic product. |
| $d_t$ | Time dummies: Included to account for economy wide shocks. |
| $d_j$ | Industry dummy, constructed at two-digit ISIC/NACE industry classification |

Note: Except for a), b), c), d) and e) all other variables are available at the firm level.

**Table 2: Mean and standard deviation of main variables.**

| Variable | No. of Observations | Mean | St. Dev |
|---|---|---|---|
| Sales | 2,335 | 25,595.41 | 65,418.32 |
| Number of Employees | 2,332 | 153.5858 | 415.281 |
| Capital Intensity | 2,332 | 56.34414 | 185.8232 |
| Labour Quality | 2,332 | 26.58465 | 26.83318 |
| Nr. Of Foreign Exporters | 2,335 | 4.59743 | 3.448208 |
| Foreign Firms' share in Exports | 2,311 | 0.233603 | 0.279102 |

Note: Sales, capital and labour used in calculation of capital intensity, and average labour cost used to construct the labour quality variable, are all deflated to the 1994 prices.



**Table 3: Export Persistence, Entrants to and Exits from the Export market (Balanced panel)**

| **T** | **t+1** | **94-95** | **95-96** | **96-97** | **97-98** | **98-99** |
|---|---|---|---|---|---|---|
| Non-Exp | Non-Exp | 84.78 | 82.61 | 82.98 | 80.77 | 80 |
| | Export (Entrants) | 3.85 | 6.15 | 5.43 | 4.03 | 6.61 |
| Exporters | Non-Exp (Exits) | 15.22 | 17.39 | 17.02 | 19.23 | 20 |
| | Export | 96.15 | 93.85 | 94.57 | 95.97 | 93.39 |

**Table 4: Export Transitions over Time.**

| Sequences | Freq. | Percentage |
|---|---|---|
| 000000 | 28 | 15.90909 |
| 000001 | 1 | 0.568182 |
| 000010 | 2 | 1.136364 |
| 000100 | 1 | 0.568182 |
| 001000 | 2 | 1.136364 |
| 010000 | 3 | 1.704545 |
| 100000 | 1 | 0.568182 |
| 000011 | 2 | 1.136364 |
| 000110 | 1 | 0.568182 |
| 011000 | 1 | 0.568182 |
| 110000 | 2 | 1.136364 |
| 100001 | 1 | 0.568182 |
| 000111 | 4 | 2.272727 |
| 001101 | 1 | 0.568182 |
| 101100 | 1 | 0.568182 |
| 111000 | 4 | 2.272727 |
| 111010 | 1 | 0.568182 |
| 101011 | 1 | 0.568182 |
| 101101 | 1 | 0.568182 |
| 101110 | 1 | 0.568182 |
| 110101 | 2 | 1.136364 |
| 111001 | 1 | 0.568182 |
| 111100 | 6 | 3.409091 |
| 011111 | 7 | 3.977273 |
| 101111 | 1 | 0.568182 |
| 110111 | 1 | 0.568182 |
| 111101 | 1 | 0.568182 |
| 111110 | 8 | 4.545455 |
| 111111 | 90 | 51.13636 |
| Total | 176 | 100 |

**Table 5: Balanced Panel Random Effects Probit Estimation Accounting for Firm Heterogeneity and Initial Conditions.**

| **Variables** | **Model 1** | **Model 2** | **Model 3** | **Model 4** | **Model 5** |
|---|---|---|---|---|---|
| Exported last year | 2.48* | 1.22* | 1.99* | 1.055** | 1.05** |
| | (12.09) | (2.57) | (7.5) | (2.07) | (2.11) |
| Exported last two years ago | 1.44* | 0.97** | 1.23* | 0.95** | 0.96** |
| | (4.68) | (2.41) | (3.8) | (2.2) | (2.2) |
| Firm Size$_{t-1}$ | 0.32*** | 0.53*** | 0.28 | 0.56*** | 0.55*** |
| | (1.77) | (1.77) | (1.5) | (1.74) | (1.71) |
| Capital Intensity$_{t-1}$ | 0.27*** | 0.43** | 0.30** | 0.44** | 0.438** |
| | (1.91) | (2.24) | (2.08) | (2.16) | (2.13) |
| Labour Quality$_{t-1}$ | -0.25 | -0.24 | -0.35 | -0.36 | -0.35 |
| | (-1.01) | (-0.7) | (-1.35) | (-0.93) | (-0.91) |
| Labour Productivity$_{t-1}$ | -0.026 | -0.0086 | -0.017 | 0.03 | 0.025 |
| | (-0.14) | (-0.03) | (-0.08) | (0.1) | (0.08) |
| Dummy Foreign$_{t-1}$ | 0.82** | 1.11*** | 1.048** | 1.05 | 1.16*** |
| | (2.07) | (1.82) | (2.14) | (1.4) | (1.68) |
| Dummy Manager$_{t-1}$ | 0.57*** | 0.86*** | 0.63*** | 0.95*** | 1.01*** |
| | (1.81) | (1.8) | (1.89) | (1.78) | (1.87) |
| Dummy Employee$_{t-1}$ | 0.77** | 1.14** | 0.92** | 1.25** | 1.29** |
| | (2.19) | (2.14) | (2.41) | (2.11) | (2.18) |
| Dummy Domestic$_{t-1}$ | 0.22 | 0.16 | 0.15 | 0.16 | 0.19 |
| | (0.74) | (0.37) | (0.5) | (0.36) | (0.41) |
| Private Consumption $_{t}$ | -6.97** | -7.15 | -10.34** | -8.81 | -9.01 |
| | (-1.6) | (-1.32) | (-2.17) | (-1.53) | (-1.56) |
| No. of Exporters$_{t-1}$ | | | -0.12* | | |
| | | | (-2.65) | | |
| (No. of Exporters * Dummy Foreign) $_{t-1}$ | | | -0.0058 | | |
| | | | (-0.33) | | |
| No. of Foreign Exporters$_{t-1}$ | | | | -0.023 | |
| | | | | (-0.27) | |
| (No. of Foreign Exporters * Dummy Foreign) $_{t-1}$ | | | | 0.041 | |
| | | | | (0.34) | |
| MNE Spillover$_{t-1}$ | | | | | 0.063 |
| | | | | | (0.12) |
| (MNE Spillover * Dummy Foreign) $_{t-1}$ | | | | | 0.17 |
| | | | | | (0.25) |
| Share of Industry's Exports $_{t-1}$ | | | 17.16 | 27.1*** | 26.7*** |
| | | | (1.4) | (1.67) | (1.65) |
| Initial Condition ( $\eta_0$ ) | | 1.32* | 0.58* | 1.58* | 1.59* |
| | - | (2.6) | (3.74) | (2.62) | (2.66) |
| **Industry Dummies** | Yes | Yes | Yes | Yes | Yes |
| **Time Dummies** | Yes | Yes | Yes | Yes | Yes |
| **Number of Observations** | 704 | 704 | 704 | 704 | 704 |
| $\chi^2$ **-test** | 222.63 | 89.71 | 82.6 | 73.13 | 71.84 |
| (joint significance of coefficients) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |

*Note:* A constant and mean firm level characteristics are included in all estimations.
*, **, *** significant at 1%, 5% and 10%, respectively.
z-statistics in parenthesis

## Table 6: The Marginal Effects.

| **Variables** | All Firms | With Past Export Experience ($y_{i,t-1}=1$) | Without Past Export Experience ($y_{i,t-1}=0$) | With Exporting Experience last two years ago ($\tilde{y}_{i,t-2}=1/\ y_{i,t-1}=0$) | Have Not Exported in the last two years ($\tilde{y}_{i,t-2}=0/\ y_{i,t-1}=0$) |
|---|---|---|---|---|---|
| Firm Size$_{t-1}$ | 0.0162 | 0.00022 | 0.0600 | 0.211 | 0.0316 |
| Capital Intensity$_{t-1}$ | 0.0131 | 0.00018 | 0.0484 | 0.170 | 0.0255 |
| Labour Quality$_{t-1}$ | -0.0075 | -0.00010 | -0.0276 | -0.097 | -0.0146 |
| Labour Productivity$_{t-1}$ | -0.0003 | 0.00000 | -0.0010 | -0.003 | -0.0005 |
| Dummy Foreign$_{t-1}$ | 0.019 | 0.00029 | 0.2441 | 0.384 | 0.168 |
| Dummy Manager$_{t-1}$ | 0.0168 | 0.0002 | 0.144 | 0.3151 | 0.084 |
| Dummy Employee$_{t-1}$ | 0.0176 | 0.00018 | 0.2 | 0.367 | 0.1165 |
| Dummy Domestic$_{t-1}$ | 0.0045 | 0.00006 | 0.0186 | 0.0622 | 0.0099 |
| Private Consumption $_{t}$ | -0.2170 | -0.00295 | -0.8037 | -2.828 | -0.4239 |
| **The Spillover Variables**[8] | | | | | |
| No. of Exporters$_{t-1}$ | -0.0099 | -0.00056 | -0.014 | -0.046 | -0.0088 |
| No. of Exporters * Dummy Foreign | -0.0005 | -0.000028 | -0.00073 | -0.00231 | -0.00044 |
| Share of Industry's Exports $_{t-1}$ | 1.470 | 0.08222 | 2.145 | 6.813 | 1.3035 |
| No. of Foreign Exporters$_{t-1}$ | -0.00031 | -1.37E-06 | -0.0023 | -0.009 | -0.0011 |
| No. of Foreign Exporters * Dummy Foreign | 0.00055 | 2.43E-06 | 0.004 | 0.0159 | 0.00194 |
| Share of Industry's Exports $_{t-1}$ | 0.3624 | 0.00161 | 2.698 | 10.562 | 1.2876 |
| MNE Spillover$_{t-1}$ | 0.00098 | 5.24E-06 | 0.006 | 0.0243 | 0.0029 |
| MNE Spillover$_{t-1}$* Dummy Foreign | 0.0028 | 0.000015 | 0.0171 | 0.068 | 0.00812 |
| Share of Industry's Exports $_{t-1}$ | 0.42 | 0.0022 | 2.61 | 10.41 | 1.2387 |
| **The Predicted probability of Exporting** ($\bar{x}'\beta$) | 0.986 | 0.999 | 0.056 | 0.554 | 0.0245 |

[8] The marginal effects for the spillover variables are estimated from the respective estimated equations of Table 5, Models 3-5.

## Appendix

**Table**: Correlation Matrix of Main Variables (Balanced Panel, N=1056)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.Export market participation | 1 | | | | | | | | | | | | | |
| 2. Private Consumption | 0.05 | 1 | | | | | | | | | | | | |
| 3. Labour Quality | 0.24*** | 0.33*** | 1 | | | | | | | | | | | |
| 4. Labour Productivity | 0.16*** | 0.16*** | 0.509*** | 1 | | | | | | | | | | |
| 5. Capital Intensity | 0.21*** | 0.196*** | 0.481*** | 0.529** | 1 | | | | | | | | | |
| 6. Firm size | 0.29*** | 0.035 | 0.0428 | -0.0069 | 0.182*** | 1 | | | | | | | | |
| 7. Foreign Dummy | 0.22*** | 0.092*** | 0.415*** | 0.473* | 0.368*** | -0.0316 | 1 | | | | | | | |
| 8. Dummy Manager | -0.068** | 0.103*** | -0.13*** | -0.05 | -0.16*** | -0.17*** | -0.23*** | 1 | | | | | | |
| 9. Dummy Employee | -0.12*** | -0.071** | -0.15*** | -0.199* | -0.19*** | -0.08*** | -0.18*** | -0.19*** | 1 | | | | | |
| 10. Dummy Domestic | -0.028 | 0.187*** | -0.034 | -0.081* | 0.0019 | 0.11*** | -0.3*** | -0.32*** | -0.27*** | 1 | | | | |
| 11. Dummy State | -0.024 | -0.31*** | -0.12*** | -0.141* | -0.0053 | 0.21*** | -0.18*** | -0.19*** | -0.16*** | -0.265** | 1 | | | |
| 12. No. of exporters in the industry | 0.082*** | 0.14*** | 0.118*** | 0.271* | 0.11*** | 0.0048 | 0.061 | 0.056** | -0.12*** | 0.0467 | -0.0398 | 1 | | |
| 13. No. of foreign exporters in the industry. | 0.15*** | 0.27*** | 0.257*** | 0.35* | 0.21*** | -0.0135 | 0.298*** | -0.065** | -0.15*** | 0.031 | -0.12*** | 0.5*** | 1 | |
| 14. MNE Spillovers | 0.17*** | 0.129*** | 0.292*** | 0.2* | 0.28*** | 0.0427 | 0.335*** | -0.16*** | -0.11*** | -0.04 | -0.0241 | -0.0045 | 0.499*** | 1 |
| 15. Share of Export Activity | 0.21*** | 0.38*** | 0.154*** | 0.04 | 0.184*** | 0.25*** | 0.097*** | -0.063** | -0.15*** | 0.0005 | 0.128*** | 0.27*** | 0.227*** | 0.25*** |

Notes: ***, **, significant in 1% and 5% respectively.