Factors driving the firms decision to export. Firm-level evidence from Poland.

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6 June 2007

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Abstract

The model by Melitz (2003) predicts that if firms differ in their productivity (TFP) and there exists a fixed costs of entry to export markets, firms begin exporting if productivity exceeds a certain threshold value. Productivity is thus a crucial factor behind firms' export market participation. To verify this, I estimate a simple probit model of the firms decision to export, based on the Polish manufacturing firm-level data. Estimation of productivity of individual firms is troublesome as the standard OLS method produces biased estimates due to the endogeneity of factor choice. I use a multi-stage semi-parametric approach, as proposed by Olley and Pakes (1996) controlling for endogeneity and the bias caused by firms exiting and entering the sample during the period under consideration. Besides determining the significance of the TFP coefficient in the probit regression, I examine the paths of productivity of firms entering the export market and make an attempt to identify the potential learning-by-exporting effects.

Keywords: productivity, exports, firm-level data

JEL classification: F10 F14 D21 L60

Introduction

Empirical literature on international trade seems to gradually drift away from the concept of symmetric firms within an industry. Analysis of firm level data indicates, that there exists not only a great deal of heterogeneity among firm, but there are also significant differences in firm behavior. One of the topics that has recently attracted a lot of attention of both the empirical and theoretical literature is the fact that only a fraction of firms in any given industry decides to exports while the rest is only supplying to domestic market.

Theoretical literature provides the following explanation of this phenomenon. Initiation of exports requires bearing some fixed and sunk costs of entry and the firm has to generate a sufficient level of profits to make sure that it can afford entry into export market. Thus, more effective firms export while the less effective firms are below the required efficiency threshold and decide to stay away from the foreign market. Besides the above mechanism, there is another intuitive channel of interaction between exports and productivity. Firms engaging in contacts with other markets can benefit from experience of foreign firms and use these knowledge in domestic markets. Moreover, firms competing in the foreign market may try harder in terms of quality of their products which in turn also affects home consumers.

This article is an attempt to explain the determinants of export decision of Polish firms in the period 1997-2004. The factors that has been taken into consideration are firm productivity and firm size and other firm characteristics. The regression analysis includes also such sectoral factors as export penetration, industry concentration and the existence of technical barriers to trade. An attempt has been made to verify the causality direction between productivity and exporting.

The article has a following structure. In the first section I review the relevant empirical and theoretical literature related to firm heterogeneity and international trade. Second section presents the theoretical background behind the estimation equation. A detailed description of included variables and data used is contained in section three. Section four follows with the estimation results together with sensitivity analysis and Granger causality

tests.

1 Literature review

Traditional trade theory is based on an assumption of constant returns to scale and perfect competition. Thanks to these assumptions, all conclusions are formulated on the industry level and individual firm behavior is regarded as almost not important as it does not have any impact on the industry situation. This theory cannot explain many issues that characterize modern international trade, such as intra-industry trade. The direction and volume of trade is determined either by comparative advantage (the Ricardian framework) or by relative endowment of factors of production (Heckscher-Ohlin model).

The so called new trade theory associated usually with such names as Krugman or Helpman seems to partially solve the problems. In the Krugman (1980) model, monopolistically competitive firms exports their products thanks to consumers characterized by a love-for-variety utility function (getting a higher utility level thanks to extra varieties imported). The Krugman and Helpman (1985) model extends the analysis by elements of the Heckscher-Ohlin model, allowing for the impact of relative factor endowments on the direction and volume of trade. These models, while clearly being probably the most important contributions to the international trade literature in the second half of the XX century, are based on the representative firm assumption - all firms in an industry are identical and make identical decisions. If one of them decides to export, all others follow.

Inspection of Polish manufacturing firm-level data in the period of 1997-2004 (Table 1) shows that not all firms export. Depending on the criterion used to classify firms as exporters, the percentage of firms that export is between 61 and 76 percent in 2004. Moreover, the fraction of exporting firms is visibly changing in time - in the 1997-1999 period, the fraction of exporting firms was visibly lower than in 2004. It is worth noting that the sample of firms used to prepare table 1 contains only data on large firms that employ over 50 people. Similar

Table 1: Share of exporters in total number of firms

	Share of exporters		
year	$X > 0$	$\frac{X}{PKB} > 0.01$	$\frac{X}{PKB} > 0.025$
1997	71,44%	58,31%	51,80%
1998	70,36%	58,13%	51,95%
1999	69,78%	56,54%	50,10%
2000	71,00%	58,53%	52,37%
2001	72,54%	60,10%	54,04%
2002	70,70%	60,31%	53,82%
2003	72,01%	62,68%	57,56%
2004	76,07%	67,04%	61,30%

First column shows percentage of all firms that had positive exports, columns two and three, percentage of firms where exports to revenue ratios were higher than the given threshold.

calculations for the United States (Bernard, Eaton, Jensen and Kortum 2003) reveals slightly different distribution of firms. In 1992, only 21 percent of American entreprises exported their product and two thirds of them exported less than 10 percent of the value of total sales. Empirical research in other countries also questions the representative firm assumption.

The theoretical literature modeling heterogeneity of firm behavior is probably the fastest growing branch of international trade research currently. The most important contributions so far are without doubt the works by Melitz ((2003), with further extensions) or Bernard et al. (2003). The Melitz model is in its structure slightly similar to the Krugman (1980) model. The demand side is almost identical (consumers are characterized by a CES utility function). The supply side assumes, that every firm's productivity is revealed to her (drawn from an exogenous probability distribution) before the entry, exit or export decisions are made. Entry into export market involves fixed costs. Firm enters export markets if the present value of doing so is exceeding the value of restricting supplies to the home market. Melitz shows that firm will enter the export market when its productivity exceeds a certain threshold value.

There are some important implications of the Melitz model. First, firms, whose pro-

ductivity are above the threshold, export, the other firms supply to the domestic market or exit the industry. Second, trade liberalization induces some firms that did not export before to start exporting. At the same time, with an increase of the factor prices and a shift of resources towards exporting firms, the least exporting firms drop out of the market (the productivity threshold for the firm presence in the domestic market shifts upwards). It means that trade liberalization causes an increase of average productivity.

Bernard, Eaton, Jensen and Kortum (2003) build a model based on firm heterogeneity, that assumes that firms compete in a Bertrand fashion. The model assumes that international differences in costs are stemming from differences in factor prices. Similarly as in Melitz, firms are heterogeneous in terms of their marginal cost - only some of them self-selects to the export market. The model shows that exporting firms generate higher profits, are more productive and are larger than non-exporters. The empirical verification of the model seems to indicate good performance in the model in explaining the trends in American firm-level data.

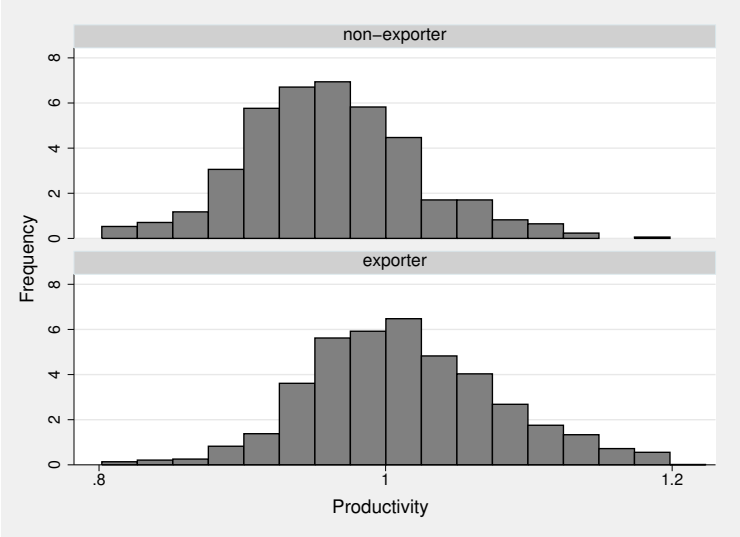

Figure 1: productivity of exporters and non-exporters

The literature cited above postulates the existence of a self-selection mechanism of firms into export market. The high-productivity/low-cost firms decide to start exporting, while the less effective firm supply only to domestic market. Does the reality confirm that? Figure

1 shows the distribution of total factor productivity (TFP) for Polish firms in 2003 [1]. We can see that the distribution of productivity of exporters is clearly shifted to the right relatively to non-exporters. Bernard, Eaton, Jensen oraz Kortum (2003) report 33 percent advantage of exporters over non-exporters in terms of labor productivity. The relatively lower difference between exporters and non-exporters in the case of Polish firms might stem out from the fact that the Polish data contains only large firms, and the export status is correlated both with productivity and size of firms as will be shown later.

Differences in efficiency of firms with connection to export decision were analysed in detail by Bernard and Jensen (1997) using a panel of 50-60 thousand firms. Productivity (measured by TFP, value added per worker etc.) was regressed on firm level and sectoral control variables and the exporting status. In all cases, the result suggest an advantage of exporting firms of 12 to 24 percent relative to non-exporters. Moreover, exporting firms were 50-60 percent larger than others.

Another branch of literature is trying to explain the causal relationship between the productivity level and exports. There exists a common belief that export participation can positively influence productivity - the so-called *learning-by-exporting* effect. At the same time the theoretical literature postulates the self-selection mechanism described earlier. Clerides, Lack and Tybout (1998) estimate the firm export participation equation together with a cost function, where, besides a set of control variables, past export participated is included (the study is one for Morocco, Mexico and Columbia). While the results clearly indicate the self-selection mechanism (from productivity to exporting), learning-by-exporting is present only in selected sectors. Both Bernard and Jensen (1999) and Aw, Chen and Roberts (1997) arrive at similar conclusions. In the case of the former, a study based on American firms data, past export status is significant for survival rates but does not have any impact on traditional productivity measures. The latter study, based on Taiwanese data, learning-by-exporting effects seem to be significant only for selected sectors. Arnold and Hussinger (2005) estimate

[1] The method of calculation of TFP is described in detail in later

the impact of past export status on productivity using German data - productivity Granger causes export but the opposite causality is nonexistent.

Pavcnik (2002) makes an attempt to explain the link between trade liberalisation and productivity, using Chilean data. The results show that both in sectors where export penetration is high and in export oriented sectors trade liberalization causes an increase in productivity. At the same time, Pavcnik shows that firms of highest productivity increase their market shares after trade liberalization. This indicates a reallocation of resources from less effective to more effective firms. Bernard, Jensen and Schott (2003) perform a similar study for the United States and show that the increase in productivity is stronger in sectors, where trade costs decreased faster.

2 Theory and methodology

An empirical model of determinants of export decision of a firm is directly motivated by existing theoretical literature on heterogeneous firms, especially the Melitz model (2003). As was indicated earlier, a firm enters the foreign market when revenues from doing so exceed the fixed cost of entry. Similarly as in Arnold and Hussinger (2005) this condition can be formulated as follows:

$$\text{Export if:} \quad R^e_{i,t} - C^e_{i,t}(Z^e_{i,t}) > 0, \tag{1}$$

where R is revenue, C - production and sales cost Z_{it} - cost determining variables. Subscript e indicates variables related to the export market. When there are fixed (sunk) cost to export, the problem becomes dynamic and can be summarized by the following Bellman equation:

$$V_t = \max_{X_t \in \{0,1\}} \Big(R^e_t - C^e_t(Z^e_t) - S(1 - X_{t-1}) + \delta E(V_{t-1}) \Big), \tag{2}$$

where X_t is an export participation dummy variable (subscripts i were suppressed) for period t, C_t is production cost t, not including the cost of entry to export market S. δ is a discount factor. Equation (2) says that firms make the export decision maximising current and future profits from the presence in the export market.

Export decision is made in the following way. This formulation is taken from Arnold and Hussinger (2005) (see also Roberts and Tybout 1997):

$$X_t = \begin{cases} 1 & \text{if } R_t^e - C_t^e(Z_t^e) + \delta[E_t(V_{t+1}|X_t = 1) - E_t(V_{t+1}|X_t = 0)] > 0 \\ 0 & \text{otherwise} \end{cases} \tag{3}$$

The firm will enter the export market if the profits from export in time t including the future expected value of participating in the export market are positive. E_t stands for expected value at time t.

Vector Z_{it} contains the variables determining the cost of a firms. These might be either sector specific, time specific or firm-specific. Costs can be largely determined by firm-level productivity (TFP). This variable is unobservable for the researcher, however it is observable by the firm.

Lets assume the standard Cobb-Douglas production function:

$$Y_t = A_{i,t} K_{i,t}^{\alpha} L_{i,t}^{\beta} \tag{4}$$

in logs and after adding the error terms:

$$y_{i,t} = a_{i,t} + \alpha k_{i,t} + \beta l_{i,t} + u_{i,t} \tag{5}$$

Variable $a_{i,t}$ can be interpreted as TFP, $u_{i,t}$ are errors not related to TFP.

It seems at first that by estimating (5) using standard OLS, we can obtain TFP as residuals from regression. Assuming that TFP is constant through time, we could also estimate this measure using fixed effects panel regressions (such calculations for Central and

Eastern Europe were performed by: Estrin et al. 2002).

According to Olley and Pakes (1996) and later Levinsohn and Petrin (2003), estimating firm level productivity using OLS on a production function leads to an endogeneity of factor choice problem. Omitting unobservable TFP in the estimation equation leads to omitted variable bias - TFP is correlated with factor choice. Pavcnik (2002) claims that using fixed effects partially solves the problem but leads to an estimator of TFP that is constant in time. Another partial solution is interacting firm-specific dummy variables and a polynomial of t to account for TFP trends.

Olley and Pakes (1996) formulate a model, which allows for consistent estimators of parameters of the production function and thus a consistent estimator of TFP. It assumes that the accumulation of capital is given by the following equation:

$$K_{t+1} = (1 - d)K_t + I_t, \tag{6}$$

where d is capital depreciation. It means that investment at time t does not influence capital in the same period. Olley and Pakes assume that productivity observed by firms a_t has an impact on investment in the same period: the higher the productivity, the higher the investment. However, the functional form of the relationship is unknown:

$$i_t = i(a_t, k_t), \tag{7}$$

its inverse is of the form:

$$a_t = h(i_t, k_t). \tag{8}$$

We can then write (5) in the following way (Arnold, 2005):

$$y_t = h(i_t, k_t) + \alpha k_t + \beta l_t + u_t \tag{9}$$

or:

$$y_t = \beta l_t + \phi(i_t, k_t) + u_t \tag{10}$$

The above equation can be estimated by nonparametric methods or by a polynomial approximation of the unknown function $\phi = \alpha k_t + h(i_t, k_t)$. This gives a consistent estimator of β.

Firm makes its investment decision based on productivity in time t and future profitability. Given that capital at time t_1 is a function of investment in period t, capital and productivity are correlated. Expectations concerning productivity in the next period are a function of productivity in period t: $E(a_{t+1}|a_t, k_t) = a_{t+1} - \psi_{t+1}$ (where ψ is an error). We can then write (Pavcnik, 2002):

$$E(a_t|a_{t-1}, k_{t-1}) = g(a_{t-1}) = g(h(i_{t-1}, k_{t-1})) = g(\phi(i_{t-1}, k_{t-1}) - \beta k_{t-1}), \tag{11}$$

where g is an unknown function of ϕ and k_{t-1} Substituting the above at t into(5) instead of a_t and reformulating we get:

$$\begin{aligned} y_t - \beta k_{t-1} &= \beta k_t + E(a_t|a_{t-1}, k_{t-1}) + \psi_t + u_t \\ &= \beta k_t + g(\phi(i_{t-1}, k_{t-1}) - \beta k_{t-1}) + \psi_t + u_t \end{aligned} \tag{12}$$

The above equation can be estimated by non-linear method of g through a polynomial expansion of a function of h and k_{t-1}. Obtained β_k together with β_l can be then used to calculate TFP.

2.1 Data and estimation details

I estimate here a probit model of firms' export decision. The calculations were performed on Polish firm-level data in manufacturing industry, collected by Polish Central Statistical

Office (GUS) using F-01/F-02 forms during 1996-2004. Separate estimations were performed for different thresholds of the share of exports in total firm revenue, to eliminate firms that export only a tiny share of their sales. Three different export decision dummy variables were created: for firms whose exports were greater than zero and for firms whose exports exceed 1 and 2.5 percent of revenue.

The explanatory variables in the model are the following:

- productivity (TFP[t-1]) - this variable is estimated using the Olley and Pakes method. All data on capital, investment, employment and value added are taken from GUS data. The proxy for capital is the value of fixed assets. To account for industry technology heterogeneity, TFP estimations were performed separately for each of the 2-digit NACE sectors (greater disaggregation was not possible due to insufficient number of observations in some sectors. The correction for firms entry and exit was performed using a probit survival equation. Equation (12) takes the form:

$$y_t - \beta k_{t-1} = \beta k_t + g(\phi(i_{t-1}, k_{t-1}) - \beta k_{t-1}, P_t) + \psi_t + u_t, \tag{13}$$

  , where $P_t = p(i_{t-1}, k_{t-1})$ the probability of survival until time t is a function of past investment and capital (see Pavcnik 2002). This equation is estimated using NLS and a third degree polynomial expansion of the unknown function g.

- exporter[t-1] - lagged export status. This variable measures the importance of the fixed entry cost of export participation. If the obtained estimator is positive and significant, the presence of a firm in a export market is stable. Otherwise, the costs of entry are significant or does not have to be incurred in subsequent entries if the initial entry was made (see Roberts and Tybout 1997).

- firm size - this is measured by the log of employment. Larger firms exploit economies of scale to a larger extend and can be more effective. Moreover, given the size of overall costs of the large firms, the entry cost can be relatively less important.

- foreign ownership - a dummy variable indicating majority of foreign ownership of a firm. Foreign firms tend to function as subsidiaries of multinationals and their participation in export markets reflects the nature of their activity as part of the multinational structure.

- state owned - a dummy variable indicating majority of state ownership of a firm. On one hand, SOE are usually regarded as less economically effective, because they tend to have goals other than pure profit maximization. According to the theory above, these enterprises should on average less frequently participate in international trade. On the other hand, in the case of transforming economies, such as Poland, SOE have been present in the market longer that private firms and the costs of export participation may have been incurred relatively earlier and do not play a significant role (and the costs may have been also easier to bear due to the old system's „soft budget constraint".

- large - a dummy variable corresponding to enterprises employing more than 500 employees.

The following sectoral variables were also included.

- industry concentration - Herfindahl index calculated using firm-level revenues data in each 3-digit NACE industry. Firms operating in highly concentrated sectors tend to generate higher profits and it might be easier to them to bear the costs of export participation. Moreover, having large market shares in the domestic market may allow them to cross-subsidize their sales in the foreign market to secure better position there. On the other hand, intensive competition and low concentration may push firms to seek new opportunities abroad.

- import penetration - a ratio of imports to total sales in the domestic market, calculated using OECD (ITCS database) international trade data for 1996-2004 and sales data from F-01 forms. An increase in import penetration leads to shrinking profits and pushes out firms into the foreign market or induces them to exit the domestic market.

- technical barriers to trade (TBT) - a dummy variable. Since all traditional trade policy instruments in nonagricultural trade were largely removed in the process of integration with the EU, what is left are institutional barriers to trade. EU Single Market Program is targeting technical barriers to trade as most important source of remaining costs of trade. Presence of the EU policy in a particular sector indicates importance of TBT's. Data on the EU policy coverage in the NACE 3-digit classification is taken from EC (1998).

Unobserved time and sectoral effects are modeled through relevant dummy variables.

3 Results

3.1 Estimation results

Table 2 shows the results of profit estimations. These results have been obtained for firms where exports exceed 1 percent of revenues. Estimations were made for all enterprises, private companies and only domestic companies. Results are more or less in line for all three groups.

Past export status is significant for all groups of firms under consideration. This indicates the existence of a mechanism described by Roberts and Tybout (1997). After entry to an export market, firms presence is stable due to high entry and re-entry costs.

Table 3 shows the calculated marginal effects for average values of variables. For discrete variables, the table shows effects of change from 0 to 1. The results suggest that the probability of export in period t goes up by 77 percent if a firm was exporting at $t-1$. Past export status is thus a dominant factor driving the current export status.

TFP is significant at 1 percent level in all cases under consideration. This indicates that the self-selection to export market is present, which is in line with theoretical literature. This effect is stronger in the group of domestic enterprises than in the overall sample, which probably stems from the weaker sensitivity of export status of foreign firms due to the nature

Table 2: Probit estimation results

Variable	all firms	private	domestic
Exporter (t-1)	2.453	2.443	2.442
	(107.45)***	(99.39)***	(101.33)***
TFP (t-1)	1.021	1.067	1.242
	(3.91)***	(3.81)***	(4.30)***
Size	0.108	0.097	0.113
(log[employment])	(4.23)***	(3.53)***	(4.11)***
State owned	0.087		0.077
	(2.52)**		(2.25)**
Large	0.079	0.100	0.046
	(1.58)	(1.80)*	(0.85)
Foreign	0.478	0.486	
	(13.68)***	(13.81)***	
Concentration	0.057	0.036	0.093
	(2.22)**	(1.27)	(3.26)***
Import penetration	0.184	0.188	0.133
	(2.31)**	(2.18)**	(1.59)
TBT	-0.218	-0.264	-0.154
	(4.02)***	(4.44)***	(2.67)***
Constant	-2.465	-3.044	-2.931
	(11.13)***	(7.35)***	(12.28)***
N of observations	28365	24626	23449
Dummies:			
Years	YES	YES	YES
Sectors	YES	YES	YES

Estimation results, z statistics in parentheses
* significant at 10%; ** 5%; *** 1% level

Table 3: Marginal effects

Variable	Marginal effect	X value
State owned	0,030	change 0 -> 1
Large	0,027	change 0 -> 1
Foreign	0,154	change 0 -> 1
Exporter (T-1)	0,768	0,603
TFP (T-1)	0,362	1,009
Size	0,038	5,200
Concentration	0,020	0,507
Import penetration	0,065	0,286
TBT	-0,068	change 0 -> 1
year 1998	-0,077	change 0 -> 1
year 1999	-0,093	change 0 -> 1
year 2000	-0,034	change 0 -> 1
year 2001	-0,028	change 0 -> 1
year 2002	-0,048	change 0 -> 1
year 2003	0,000	change 0 -> 1
year 2004	0,071	change 0 -> 1

of their activity (dependent on exports and imports within the multinational structure). An increase of TFP by 10 percent relative to average causes the probability of export to rise by 4 percent.

Size is significant in explaining export status of firms. An increase in the number of employees from the average of 181 to 281 increases the probability of export by 2 percent. Variable „large" has no significant impact on the export decision.

Both variables „state owned" and „foreign" are important in explaining the current export status. As I mentioned before, state owned enterprises can have better position in foreign markets due to their relatively longer history than private domestic companies. This may also be a side effect of 1970s era of Gierek's industrialization where public companies were expanding rapidly enjoying soft budget constraints and foreign loans abundant at this time. Foreign companies are involved in international exchange almost by definition. Marginal effect of state ownership is 3 percent and by this factor the SOEs have a higher than average probability of export. At the same time, the foreign firms export with probability greater by 15 percentage points than their domestic competitiors.

Market concentration is significant in explaining export status for all groups of companies. The larger the concentration, the higher is the probability of exporting. However, the marginal effect is rather low - a change of the Herfindahl index by 0,1 makes the export decision only 0,2 percent more likely. It is possible that the size of the coefficient is a result of existence of two competing effects - pro-export effect of monopolisation and the pro-export effect of competition. Import penetration is significant, however, as in the case of market concentration, its effect on the probability of export is not very spectacular - an increase in penetration by 0,1 causes the probability of export to raise by 0,65 percentage points.

It seems that technical barriers to trade are important in explaining the export decision of firms. Presence of any of the EU approaches to technical barriers to trade (mutual recognition, harmonization or new approach - essential requirements) decreases the probability of exporting by 7 percent. This value seems rather large compared to explanatory power of other variables. However, it seems (or at least we could hope for it) that it is not the EU policy that is actually causing barriers to trade but in sectors where these measures are present, the overall level of TBT is high. The expected value of the coefficient is even lower (higher in absolute value) if these measures were not in place.

Marginal effects calculated for subsequent years shows a gradual increase of the share of exporters in the total number of firms. The probability of exporting between 1999 and 2003 increases by 8 percent. Very important increase of the number of exporters occurred between 2003 and 2004. The probability increases by another 7 percent in this time. This can be caused both by the gradual dampening of recession in 2004 and the Polish accession to the EU that, in a „step" fashion" facilitates entry to EU markets.

3.2 Productivity and decision to export - sensitivity analysis

Subsequently, I analyze the sensitivity of estimates to the choice of export threshold and productivity measure. Table 4 shows the estimation results with different export to total revenue ratio thresholds (0 percent, 1 percent and 2.5 percent) and with alternative notions

Table 4: Sensitivity analysis

	TFP w/selection	TFP w/selection	TFP w/selection	Labor productivity	TFP w/o selection	TFP w/o selection
Export threshold	1 percent	0 percent	2,5 percent	1 percent	1 percent	1 percent
Exporter (t-1)	2.453	2.107	2.530	2.451	2.452	2.454
	(107.45)***	(91.24)***	(110.96)***	(107.31)***	(108.00)***	(108.08)***
TFP (t-1)	1.021	2.132	0.667	0.077	1.002	0.066
	(3.91)***	(8.21)***	(2.59)***	(4.71)***	(3.89)***	(3.35)***
Size	0.108	0.130	0.117	0.173	0.178	0.118
(log[employment])	(4.23)***	(5.21)***	(4.70)***	(8.97)***	(9.30)***	(4.64)***
State owned	0.087	0.123	0.051	0.085	0.089	0.089
	(2.52)**	(3.65)***	(1.48)	(2.47)**	(2.59)***	(2.60)***
large	0.079	0.123	0.057	0.076	0.081	0.083
	(1.58)	(2.13)**	(1.17)	(1.52)	(1.64)	(1.67)*
foreign	0.478	0.567	0.477	0.460	0.467	0.476
	(13.68)***	(14.93)***	(14.19)***	(13.08)***	(13.51)***	(13.71)***
concentration	0.057	0.120	0.035	0.050	0.055	0.052
	(2.22)**	(4.08)***	(1.47)	(1.96)*	(2.14)**	(2.04)**
import penetration	0.184	0.159	0.174	0.214	0.186	0.186
	(2.31)**	(1.98)**	(2.29)**	(2.67)***	(2.34)**	(2.34)**
TBT	-0.218	-0.281	-0.177	-0.220	-0.201	-0.204
	(4.02)***	(4.98)***	(3.40)***	(4.04)***	(3.68)***	(3.72)***
Constant	-2.465	-3.545	-2.901	-2.119	-2.402	-1.820
	(11.13)***	(16.20)***	(9.35)***	(11.75)***	(9.73)***	(10.98)***
N of observation	28365	28365	28365	28365	28640	28640
Dummy variables:						
Years	YES	YES	YES	YES	YES	YES
Sectors	YES	YES	YES	YES	YES	YES

Estimation results, z statistics in parentheses.
* Significant at 10%; ** 5%; *** 1%

of productivity: labor productivity (ratio of employment to value added), TFP without correction for firms' entry and exit, and absolute TFP (all previous calculations were performed using TFP relative to average in a given time period and sector).

Results indicate some extent of sensitivity of the TFP variable coefficient estimates to the choice of export threshold. When we treats all firms had positive revenues from exports as exporters, the estimated coefficient is almost twice as large as the one in the case of a 1 percent threshold and as three times as large as in the case of the 2,5 percent threshold. That indicates higher level of productivity among exporter firms than non-exporters, irrespective of the threshold. In all three cases estimated coefficient is significant and positive.

The significance of „state owned" and „large" variables changes with different export thresholds. State owned enterprises are, on average, characterized by a lower share of exports in total revenues than private firms. On the other hand, large enterprises have higher share of exports in total revenues than remaining enterprises.

Use of labor productivity instead of TFP as explanatory variable does not alter the main conclusion so far. The estimate is significant and positive. Obviously, the size of the estimator is different than in the case of „relative TFP" due to different construction and variation of this variable. Similar conclusion may be drawn for the „absolute TFP" - it is

Table 5: Learning by exporting

Explained variable	**Exporter**	
Export threshold	0 percent	1 percent
H0: B[TFP(t-1)] = B[TFP(t-2)] = 0	4.98***	5.51***
Explained variable	**TFP**	
Export threshold	0 percent	1 percent
H0: Exporter(t-1) = Exporter(t-2) = 0	1.40	0.21

F test statistics, ***reject H0 at 1 percent level

The table shows test statistics for joint significance of lagged „exporter" and „TFP" variables in explaining their current values.

significant and positive but cannot be compared to relative TFP. We have to bear in mind that the variation of „absolute TFP" is different depending on a sector (there was a separate production function estimated for each sector) and the conclusions drawn may stem from the cross-sectoral variation and not necessarily from firm heterogeneity. Using of the entry and exit correction in the relative TFP estimation does not lead to large changes in estimates.

The above results lead to a question: is firm behavior only a self-selection into export market, based on their current productivity? Or maybe the model is incorrectly specified and the causality is different: exporting leads to higher productivity.

Similarly as in (Arnold and Hussinger 2005), I seek for answers to that question using the Granger causality concept. I use a simple VAR model, where the explained variable is productivity (or export status) and on the right hand-side we have the lagged values of productivity and export dummy. The maximum lag is 2 periods, due to a rather small number of periods in the sample. The model is estimated using fixed effects to eliminate the risk of omitted variable bias.

Tests for significance of lagged export status in explaining the current values of TFP and significance of lagged TFP in explaining the current export status were carried out. Table 5 shows test statistics for the null hypothesis of no effect of these variables on the endogenous variable. The results suggest that there exist a clear causal direction from TFP to export decision (we reject H_0 at 1 percent level). At the same time we cannot reject the hypothesis of no learning by exporting even at 10 percent level.

Figure 2: Changes in productivity when entering the export market

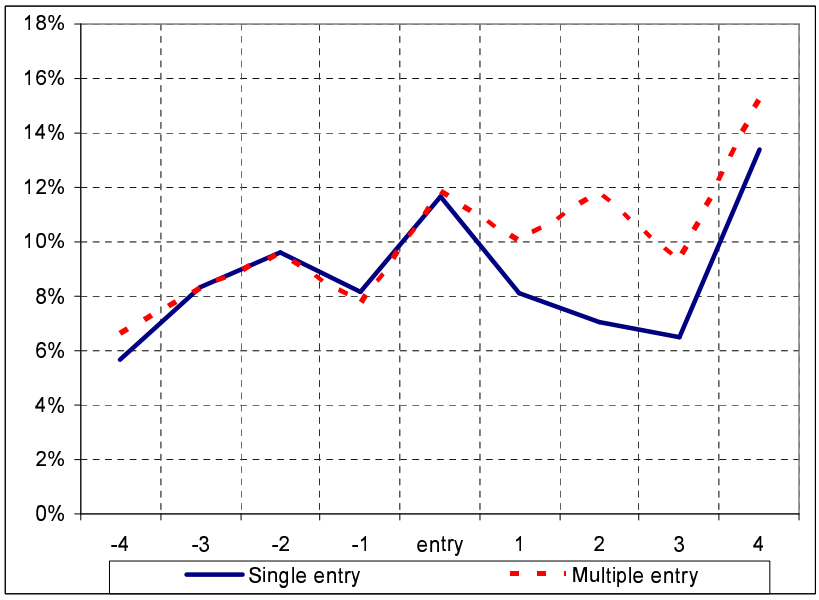

Figure shows the deviation of productivity of firms entering export markets (in percent of standard deviation). This effect is purged of year and sectoral effects.

Figure 3: Changes in export after entry

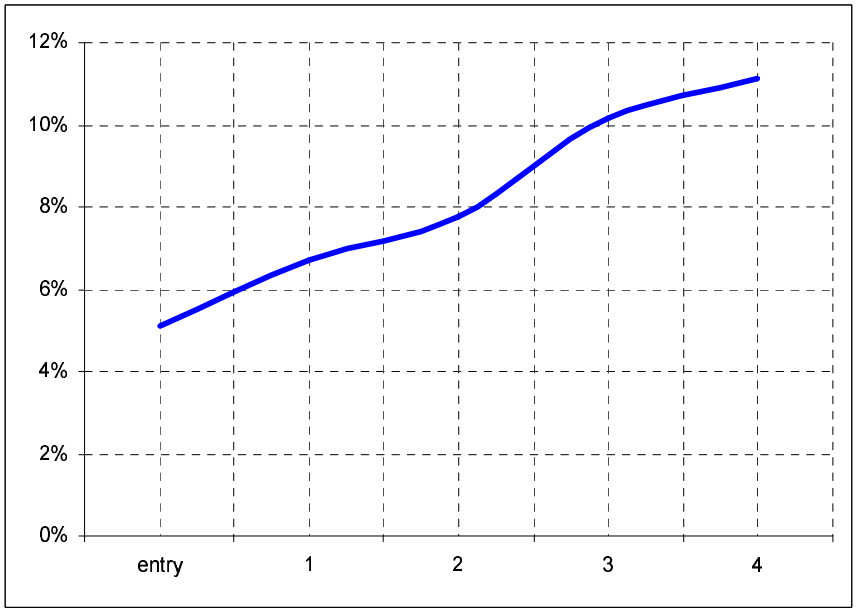

Figure shows the share of exports in total revenues after entry to the export market, purged of year and sectoral effects.

Is there really only a self-selection mechanism and firms do not improve productivity thanks to interaction with new markets, restructuring forced by foreign competition or by knowledge spillovers abroad? I seek answers to that question by examining the paths of productivity of firms entering the export market.

Figure 2 shows changes in productivity of firms in the period of four years proceeding export initiation and four subsequent years. This calculations were separately performed for firms who start exporting only once and for firms who start and stop exporting. Export threshold was chosen at 0 percent to eliminate firms whose export revenue oscillate around a chosen threshold

We can see, that in the periods following entry (in the case of single-entry firms), the local maximum of productivity (significantly greater than the average of non-exporting firms and than in the period $t-4$) occurs at the time of entry. In the subsequent periods we observe a short drop in productivity and in period $t+4$ we see an increase in productivity that leads to a level higher than in any of the nine periods under consideration. In the case of firms with multiple entries, the post-entry drop in productivity is lower.

The path in the export share of revenues (for „single-entry" firms) is shown on figure 3. We can see, that since the first year of exporting, the share of exports increases from 5 up to 11 percent in four years after export initiation. The average (among all exporting firms) export revenue share is 26 percent. Also, the productivity of firms that are present in the export market during all periods have a significantly higher productivity level than firms that start exporting during the period under study. It seems reasonable to think that the learning by exporting effects are more of long run type and start to appear after exports gain a significant share of total revenues. It may be the case that identification of these effects with a 8-year sample is not possible.

Conclusions

This paper uses the Polish firm-level data to evaluate the determinants of export decisions. The results obtained indicate an important role of productivity in decision making. This conclusion is irrespective of the notion of productivity used. What stems out from this analysis is the existence of a self-selection into export markets - more productive firms export with greater productivity than less effective firms. At the same time, the importance of lagged export status in determining the current export status indicates existence of high fixed entry cost into export markets. It is also in line with the intuition - to start exporting it necessary to establish contacts in the destination country, establish a retail network, support and service centers etc.

Estimation results also show a surprising fact that state owned enterprises tend to export more frequently than private firms. This may result from their, on average, longer history and better experience. At the same time, foreign firms export with greater probability than domestic firms.

Tests that were carried out, seem to reject the hypothesis of learning by exporting in favor of the self selection mechanism. Current productivity is not affected by lagged export status in a Granger sense but current export status is indeed affected by productivity. At the same time, the paths of productivity of exporting firms reveal a significant increase of productivity four years after entry into export markets. This may be an indication of existence of two paths of causation: short term (from productivity to export) and long term (from export to productivity). Formal verification of this hypothesis needs longer samples and is clearly a field for future investigation.

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