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Performance of exporters: continuous productivity improvements or capacity utilization*

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Abstract

Following along the lines of a growing literature on the causal link between exporting and productivity this paper analyzes the existence of "learning-by-exporting" using firm-level data. The paper asks whether, in addition to better performing firms self-selecting into exports and multinational production, exporting (multinational production) further improves their performance compared with non-exporters. We develop and test a simple model of trade and international production with heterogeneous firms that generates learning effects through competition in the export markets. The estimations performed on the sample of Slovenian manufacturing enterprises between 1994 and 2002 indicate that more productive firms tend to self-select into more competitive markets, while there is no conclusive evidence of learning-by-exporting. Although new exporters experienced a surge in productivity in the initial year of exports the effect dissipates as soon as the following year. Confronting the data on factor accumulation with TFP measures indicates that the perceived learning effects may in fact only be a consequence of increased capacity utilization brought forth by the opening of an additional market.

JEL Classification: D24, F12, F14
Keywords: Firm heterogeneity, exports, learning-by-exporting, difference-in-differences, matching

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1 Introduction

In recent years we are witnessing a substantial increase in the availability (and quality) of firm and plant level data on a broad selection of variables, which has enabled a shift in the focus of trade analysis from countries and industries to individual firms. Along with the introduction of a variety of microeconometric tools, the increased access afforded to researchers on a growing number of large scale firm level data set has driven an expansion in primarily empirical literature on the causal linkages between firm characteristics and their involvement in foreign markets. This has resulted in new insights into the forces which determine the decision to participate in exports and/or multinational production, the extent of commitment to foreign markets, the choice of location for footloose firms, productivity improvements through foreign market participation and so on. Although the literature was initially empirically led, recent theoretical developments have served to expand the framework for further research.

The prevailing question in this strain of literature seems to be whether firms self-select into exporting or multinational production (and what characteristics determine this selection) as well as whether exporting (and/or multinational production) serves to ensure ongoing productivity benefits compared with firms producing solely for the local/national markets. This paper contributes to that literature. Its focus is the exporting behavior of Slovenian manufacturing firms. Some of the questions asked in this paper are similar to those asked in the context of research on exporting in other countries and will serve to reconcile the properties of Slovenian exporters with the relevant anecdotal and empirical evidence from other countries. Other questions are new and serve to refocus the analysis on the effects the exporting markets may have on the characteristics of exporting and multinational firms. Most crucially, the paper attempts to answer the question whether foreign market competition can have a beneficial effect on firm productivity growth.

Previous research has found convincing evidence of self-selection into exporting and multinational production by Slovene manufacturing enterprises (Damijan et al., 2005; Kostevc, 2005). This confirms that at least some part of the pronounced productivity differences between non-exporters, exporters and multinational enterprises can be attributed to the fact that productive enterprises self-select into exports and multinational production. In this paper we explore the other possible cause of productivity differences between domestic firms and those involved in the foreign markets by constructing a simple model of learning-by-exporting and testing its implications on the sample of Slovene manufacturing firms.

It is revealed that evidence on the existence of learning-by-exporting and the effects of foreign market competition is far less conclusive than was the case with self-selection. Whereby the initial conditions in foreign markets seem to have some effect on productivity growth, the matching and difference-in-differences techniques reveal significantly higher productivity growth only in the initial period of exporting, but the effect diminishes in subsequent years. As it turns out, the more credible explanation for this occurrence may be simple utilization of excess capacity caused by the sudden availability of a larger product market.

The rest of the paper is organized as follows. In section 2 a short literature survey is presented, while section 3 describes the model of learning-by-doing. Section 4 contains a description of the database, the methodology and the empirical approach used in the estimation are discussed in section 5. The results and their implications are discussed in section 6, while section 7 concludes.

2 Literature review

The literature on the causality between firm characteristics and exporting status can quite clearly be divided into two groups. On one hand, there is extensive evidence on the self-selection hypothesis that more productive firms self-select into exporting, while less productive firms remain confined to their domestic markets (the alternative with multinational firms proposes that only most productive firms select into foreign based production), on the other hand, evidence on the learning-by-exporting has proven harder to come by.
In the former group, Bernard and Jensen's (1995) work represents one of the earliest pioneering attempts at reconciling populist rhetoric about exports (and exporters) with actual empirical facts. Using census data on U.S. manufacturing firms from 1976 to 1987 they find that, on average, exporting plants were more productive, larger, paid higher wages, were more capital intensive in production, and invested more per employee compared with non-exporting firms. The authors go on to focus on the observed wage differences between exporting firms and firms servicing only their domestic markets, whereby they discover that, after controlling for plant size, capital intensity, and hours per worker, exporting firms still paid both higher wages and higher benefits. The bulk of the wage differentials between exporters and non-exporters though were due to differences in plant characteristics, location and industry. Despite proving substantial advantages exporting firms posses over non-exporters, those advantages do not seem to translate to long-run success as exporting was not determined to be a significant indicator for future success. The self-selection hypothesis is also confirmed by Aw and Hwang (1995) on Taiwanese data, Clerides, Lach and Tybout (1996) on data for Colombia, Morocco and Mexico, Bernard and Jensen (1997, 1999) on U.S. data, Tybout and Roberts (1997) on a sample of Colombian enterprises and Bernard and Wagner (1998) on German data, Girma et al. (2003) on UK firms and Damijan et al. (2004) on Slovenian data[1]. Helpman et al. (2003) and Head and Ries (2003) provide theoretical backing for the proposed productivity ordering (and its possible reversal). In contrast to the seemingly abundant evidence on self-selection, none of the aforementioned analyses finds conclusive evidence of learning-by-exporting.
Some evidence on learning-by-exporting is found by Greenaway and Kneller (2004) on a large sample of UK manufacturing firms, but the learning effects are found to be significant in only the initial couple of periods after entry and are by no means persistent. In an interesting twist, Van Biesbroeck(2003) and Blalock and Gertler (2004) find evidence that exporter productivity benefits from their engagement in the export markets for less developed countries (sub-Saharan Africa and Indonesia, respectively). Based on the evidence, Blalock and Gertler explain the presence of learning effects by suggesting that the scope for learning through exports is far greater for firms from less developed countries (through trade with developed countries) than firms from developed countries.

3 The model

In order to gain the necessary insight into the proposition that intense foreign market competition may induce productivity improvements in exporting (multinational) firms engaged in those markets, we present a general equilibrium model of trade and foreign based production which can serve to generate the above results. The basic premise of the modelling exercises is fairly straightforward. We namely propose that the increased level of

[1] Greenaway et al. (2003) do not find evidence of either self-selection nor learning-by-exporting in the sample of Swedish firms, which they attribute to the very high export participation rates.

competition an exporter faces in foreign markets negatively effects his price-cost mark up (and ultimately his profit margin) through its effect on demand elasticity for his product. Exporters from less developed countries (where home market competition is less intense) therefore face far more elastic demand for their products in the export markets than they would at home, which, depending on the level of foreign market competition, leaves them with two alternatives: improve their productivity or exit the market. The framework of the model will rely heavily on the tried and tested monopolistic competition general equilibrium modelling of trade (see for instance Fujita et al. 1999).
The fact that increases in the number of supplied varieties of differentiated goods increase the elasticity of substitution between those varieties has been often implied (compare Dixit-Stiglitz, 1977, Lawrence-Spiller, 1983, Rumbaugh, 1991, Montagna, 1998) but rarely applied in models of monopolistic competition. With an increasing number of varieties becoming available to consumers, they become less likely to be able to differentiate between the products on offer. Crowding of the product space therefore increases the elasticity of substitution between the existing varieties. This, in turn, impacts both the aggregate demand for differentiated products as well as the individual firm demand functions through increases in the elasticity of demand. Most commonly in the Dixit-Stiglitz type monopolistic competition models, the so called Chamberlinian assumption or the "large number of firms" proposition is implemented. This ensures that any one firm does not affect other market participants by its actions and subsequently that the elasticity of substitution and demand elasticity are of the same size in absolute value

$$\varepsilon = -\sigma \qquad \text{where} \qquad 1 < \sigma < \infty \tag{1}$$

where ε and σ are the demand elasticity and elasticity of substitution, respectively.[2] Increased market competition can, hence, be seen to decrease the slopes of individual firm demand curves (as well as the slope of the aggregate demand curve) and lower the price-cost mark-up of those firms. As market competition intensifies firms struggle to reach their previously achieved profit levels as their mark-up decreases. Firms may respond to such market conditions by lowering their marginal costs (increasing their productivity) in order to sustain their previous profit levels or just break even. Our aim in this section is to present a simple two-country general equilibrium model that illustrates the effects that crowded product markets may have on firm profits and subsequently firm productivity.

3.1 Consumption

The utility function of the representative consumer is assumed to be Cobb-Douglas, where the differentiated good (X_c) is represented by a CES composite index of all available varieties

$$U = X_c^{\beta} Y_c^{1-\beta}, \qquad X_c = \left[\sum_{i=1}^{N} X_i^{\alpha} \right]^{\frac{1}{\alpha}} \tag{2}$$

[2]When the "large numbers" assumption cannot be used Yang and Heijdra (1993) propose an alternative definition of the demand elasticity

$$\varepsilon = -\sigma + \frac{\sigma - 1}{N}$$

where N is the number of differentiated good varieties on offer.

where Y_c and X_c are the consumptions of the homogeneous and differentiated goods, respectively, β is the marginal propensity to consume differentiated goods, while α $(0 < \alpha < 1)$ represents the intensity of the preference for variety.[3] Using the standard two-stage budgeting process, in which the consumer allocates her total income (M) between Y_c and X_c in the first stage and determines the consumption of individual differentiated varieties in the second stage, we can determine the demand for individual varieties [4]

$$X_{ii}^{do} = p_i^{-\sigma} g_i^{\sigma-1} M_{ix} \qquad X_{ji}^{ex} = p_j^{-\sigma} t^{1-\sigma} g_i^{\sigma-1} M_{ix} \tag{3}$$

where X_{ii}^{do} is the home country demand for domestic varieties, X_{ji}^{ex} is the home country demand for foreign country varieties, t is iceberg transport cost and M_x is the amount of income spent on differentiated goods $(M_x = \beta M)$ (from henceforth the asterisk denotes the foreign country variables). The price index for country i (g_i) is defined as

$$g_i = \left[\int_{i=1}^{N_{do}} p_i^{1-\sigma} di + \int_{j=1}^{N_{ex}^*} \left(p_j^* t\right)^{1-\sigma} dj \right]^{\frac{1}{1-\sigma}} \tag{4}$$

where N_{do} and N_{ex}^* are the number of home-country domestic firms and the number of foreign-country exporting firms, respectively, while p and p^* are home and foreign prices.

3.2 Production

We assume that firm production occurs under increasing returns to scale. Labor is the only factor of production. Firms are assumed to be heterogenous in terms of the marginal cost (and hence in their productivity). The technology of producing X_i units of variety i in terms of labor (l) for domestic producers is given by

$$l_i = f + c_i X_i \tag{5}$$

where f is fixed cost common to all firms and independent of productivity, while c_i is firm-specific marginal cost. We follow Melitz (2003) in assuming that an initial marginal cost is assigned to firms by a lottery.[5]
Profit maximization gives the standard result that in equilibrium a firm sets prices at a mark-up over the marginal cost

$$p_i = w c_i \left[\frac{\varepsilon}{\varepsilon + 1} \right] \tag{6}$$

where w is the wage rate.[6] (6) postulates that the size of the mark-up depends on the elasticity of demand ε (and in turn elasticity of substitution σ between varieties).
Using the pricing equation (6) the price index can be rewritten as

[3] where the elasticity of substitution (σ) is defined as $\sigma = 1/(1-\alpha)$

[4] For details see Fujita et al. (1999) or Markusen (2002).

[5] Upon market entry a lottery matches firms to marginal cost in a distribution. Having realized their productivity, some firms whose marginal costs exceed the cut-off level imposed by the zero-profit condition, exit the market.

[6] In order to simplify matters the wage rate will be set as a numeraire.

$$g_i = \left(\frac{\varepsilon}{\varepsilon+1}\right)\left[\int_{c_{\min}}^{c_{do}} c_i^{1+\varepsilon} di + \int_{c^*_{\min}}^{c^*_{ex}} \left(c^*_j t\right)^{1+\varepsilon} dj\right]^{\frac{1}{1+\varepsilon}} \tag{7}$$

where $c_{\min}$ and $c^*_{\min}$ are minimum marginal cost (marginal cost of the most productive firms) for home and foreign country firms. c_{do} is marginal cost of the marginal domestic producer in the home country, which represents break-even marginal cost of a domestic firm, while c^*_{ex} is break-even marginal cost of a foreign exporting firm. The one-period profit function (including the fixed cost of production) assumes the following form

$$\Pi_i = (p_i - c_i) X_i - f \tag{8}$$

Using the pricing equation (6) and firm demand (3) in a per period profit function yields

$$\Pi_i = (c_i)^{1+\varepsilon}\left(\frac{1}{-\varepsilon-1}\right)\left(\frac{\varepsilon}{\varepsilon+1}\right)^{\varepsilon}\left(\frac{t}{g^*}\right)^{1+\varepsilon}\beta M - f \tag{9}$$

the break-even marginal cost of a home-country exporting firm is therefore

$$c_i = \left[\frac{f(-\varepsilon)}{\beta M t^{1+\varepsilon}}\left(\int_{c^*_{\min}}^{c^*_{do}} (c^*_n)^{1+\varepsilon} dn + \int_{c_{\min}}^{c_{ex}} (c_m t)^{1+\varepsilon} dm\right)\right]^{\frac{1}{1+\varepsilon}} \tag{10}$$

Increases in the number of firms are assumed not to cause changes in either the fixed cost (f), the income spent on differentiated goods (M) or transport cost (t). The first term (fraction) in the brackets is clearly increasing in ε, while the second term is increasing in the number of available varieties, but decreasing in ε. As the exponent is negative, all increases (of ε and the number of varieties) in the bracketed term will serve to decrease the break-even marginal cost, while, on the other hand, larger demand elasticity will also decrease the exponent lessening the primary negative impact.
Increases in the level of foreign market competition impact the break-even marginal costs of exporters in two directions as the direct effect of a larger number of competing firms is reflected in growth of the first integral in the round brackets while, indirectly, the competition effect also filters through the demand elasticity (ε). The effect of growth in ε, unlike the aforementioned direct effect of growth in the number of firms (varieties) in the foreign market, cannot be unambiguously determined without assuming a functional form of the relationship between the elasticity and the number of products (firms). To maintain the generality of the disposition, we do not propose any single functional relationship (and attempt to argue its merits), but rather analyze the impact of several different functional relationships between demand elasticity and the number of firms on the break even marginal costs.

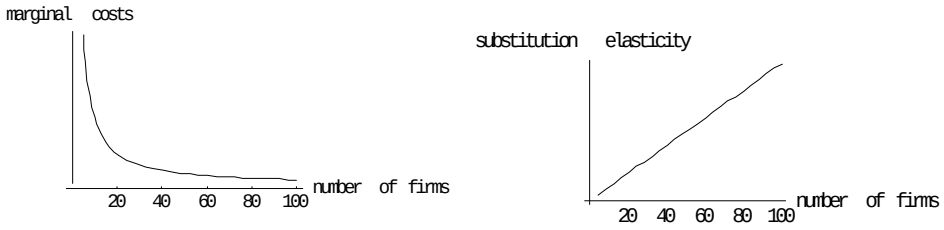
3.3 Foreign market competition effects

In order to present the effects of foreign market competition on the break even productivity of the exporter, we present simulations of the above system of equations with different

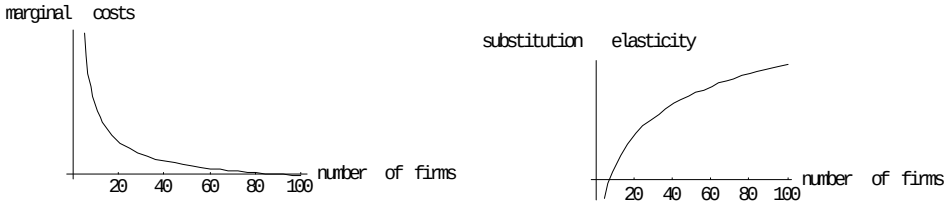
definitions of the demand elasticity-firm number relationship.[7] In line with the theory, we expect that increased market competition, as measured by the number of firms in the market, will negatively impact the marginal costs required to break even. As market conditions intensify making it more difficult for individual producers to break even, the marginal exporter's units costs should decrease for him to remain in the market. The alternative is, of course, negative profits and exit out of the market. In testing this proposition on the above model we employ a linear, logarithmic and quadratic definition of elasticity of substitution with respect to the number of varieties on offer in a given market.[8] The results of the simulation are presented in Figure 1.

Figure 1: Simulated response of exporter break-even costs to an increase in the number of competitors[9]

1a: Linear elasticity specification



1b: Logarithmic elasticity specification



[7] I employ the Yang, Heijdra (1993) definition of the demand elasticity (ε) instead of assuming that $\varepsilon = -\sigma$.

[8] The linear, logarithmic and exponential functional forms, respectively, are

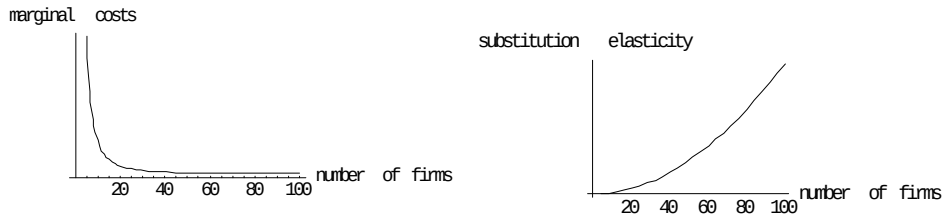
$$\sigma = (N - 1) \text{ for } N \geq 2 \tag{11}$$

$$\sigma = (\ln(N) + 1) \text{ for } N \geq 2 \tag{12}$$

$$\sigma = ((N - 1)^2) \text{ for } N \geq 2 \tag{13}$$

[9] All simulations performed with Mathematica version 5.1 with the following parameter values $L = 20$, $t = 1.2$, $\beta = 0.6$, $c_{\min} = c^*_{\min} = 0.1$, $c \backsim N(5, 1)$

1c: Quadratic elasticity specification



Note: The simulated results are presented pairwise (the left hand side graph represents the response of marginal costs, while the right hand graph depicts the corresponding elasticity (in absolute value)-firm number relationship)

The simulations[10] although not conclusively providing the exact response of marginal cost (productivity) of exporters to foreign market competition, do indicate that the functional form of the elasticity specification does not markedly alter the basic response of the marginal cost function. The only notable differences to the marginal-cost response function appear with changes in the distribution of firm productivity (Appendix A). As can be clearly observed, if demand elasticity and the number of products (firms) are negatively correlated, the impact of competition clearly forces the marginal firm into productivity improvements or, alternatively, to exit the market.

4 Data, sample characteristics and methodology

The data employed in the empirical analysis is firm-level data on Slovene manufacturing firms active in the period between 1994 and 2002. The data set contains detailed accounting information as well as a fairly complete set of data on external trade and capital flows of individual firms (such as exports, imports, outward and inward direct investments etc.). The sample resembles the one used by Damijan et al. (2004) but has been constructed from alternative sources. The original accounting data for the period between 1994 and 2002 was provided by AJPES (Agency of the Republic of Slovenia for Public Legal Records and Related Services) and has been enriched with the addition of trade and FDI data the Statistical Office of the Republic of Slovenia (1994-2002). All data is in Slovenian tolars and has been deflated using the consumer price index (for data relating to capital stock) and producer price index (at the 2-digit NACE industry level) for data relating to sales and added value. Data on the foreign-market (European Union, Eastern and Central Europe as well as former Yugoslav republics) characteristics (sales, number of firms,...) stem from the UNIDO INDSTAT 4 (2003) database.
For the purposes of this analysis we restricted the sample only to manufacturing establishments (NACE rev.1 industries 15 to 37) with at least 10 employees in all years of observable data. The reason for the restriction lies in the fact that accounting data for very small firms is highly unreliable and noisy.[11] The database used in the estimations hence includes

[10]The effects of changes in parameter estimates are seen in Appendix A.

[11]In order to offer additional insight into these establishments, results of estimates on the learning-by exporting hypothesis on the complete data set (including firms with less than 10 employees) are presented in Appendix E.

information on 903 firms (in year 1994) up to 1379 firms (in 2002). Given the substantial entry and exit dynamics, we are dealing with an unbalanced sample of firms. The entry/exit dynamics into the export market are described in Table 1.

Table 1: Export entry and exit dynamics in the sample of Slovene manufacturing firms

Year	All	Exporters	% Exporters	Enter	Exit	Net
1994	903	778	86.2	-	-	-
1995	1,039	881	84.8	198	33	165
1996	1,133	937	82.7	184	50	134
1997	1,235	1012	81.9	164	38	126
1998	1,310	1082	82.6	154	39	115
1999	1,365	1135	83.2	136	47	89
2000	1,376	1162	84.4	146	33	113
2001	1,358	1150	84.7	109	34	75
2002	1,379	1166	84.6	83	39	44

Source: Bank of Slovenia and authors' own calculations

As can be seen from the above table, Slovene manufacturing is characterized by very high export participation rates as these remain around 80 to 85% through the period. In addition, the vast majority of exporters exported to the EU market, the market of the former Yugoslav republics or both. These participation rates are not unlike the ones reported by Greenaway et al. (2004) and can be explained in most by the relatively small size of the home market. On the other hand, the entry/exit dynamics reveal higher entry rates at the beginning of the period (resulting in relatively high rates of net entry in the initial years) but a decline in the rate of entry at the end of the observed period. This is not unexpected as the early 1990s represented a period of transition for Slovene firms as they continued the adjustment from a socialist to market led economy. Other salient features of the sample data, such as the evolution of the value added per employee, firm size in terms of employment and the number of firms according to the market servicing mode (firms with domestic sales only, exporting firms and firms with outward foreign direct investment) are reported in Table 2.

Table 2: Structure of firms in the sample with respect to firm type by average productivity, size and the number of enterprises

	Domestic sales only				Exporters w/o OFDI				Exporters w/ OFDI			
Year	y^*	ry^+	$l^\#$	N	y^*	ry^+	$l^\#$	N	y^*	ry^+	$l^\#$	N
1994	2156	0.97	50	158	1849	1.03	142	713	2300	1.11	654	115
1995	2558	0.99	39	195	2032	1.03	126	813	2570	1.08	657	120
1996	2820	0.98	37	239	2496	1.04	115	850	3052	1.10	564	137
1997	2910	0.93	38	283	2943	1.03	103	917	3710	1.14	542	142
1998	3220	0.96	36	285	3197	1.03	99	973	3914	1.12	470	162
1999	3518	0.96	34	286	3672	1.02	95	1,025	4805	1.15	432	169
2000	3852	0.94	33	266	4048	1.03	91	1,035	4584	1.07	406	183
2001	3852	0.90	33	255	4394	1.04	90	988	5083	1.10	360	213
2002	3967	0.88	31	257	4950	1.05	84	1,007	5575	1.11	368	212

Notes: *value added per employee, in thousands of Slovenian tolars,$^+$ relative value added (with respect to the 3-digit NACE industry average), # number of employees
Source: Bank of Slovenia and authors' own calculations

The two prevailing features of Table 2 are the pronounced differences in terms of the value added per employee as well as firm size between firms servicing solely the domestic market,

exporting firms and firms that, in addition to exporting, also engaged in outward foreign direct investment. It can also be noticed that the average firm size in all three groups has been decreasing which is in line with expectations given the observed period in large part coincides with the period of transition in the Slovene manufacturing sector.
As expected, multinational producers are revealed to have the highest value added per employee followed by exporting and domestic firms. This occurrence leads to the familiar question with regards to the cause of these productivity differences: self-selection or learning-by-exporting. In spite of the wealth of research on the topic the direction of causality between productivity levels and engagement in foreign markets there is no conclusive evidence on the true nature of the causality. As noted above, evidence on the self-selection hypothesis has been found in the majority of developed countries' manufacturing sectors. Damijan et al. (2004) who, by estimating a probit model of the decision to export, and Kostevc (2005), adopting the Kolmogorov-Smirnov (and Mann-Whitney) stochastic dominance tests, prove the existence of self-selection in the sample of Slovene manufacturing firms.
In the remainder of the of the paper we focus on an alternative source of productivity differences between those enterprises that are involved in foreign markets and those that have restricted their operations to the home-country markets. We therefore direct our attention to finding evidence of learning-by-exporting in the Slovenian manufacturing sector.

5 Empirical model and econometric issues

This section presents the empirical model for estimating the effects of foreign market competition on exporter productivity. The presentation of the proposed functional form and the included variables is followed by an analysis of the likely econometric issues that may effect the estimation results. The first of the subsections discusses the possibility of the simultaneity bias (in estimates of the production functions) and the offers some of the likely corrective measures to mitigate the problem. The issue of self-selection of firms in the sample is dealt with in the second subsection, while the third subsection reviews the effects of matching and difference-in-differences techniques in estimating the effects of learning by exporting.
In constructing the model, which will enable us to analyze the effects of the intensity of market competition in target markets on the productivity of exporting firms, we adopt a dynamic specification of the productivity equation. This approach is in line with the prevailing trend in the relevant literature on productivity, firm heterogeneity and trade (Damijan et al. 2004,....) and finds its theoretical basis in the proposition commonly applied to models of firm activity and market interaction that productivity follows a exogenous Markov process (Hopenhayn, Rogerson, 1990; Olley, Pakes, 1992; Amiti, Konings, 2005), which in turn ensures the theoretical foundation for the well documented empirical finding of high serial correlation of measures of productivity. In addition to the above justification, the inclusion of the lagged dependent variable is also merited by the fact that its introduction can serve as a proxy for the unobserved serially correlated state variables (that serve as determinants of omitted idiosyncratic firm characteristics).
The empirical exploits to follow are based on the standard Cobb-Douglas production function following Griliches and Mairesse (1995), who estimate the "approximate total factor productivity" (ATFP) as: $ATFP = \ln Y/L - s \ln K/L$ or $ATFP = \ln y - s \ln k$. The residual of the regression of labor productivity (y) on capital intensity (k) could be interpreted

as a measure of total factor productivity.[12] Any additional right-hand-side regressors will hence serve to explain total factor productivity. In order to analyze the effects of the intensity of market competition on the relative value added of exporting firms we estimate the following modified production function:

$$\Delta ry_{it} = \alpha_0 + \alpha_1 ry_{it-1} + (\alpha_2 ry_{it=0}) + \alpha_3 rk_{it} + \alpha_4 r \sum_{j=1}^{m} ExSh_{ijt_0} * N_{jt_0} + \tag{14}$$

$$+\alpha_5 OFDI_{t-1} + \alpha_6 IFDI_{t-1} + \alpha_7 rl_{it=0} + \alpha_8 EX\_years_{it} + \alpha_9 No\_ex_{it} +$$

$$+ \sum_k \alpha_{10,k} T_k + \sum_j \alpha_{11,j} D_j + \mu_i + \varepsilon_{it}$$

$$\varepsilon_{it} \sim N(0, \sigma^2)$$

where Δry_{it} denotes the growth rate of the relative labor productivity (relative to the average of the NACE 3-digit industry) of firm i at time t, ry_{it-1} is the lagged relative labor productivity, $ry_{it=0}$ is the initial (first year) relative labor productivity, rk_{it} is the relative capital intensity, $r \sum_{j=1}^{m} ExSh_{ijt_0} * N_{jt_0}$ measures the impact of relative foreign markets on productivity[13], $OFDI_{t-1}$ and $IFDI_{t-1}$ are the dummy variables for outward and inward direct investment in the previous period, respectively. A viable alternative to using the number of competing firms as a measure of market competition are also measures of market concentration such as the Herfindahl-Hirschman index. Although, concentration indices could present a useful tool in the analysis, the availability of reliable sales data and issues with the intuition behind the use of these indices[14] mean they only serve as a supplement to the basic estimates. We present a concentration-index analog estimation of equation 14 in Appendix B.[15] The initial relative size of the firm (with respect to other firms within the same NACE 3-digit industry) is denoted by $rl_{it=0}$, EX_years represents the length of the exporting period (which also serves as a proxy for the age of the firm), No_ex are the number of markets where the firm exports to. T_k and D_j denote time and sectoral dummies, respectively. μ_i captures potential remaining unobserved firm specific characteristics apart from those captured by the lagged or initial relative productivity, while ε_{it} denotes normally distributed residuals with mean zero and variance σ^2.
The unobserved permanent firm-specific characteristics (μ_i) are clearly correlated with the observed firm specific effects (lagged and/or initial relative productivity). This view is easily confirmed by a simple modification of (14):

$$ry_{it} = \alpha_0 + \alpha_1^* ry_{it-1} + ... + \mu_i + \varepsilon_{it} \tag{15}$$

where $\alpha^* = \alpha + 1$. Given the latter formulation, it is obvious that the permanent firm-specific effects (μ_i) are correlated with the contemporaneous levels of the relative productivity and, given that μ_i is time invariant, it is also correlated with the lagged dependent variable (ry_{it-1}). This violates even the least restrictive of the exogeneity assumptions

[12] In a parallel approach total factor productivity is used in some of the regressions as a measure of productivity. This provides a robustness check for the basic results with value added.

[13] The variable is constructed as a sum (over all exporting markets) of a product of the share of sales in a given broadly defined market and the number of incumbent firms competing in those markets by NACE 3-digit industry.

[14] The theoretical model assumes monopolistic competition with varying levels of market crowding. This is best measured by the number of firms in the market.

[15] The theory suggests that a lower index of concentration (indicating intense competition) would lead to larger productivity improvements.

(contemporaneous noncorrelation) placed on the regressors and insures that regressions that fail to account for this factor would be inconsistent and the coefficients on the lagged dependent variable would be upwardly biased (OLS). If the remaining unobserved firm-specific effects were time invariant, then a fixed effects estimator could be used to solve the endogeneity problem at hand. As it turns out though, fixed effects estimates produce downward biased and inconsistent estimates of the lagged dependent variable coefficients (see Nickell (1981)), but as Griliches and Mairesse (1995) note that there is also a related problem of the possible simultaneity between the lagged dependent variable and the unobserved firm heterogeneity. This serves as another source of inconsistency and bias of the OLS estimates. The OLS estimates are biased due to the correlation of the lagged dependent variable with the individual specific effects as well as its correlation with the remaining independent variables.

5.1 Controlling for simultaneity

In order to control for the issues of endogeneity (simultaneity) inherent to estimations based on production functions we rely on the general method of moments (GMM) as well as the Olley-Pakes estimation algorithm to instrumentalize the offending variables. Rather than apply the difference GMM estimator (as first proposed by Arellano and Bond, 1991) we will rely on the system GMM estimation procedure (sys-GMM) (Arellano, Bond, 1998; Blundell, Bond, 1998; Blundell, Bond, 1999). The former has, namely, been shown (Arellano, Bower, 1995) to perform poorly for instrumented variables with near unit-root behavior. Arellano and Bond (1998) and Blundell and Bond (1998, 1999) suggest application of the system GMM (sys-GMM) estimators. Blundell and Bond (1998) show the deficiencies of the diff-GMM estimator lie primarily in the cases where the dependent variable displays behavior close to a unit root (the coefficient of the lagged dependent variable is close to unity) and, secondly, the diff-GMM estimator becomes less informative whenever the variance of the unobserved firm specific effects is high. This can be seen by considering the somewhat reduced form of the regression function (14) for $T = 3$

$$\Delta y_{i2} = \pi y_{i1} + r_i \qquad \text{for} \quad i = 1, ..., N \tag{16}$$

Whenever the process generating the evolution of y_{it} is close to being unit root or whenever the "within" error component is large, the least square estimator of the above reduced form equation will be arbitrarily close to zero [16]. Blundell and Bond (1998) offer a solution to the problem by imposing a set of additional linear and nonlinear moment conditions for the estimations in levels in the GMM framework. This allows them to propose the use of lagged differences of the dependent variable as instruments in the level equations. Using both linear and non-linear restrictions allows one to generate the instrument matrix. The calculation of the two-step GMM estimator is analogous to the diff-GMM case with the

[16] This can be seen by observing the simplified version of (14)

$$y_{it} = \alpha y_{it-1} + \eta_i + \nu_{it}$$

where η_i are the firm-specific unobserved characteristics and ν_{it} is the random error term. If productivity (y) follows a unit root process then α would be close to 1. Acknowledging this (16) can be written as

$$\Delta y_{i2} = (\alpha - 1) y_{i1} + \eta_i + \nu_{it}$$

Blundell and Bond show that asymptotically as $\alpha \to 1$, $\pi \to 0$ and as $\sigma_\eta / \sigma_\nu \to \infty$ level values become weaker instruments for the first difference dependent variables.

distinction that the one-step GMM estimator is no longer asymptotically equivalent to the two-step estimator (even if the disturbances are i.i.d.). Blundell, Bond, Windmeijer (2000) confirm that sys-GMM estimator not only greatly improves the precision but also reduces the finite sample bias inherent in the diff-GMM estimator. In the model estimated in first differences, the corresponding instruments for Δx_{i3} could therefore be x_{i1} and Δx_{i1} (where x is used as a general notation for all included regressors) and so on for periods above $t = 3$. This approach allows the full exploitation of all available moment conditions hence allowing for a larger set of lagged levels' and first-differences' instruments. With the system-GMM approach consistency and the efficiency of the GMM estimator are maximized, but the drawback of the approach lies in the fact that relatively long time series are required (so that a loss of two periods of observations can be sustained).

5.2 Controlling for self-selection

Another issue one has to be aware of when estimating a production function is the question of self-selection. There is, namely, a clear relationship between firm productivity, on one hand, and firm survival and input demand, on the other. Olley and Pakes (1996) find that as the least productive firms exit the market, the existing capital is redistributed to their more productive counterparts generating a strong negative bias on the capital coefficients in the production function.[17] A common way of dealing with the selection issue is to consider only a balanced sample (excluding observations that are not present throughout the sample period) but, as Olley and Pakes also show, firm decisions are made, at least to some extent on their perceptions of future productivity and those, in turn, are partially determined by the realizations of their current productivity. If one were to consider only those firms that survived over the entire period this would imply that a sample would be selected, in part, on the basis of the unobserved productivity realizations. This generates a selection bias in both the estimates of the production function parameters and in the subsequent analysis of productivity. Therefore they present an alternative solution that serves to deal with both the simultaneity and self-selection issues at the same time.
The estimation procedure that was first introduced by Olley and Pakes (1996) and since used extensively relies on a three step procedure to estimate the unbiased coefficients on labor and capital in the production function. The crucial first step of the estimation serves to determine the unobserved productivity shocks for each firm by employing the (firm-specific) investment equation and the dependence of investment on productivity shocks[18]. These estimates can subsequently be used to control for the unobservable productivity

[17] Exploring a dynamic model of firm behavior Olley and Pakes (1996) show that the break-even productivity level is decreasing in capital (firms with more capital can expect larger future returns for any given level of current productivity and will therefore continue in operations at lower productivity realizations). Conditional on lagged productivity and observed inputs, the self-selection caused by exit bahavior will cause the expectation of current productivity to be decreasing in capital which will induce the afformentioned negative bias in the capital coefficent.

[18] Olley and Pakes (1996) propose the following specification of the investment function

$$i_t = i_t(\omega_t, age_t, k_t)$$

where i_t, ω_t, age_t and k_t are investment, unobserved productivity shock, firm age and capital in period t,respectively. Given that the investment equation is assumed to be strictly increasing in ω_t, it can be inverted to

$$\omega_t = h_t(i_t, age_t, k_t)$$

shocks in estimation. The empirical results we present in the following section use a forth order polynomial in capital and investment only (with a full set of interaction terms) to approximate $\phi_t(.)$, since data on firm age was not available. Using the estimates of productivity shocks, the primary production function is estimated to obtain unbiased estimates of the coefficient on labor as well as predicted values of the remaining(residual) part of the production function $(\widehat{\phi}_t)$.[19] The second step of the estimation process involves the determination of the survival probability (the probability that a firm will survive in the market), which depends on the firm's productivity remaining above the perceived cut-off level.[20] In estimating the survival probability we used a fourth order polynomial in (k_t, i_t) with industry and time dummies (which serve as a proxy for differences in market conditions and time-specific factors that impact the survival probability). The third and final step of the estimation procedure utilizes the preceding two steps to estimate an expanded production function and obtain unbiased estimates of the coefficient on capital.[21] We estimated the third step of the estimation algorithm using nonlinear least squares with bootstrapped regression coefficients (in line with Pavcnik (2002) 1000 repetitions were used in the bootstrap). Again, in contrast to the Olley-Pakes estimation, we are forced to forego the use of the firm age variable since it is not a part of the data set. Consistent and unbiased estimates of coefficients on labor (β_l) and capital (β_k) can ultimately be used to obtain unbiased estimates of total factor productivity (TFP)

$$\widehat{TFP}_{it} = y_{it} - \beta_l l_{it} - \beta_k k_{it} \tag{17}$$

The estimates of TFP will be used in place of the value added measures in estimations of the self-selection and learning-by-exporting hypotheses. The specification of the model will differ slightly from (14) since relative capital intensity will no longer need to be included in the estimation.

Van Biesebroeck (2003) and De Loecker (2004) extend the Olley-Pakes framework to introduce exporting as an additional state variable in the estimation algorithm. This allows one to control for self-selection into the export markets in addition to controlling for the selection bias and simultaneity.[22] Given that the addition of the probability of exporting

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[19]

$$y_{it} = \beta_l l_{it} + \phi_t(i_{it}, age_{it}, k_{it}) + \eta_{it}$$

where

$$\phi_t(i_{it}, a_{it}, k_{it}) = \beta_0 + \beta_a a_{it} + \beta_k k_{it} + h_t(i_{it}, age_{it}, k_{it})$$

At this stage, both β_l as well as $\widehat{\phi}_t$ are estimated.

[20] This implies a series approximation by using a polynomial series in (i_t, age_t, k_t) as regressors in a probit estimation (with the dependent variable being the operating status of the firm).

[21] The final step of the estimation envolves running nonlinear least squares on the equation

$$y_{t+1} - b_l l_{t+1} = c + \beta_a age_{t+1} + \beta_k k_{t+1} + \sum_{j=0}^{4-m} \sum_{m=0}^{4} \beta_{(h^m \wp^j)} \widehat{h}_t^m \widehat{\wp}_t^j + e_t$$

where

$$\widehat{h}_t = \widehat{\phi}_t - \beta_a age_t - \beta_k k_t$$

$\widehat{\phi}$ and b_l are taken from the first stage of the estimation, while $\widehat{\wp}$ are the estimates of the survival/entry probability obtained in the second stage.

[22] One could also state a case for using inward and outward FDI as additional state variables in the Olley-Pakes estimation algorithm whereby the reasoning for the inclusion of additional state variables follows along the lines presented in Van Biesebroeck (2003) and De Loecker (2005).

in the final step of the Olley-Pakes estimation process impacts the estimates of the size of total factor productivity, but does not have a significant impact on the relative productivity (relative to the 3-digit NACE industry average), we employ the standard Olley-Pakes estimation algorithm in determining total factor productivity and provide the estimates with exporting as a state variable in Appendix D.
Levinsohn and Petrin (2000) present a viable alternative to the Olley-Pakes estimation algorithm by introducing material costs (in place of investments) in the first step of the estimation procedure. Although their approach holds certain important advantages to the Olley-Pakes procedure, we are unable to employ it due to the lack of available data on the use of specific materials (only data on aggregate expenditure on materials was made available to us).

5.3 Matching

Given that research of economic issues rarely affords the luxury of experimental data, which would allow one to observe clearly defined treatment and control groups and make inferences based solely upon the treatment effect (by construction controlling for the remaining differences between observations). The problem when dealing with non-experimental data is therefore one of missing data, as same observation with and without the treatment effect cannot be observed.[23] Matching estimation methods (Heckman et al. 1997, 1998) allow the construction of a viable alternative to the experimental data set with the development of a counterfactual, which enables the analysis of the evolution of characteristics (such as productivity) a firm would have experienced had it not been effected by the treatment effect (such as the start of exporting).
Our aim in this section is to find evidence of the presence of the learning-by-exporting effects in addition to the well documented self-selection story (Bernard and Jensen, 1997, 1999; Helpman et.al. 2003; Damijan et al. 2004). The matching methodology will enable the evaluation of the direction of causality between productivity (productivity growth) and foreign market presence. In order to establish the existence of statistically significant productivity gains we compose a treatment group of firms that start exporting[24] and compare (match) those to the control group of non-exporters.[25] The states associated with receiving treatment or not receiving treatment are denoted "1" and "0" respectively. Firstly, we rescale the time periods so that a firm starts exporting at $\tau = 0$. The productivity growth (outcome) observed for individual i at time $\tau > 0$ is $g_{i\tau}$. Let the binary variable EXP_i take on value 1 if firm i starts to export. The effect of learning-by-exporting could be explored by observing the difference between productivity growth of exporting and non-exporting firms $g^1_{i\tau} - g^0_{i\tau}$ (where the superscript denotes export behavior). The crucial shortcoming of analyzing this specification lies in the fact that $g^0_{i\tau}$ and $g^1_{i\tau}$ cannot be observed at the same time.
Recent contributions to the matching literature (Blundell and Costa Dias, 2000; Smith and Todd, 2001) found support for the use of difference-in-differences matching estimator, which was found to be more robust and reliable than the other matching estimators. We

[23] For instance, when observing the effects of exporting on the characteristics of a particular firm, data on the same firm, were it not an exporter, is not available. At any time, firms may be in either one of the two potential states but not in both.

[24] Choosing exporters as the treatment group would not provide the necessary dynamics as the effects of exporting may have already dissipated.

[25] The matching technique will allow me to control for the self-selection effect and test the average treatment effect of learning-by-exporting.

therefore utilize the difference-in-differences matching estimator to obtain robust estimates of the impact of exporting on firm productivity growth. In line with the micro-econometric evaluation literature (Heckman et al., 1997, 1998) and empirical literature (Greenaway, Gullstrand, Kneller, 2004; Greenaway and Kneller, 2004; De Loecker, 2005) we define the average expected effect of exporting on market entrants as

$$E\left\{\Delta g^1_{i\tau+s} - \Delta g^0_{i\tau+s} \mid EXP_i = 1\right\} = E\left\{\Delta g^1_{i\tau+s} \mid EXP_i = 1\right\} - E\left\{\Delta g^0_{i\tau+s} \mid EXP_i = 1\right\} \tag{18}$$

It is of course the case that the change in productivity growth experienced by firm i had it *not* chosen to enter export markets, $\Delta g^0_{i\tau+s}$, is unobservable. Causal inference will therefore depend on the construction of this counterfactual. The strategy of the matching estimation methods relies on constructing the counterfactual by using firms that had similar observable characteristics in period t but who did not enter export markets, and remained non-exporters[26]. The average rate of growth $E\left\{\Delta g^0_{i\tau+s} \mid EXP_i = 1\right\}$ in equation (18) is measured instead using $E\left\{\Delta g^0_{i\tau+s} \mid EXP_i = 0\right\}$. The matching techniques enable the selection of a valid control group. The purpose of matching is to pair first time export firms on the basis of some observable variables with a firm that remains a non-exporter. Given the variety of firm observables (productivity, size, ownership, industry and time effects) that could potentially serve as a basis for matching one encounters the dimensionality problem. The problem of having too many possibilities for matching (too many dimensions) can be resolved by the use of the propensity score-matching (Rosenbaum and Rubin, 1983), which uses the probability of receiving a given treatment, conditional on the pre-entry characteristics of firms, to reduce the dimensionality problem (a single index is hence replacing all of the pertinent observable firm characteristics).

To identify the probability of export market entry (or propensity score) we exploit the findings of the rich empirical literature on the determinants of foreign market entry (Bernard and Jensen, 1999; Damijan, et.al. 2004; Girma, et.al. 2004). According to the literature, the primary determinants of the probability of exporting are found to be firm level characteristics such as the pre-entry productivity level, the size of the firm, the relative skill intensity, as well as fixed industry and time effects. In line with those findings, we estimate a linear probit model that includes the following variables,

$$P_{i\tau}(EXP_{i\tau} = 1) = F(ry_{i\tau-1}, rl_{i\tau-1}, rk_{i\tau-1}, IFDI_{i\tau-1}, sectoral, time\ dummies) \tag{19}$$

with $P_{i\tau}$ denoting the probability of entry at time τ for firm i, $ry_{i\tau-1}, rl_{i\tau-1}, rk_{i\tau-1}$ the relative productivity, relative size and relative capital intensity of firm i at time $\tau - 1$ and $IFDI_{i\tau-1}$ is an indicator variable for inward foreign direct investment to firm i at time $\tau - 1$. In order to obtain reliable propensity scores, they have to satisfy the balancing property (which ensures that within blocks of propensity scores there are no statistically significant differences in firm characteristics). A non-exporting firm j, which is "closest" in terms of its propensity score to firm i, is then selected as a match for the latter using the *nearest neighbor with caliper matching method*[27]. More formally, at each point in time

[26] Ideally, we would like to construct the counterfactual by using firm that are identical to the treatment group in $n-1$ (out of n) characteristics and differ only in the n^{th} characteristic, which is their exporting status.

[27] The matching is performed in Stata Version 8.2 using the software provided by E. Leuven and B. Sianesi (2003).

and each industry[28] and for each new entrant firm i, a non exporter firm j is selected such that (each non exporter can be matched to more than one firm)

$$\lambda > |P_{i\tau} - P_{j\tau}| = \min_{k\epsilon\{EXP=0\}} \{|P_i - P_j|\} \tag{20}$$

where λ is a pre-specified scalar (the caliper). The use of a caliper causes treated firms that do not have sufficiently similar control firms to be left unmatched. This type of matching is preferable to randomly choosing a comparison (control) group, because the latter is likelier to induce estimation bias by matching firms with markedly different characteristics.
Having constructed the control group we follow the findings of Blundell-Costa Dias (2000) and Smith-Todd (2001) and compare the average growth rates of the treatment and control groups using a difference-in-differences estimator. The additional advantage of using this approach is that it serves to remove all time invariant firm specific shocks and accounts for additional covariances that may determine firm performance. The difference-in-difference equation estimated takes the form:

$$did_{k\tau} = \beta_{ik} + \sum_{\tau=-1}^{3} \beta_2 D_{\tau+1} + \sum_{\tau=-1}^{3} \beta_3^{EXP} D_{\tau+1}^{EXP} + \sum_{\tau=-1}^{3} \beta_4 D_{\tau+1} markets_{initial}^{ex} + \sum \beta_5 X_{k\tau} + \varepsilon_{i\tau} \tag{21}$$

where the dependant variable $did_{k\tau}$ represents the difference between the productivity growth rate of an exporting firm $(ry_{i\tau}^1 - ry_{i\tau-1}^1)$ and a non exporter $(ry_{i\tau}^0 - ry_{i\tau-1}^0)$. The vector of coefficients β_2 captures the effects of time (year) dummy variables (capturing the effects that are common to all firms), while β_3 captures the impact on the growth rate only for the firms that entered the export market at time t. It is this coefficients that will reveal whether learning-by-exporting is present (and important) or not. β_4 reveals whether there are additional learning effects being driven by the market conditions in the exporting markets (the number of competing firms in the market will serve as a proxy for the level of competition in those markets), while coefficients β_5 include the effects of other explanatory variables such as the lagged level of difference between treatment and control groups, the relative capital intensity, relative size and changes of market conditions. Equation (21) therefore attempts to control for a large part of the variation in the productivity growth rates for the firm that cannot be attributed to the change in the export status.

6 Results

The issue of self-selection was explored in detail (and ultimately by and large confirmed) by Damijan et al. (2004) and De Loecker (2004) on data on Slovenian firms, and many others. Whereby there seems to be pervasive anecdotal and factual evidence of self-selection into the export markets, conclusive proof of there being learning by exporting has been more illusive. The finding that exporters are ex-ante more productive serves as confirmatory evidence of the existence of sunk costs upon entering foreign markets, whereby learning-by-exporting requires that exporters experience permanent productivity improvements compared with firms serving only their domestic markets. In the preceding sections a

[28] Following Greenaway and Kneller (2004) matching is done on a cross-section by cross-section basis, but in contrast to their work I matched by individual sectors as well. As mentioned by Greenaway and Kneller, this is the only appropriate way to proceed with matching.

simple model of learning-by-exporting was developed that represents the theoretical backbone for the forthcoming empirical analysis. One of the more striking findings of the model was that firms operating in more competitive markets would face greater pressure on their profit margins than their counterparts in less intensely competitive environments through the effect of the number of competing products on the elasticity of substitution and the demand elasticity.

The remainder of this section is organized in four subsections. Where the first of the subsections presents results of the static model of learning-by-doing, while the remaining subsections offer a robustness check (dynamic productivity specification and alternative productivity measures). Finally, results using the matching and difference-in-differences estimation approach are presented in the last subsection.

6.1 Results of static model estimation

All exporting firms

In Table 3 we present the basic estimates of equation (14), which are to serve as starting points for the analysis of possible learning-by-exporting effects and present a benchmark with which estimates of more complex estimation techniques can be subsequently compared. The introductory estimates presented in Table 3 rely on ordinary least squares to ascertain the possible effects of conditions in the export markets (as measured by the number of firms present in the EU market within the NACE 3-digit industry) on the firm relative productivity growth.

Table 3: Productivity improvements of exporting firms [OLS in First Differences and Cumulative Differences, 1995-2002]

Model	FD	FD	CD
ry_{it_0}	***-0.044 (-5.2)	***-0.041 (-5.4)	*** -0.270 (-7.2)
rl_{it_0}	-0.009 (1.6)	-0.008 (-1.6)	*** -0.014 (-5.6)
Δrk_{it}	** 0.406 (2.4)	** 0.400 (2.5)	*** 0.217 (10.3)
$r\sum_{j=1}^{m} ExSh_{ijt} * N_{jt_0}$	** 0.012 (2.1)	* 0.008 (1.9)	*** 0.024 (2.9)
$\Delta r\sum_{j=1}^{m} ExSh_{ijt} * N_{jt}$	0.019 (0.6)	0.101 (1.3)	*** -0.042 (4.0)
$ExSh_{EU}$	0.102 (1.3)	0.061 (0.8)	*** 0.020 (2.9)
$ImSh_{TOTAL}$	***-0.137 (-2.9)	***-0.143 (-3.3)	
No_exp		* 0.009 (1.7)	-0.001 (-0.3)
$OFDI_{EU}$	-0.033 (-1.0)	-0.027 (-0.8)	** -0.073 (-2.4)
$OFDI_{YUG}$		* -0.054 (-1.9)	*** -0.107 (-5.2)
D_IMP_{EU}	0.052 (0.8)	** 0.051 (0.7)	** 0.026 (2.1)
D_IMP_{YUG}	0.019 (0.9)	0.017 (0.8)	0.023 (0.5)
$emp100 * market_{it_0}$		-0.125 (1.6)	
sectoral dummies[29]	YES	YES	YES
time dummies	YES	YES	YES
N	3461	3461	1944
adjusted R^2	0.415	0.424	0.378

Notes: Dependent variable is Δry_{it} . t-statistic in parentheses; ***, **, and * indicate significance of coefficients at 1, 5 and 10 per cent, respectively

[29]The sectoral dummies implemented throughout the empirical analysis are based on the 2-digit NACE industry clasification of firms.

The above estimates reveal that, in line with theoretical predictions, firms that were initially more productive experienced slower growth (this fact is most pronounced in the cumulative differences estimates), while, on the other hand, relatively larger firms (in terms of employment) did not experience significantly slower growth than their relatively smaller counterparts (notably, cumulative difference estimates confirm this theoretical prediction as well)[30]. As expected, the effects of relative capital intensity on productivity growth are positive and highly significant as are the effects of the share of exports to the European Union in sales ($ExSh_{EU}$) in first difference estimates (this result is reversed in the case of cumulative differences). The two variables of particular interest, though, are the variable representing the initial conditions in the export markets ($r\sum_{j=1}^{m} ExSh * market_{it_0}$)[31] and the variable representing changes in exporting market conditions ($\Delta r\sum_{j=1}^{m} ExSh * market_{it}$). As it turns out, there was a significant positive effect of initial market conditions in the export markets on relative productivity growth (these effects are reinforced in the cumulative difference estimates). This implies that firms which exported to markets that were initially more competitive (and/or exported a large share of their sales to those markets) experienced higher productivity growth than their competitors engaging in exports to less competitive markets. The results with respect to the changes in export market conditions are less conclusive with the exception of the cumulative difference results which indicate that over the entire period of observation increased competition in the export markets (and/or increased exposure to those markets) positively effected productivity growth compared with other firms in the industry. There seem to be significant long-run effects of the market conditions (both initial and changes in the market conditions). Firms investing in either the European Union countries or countries of the former Yugoslavia do not seem to experience faster productivity growth, in fact, it seems to have a statistically significant negative impact on productivity growth in the case of cumulative differences. Data therefore imply no additional learning (no additional productivity gains) can be achieved by investing in foreign countries in addition to exports. In line with the disposition in Amiti and Konings (2005), firms that imported their inputs from the European Union experienced significantly higher productivity growth while those importing from the former Yugoslav republics did not experience significant gains. On the other hand, the share of imports in material costs ($ImSh_{TOTAL}$) had a significant negative impact on growth of relative productivity.

New exporters only

The above regression though informative does not provide conclusive evidence of the existence of learning-by-exporting as there could be a number of unobserved factors (such as firm age, length of presence in the export markets, idionsyncratic productivity shocks etc.) that are causing productivity improvements independent of the conditions in the firm's exporting markets. In order to mitigate the effects of some of the unobserved factors we reestimate the productivity equation using the subsample of new exporters (firms that start exporting during the period of observation). The reasoning behind this change is fairly straightforward, as it allows the analysis of direct effects of foreign market conditions

[30]It has to be noted here that one of the peculiarities of the transition process in Slovenia is the lack of medium-sized firms. The small number of medium-sized enterprises may affect the theoretical prediction.

[31]$r\sum_{j=1}^{m} ExSh * market_{it_0}$ represents the sum of the products of the share of sales sold in a market and the initial number of firms in that market by NACE 3-digit industries. This variable was prefered over the simple inclusion of the initial number of firms in the markets since the latter could not serve to explain the inter-industry variation of productivity growth.

on firm productivity growth without including factors that may be related to the length of firm presence in the export markets. Table 4 therefore presents estimates of equation (14) on new exporters only.

Table 4: Productivity improvements of new-exporters [OLS in First Differences and Cumulative Differences, dependent variable growth in relative value added per employee Δry_{it}, 1995-2002]

Model	FD	CD
ry_{it_0}	***-0.043 (-3.4)	***-0.231 (-5.4)
rl_{it_0}	0.005 (0.5)	** 0.047 (2.4)
Δrk_{it}	*** 0.345 (7.7)	*** 0.268 (6.4)
$r\sum_{j=1}^{m} ExSh_{ijt} * N_{jt_0}$	0.005 (0.6)	*** 0.044 (2.8)
$\Delta r\sum_{j=1}^{m} ExSh_{ijt} * N_{jt}$	-0.004 (-1.0)	-0.055 (-1.6)
$ExSh_{EU}$	** 0.175 (2.1)	0.011 (0.3)
$ImSh_{TOTAL}$	***-0.252 (-3.3)	
No_exp	*** 0.013 (3.1)	0.006 (1.2)
$OFDI_{EU}$	0.018 (0.3)	*** 0.393 (3.5)
$OFDI_{YUG}$	* -0.117 (-1.7)	** -0.235 (-2.0)
D_IMP_{EU}	0.026 (0.6)	-0.061 (-0.7)
D_IMP_{YUG}	0.021 (0.5)	0.042 (0.7)
sectoral dummies	YES	YES
time dummies	YES	YES
N	1075	733
adjusted R^2	0.255	0.424

Notes: t-statistic in parentheses; ***, **, and * indicates significance of coefficients at 1, 5 and 10 percent, respectively

Estimates performed on the subgroup of new exporters (Table 4) closely resemble the ones presented in Table 3, with some important distinctions. With most of the included variables retaining the sign as well as the magnitude of the coefficients that was observed in the analysis of all exporters, there are some subtle differences. The primary difference between these two estimates being that first-differences estimates of the effects of market conditions on productivity growth are no longer significantly positive, while, similar to the case of all exporters, analysis on cumulative differences indicates a strong and relatively substantial positive impact of market conditions on growth of relative productivity. Secondly, it seems that new exporters do experience additional productivity improvements from investing in the EU markets at least in the long run (while investing in the markets of the former Yugoslav republics seems to have the opposite effect). Finally, importing from the European Union no longer presents an additional source of productivity growth (the variable was dropped in estimation with cumulative difference due to colinearity).

6.2 Robustness of the results

In this section (and in the appendices) we consider alternative specifications of the model by testing a dynamic model of productivity improvements and, later, by using 'Olley-Pakes' total factor productivity as a measure of productivity (in place of the value added per employee).

6.2.1 Results of dynamic model estimation

In contrast to the analysis so far, we will assume a dynamic specification of productivity in this section. This specification is somewhat closer to the theoretical postulate that productivity follows a Markov process (Olley, Pakes, 1996). Due to the inherent bias in the estimation of a dynamic productivity function by either OLS or fixed effects, the variables causing the bias (lagged dependent variable) have to be instrumentalized. In finding an optimal instrument, which is both highly correlated with the variable to be instrumented and uncorrelated with the error term we employ a two step procedure. In the first phase we employ the system general method of moments[32] to estimate a dynamic production function.

$$\ln(y_{it}) = \alpha_0 + \alpha_1 \ln(y_{it-1}) + \alpha_2 \ln(k_{it}) + \alpha_3 \ln(k_{it-1}) + \alpha_5 \ln(l_{it}) + \alpha_6 \ln(l_{it-1}) + \sum_k \alpha_{7,k} T_k + \sum_p \alpha_{8,p} D_p + \varepsilon_{it} \tag{22}$$

where y_{it}, k_{it}, l_{it} are value added, capital and labor of firm i at time t , T are time dummies and D are industry dummies. The residuals of the above equation (as estimated by the general method of moments) represent the total factor productivity, which is employed in the second step of the estimation algorithm. The estimates of system GMM residuals are regressed on the remaining variables of the model, with the results presented in Table 5. This procedure ensures a dynamic estimation of total factor productivity whereby the endogenous variables are instrumented by a complete set of method of moments instruments. The residuals of this estimation are then employed in estimating the remainder of the model.[33]

[32] System-general method of moments exploits a system of employs a matrix of all available instruments (lagged levels and lagged differences) to instrument for the variables that are correlated with the error term.

[33] This two stage estimation algorithm is preferred to estimating a complete model with sys-GMM in a single stage since the GMM instruments would distort (and limit the intuition behind) the estimated coefficients of the model. The results of the 1st stage estimation procedure can be seen in Appendix C.

Table 5: Productivity improvements of exporting firms [OLS, dependent variable growth in relative TFP corrected sys-GMM $\Delta rtfp_{it}^{GMM}$]

Model	FD	FD
rl_{it_0}	* 0.010 (1.8)	* 0.011 (1.9)
$r\sum_{j=1}^{m} ExSh_{ijt} * N_{jt_0}$	* 0.006 (1.7)	* 0.005 (1.8)
$\Delta r\sum_{j=1}^{m} ExSh_{ijt} * N_{jt}$	0.026 (0.5)	0.022 (0.4)
$ExSh_{TOTAL}$		0.088 (1.6)
$ImSh_{TOTAL}$	-0.023 (-0.5)	** -0.088 (-2.1)
No_exp	-0.001 (-1.5)	** -0.002 (2.4)
$Years\_exp$	* 0.016 (1.7)	* 0.015 (1.7)
$OFDI_{EU}$	0.012 (1.0)	0.014 (1.2)
$OFDI_{YUG}$	-0.009 (-1.6)	-0.007 (-0.6)
D_IMP_{EU}	* 0.075 (1.8)	* 0.084 (1.8)
D_IMP_{YUG}	** 0.046 (2.1)	** 0.051 (2.3)
$emp100 * market_{it_0}$	-0.00002 (-1.3)	-0.00002 (-1.4)
sectoral dummies	YES	YES
time dummies	YES	YES
N	2621	2621
adjusted R^2	0.01	0.01
$AR(1)$	-1.1	-1.1
$AR(2)$	0.5	0.5

Notes: t-statistic in parentheses; ***, **, and * indicate significance of coefficients at 1, 5 and 10 per cent, respectively

The two stage estimates presented in Table 5 reveal that the effects of market competition are statistically significant and positive, while the change in market conditions though present did not significantly differ from zero. The only (other) statistically significant estimates to come out of the sys-GMM estimation reveal that imports from the EU as well as importers from the former Yugoslav republics had higher productivity growth compared to firms that did not import from those two markets, while direct investment to either the EU markets or the markets of former Yugoslavia did not have a statistically significant impact on relative productivity.

6.2.2 Results using total factor productivity

The second econometric issue that may cause bias in the estimates is the question of self-selection that was dealt with in some detail in section 5. This issue could potentially cause serious bias in the estimates of the production function and ultimately cause mismeasurement of productivity. To alleviate this problem Olley and Pakes (1996) propose a the three step estimation procedure to estimate the production function yielding unbiased estimates of total factor productivity. We present estimates of the model employing relative total factor productivity (as defined in (17)) in place of the relative value added per employee, which has been used in estimation thus far.

Table 6: Productivity improvements (measured in changes in Olley-Pakes total factor productivity) of exporters and new exporters [firm level analysis with OLS in First Differences]

Model	FD all exporters	FD new exporters
$rtfp_{it_0}$	*** -0.041 (-6.0)	*** -0.088 (-4.5)
$r\sum_{j=1}^{m} ExSh_{ijt} * N_{jt_0}$	*** 0.004 (3.1)	*** 0.008 (2.7)
$\Delta r\sum_{j=1}^{m} ExSh_{ijt} * N_{jt}$	0.001 (0.1)	-0.013 (-1.5)
$ExSh_{TOTAL}$	*** 0.038 (2.6)	** 0.077 (2.4)
$ImSh_{TOTAL}$	*** -0.096 (-4.9)	** -0.093 (-2.5)
No_exp	0.0002 (1.5)	0.0005 (1.1)
$Years\_exp$	*** 0.004 (3.6)	*** 0.005 (2.6)
$OFDI_{EU}$	-0.004 (-0.6)	0.019 (0.7)
$OFDI_{YUG}$	*** -0.023 (-3.0)	* -0.034 (-1.8)
D_IMP_{EU}	*** -0.019 (-2.7)	* -0.026 (-1.7)
D_IMP_{YUG}	0.003 (0.9)	0.008 (1.0)
$emp100 * market_{it_0}$	-0.000004 (-1.6)	-0.000002 (-0.1)
$Sec.Dummies$	YES	YES
$Time\ Dummies$	YES	YES
N	2378	1106
$adj.R^2$	0.065	0.238

Notes: Dependent variable is $\Delta rtfp_{it}$. t-statistic in parentheses; ***, **, and * indicate significance of coefficients at 1, 5 and 10 per cent, respectively

As Table 6 reveals there are scarcely any qualitative differences between estimates using relative total factor productivity and the estimates based on the relative value added per employee presented in Table 3-5. As before the initial level of total factor productivity and the share of imports have a negative effect on the growth of relative total factor productivity. The effects of initial market conditions on productivity growth are in line with the theoretical predictions revealed through the simulations, while changes in market conditions, again, do not yield any conclusive results as their effect on total factor productivity growth does not significantly differ from zero. Interestingly, whereas the effects of the number of years a firm spent exporting on productivity growth are positive for both samples analyzed, the effect of the number of export markets a firm engages is not conclusive. On the other hand, the results regarding outward foreign direct investment or imports do not conform to theoretical predictions (the results are either insignificant or have the wrong sign). Clearly, no significant qualitative differences between these and prior estimates (based on the relative value added per employee) exist, there are however substantial quantitative differences. The absolute effect of all variables is substantially lower than was the case with relative value added per employee, while the explanatory power (as seen from the determination coefficient) of this model is also substantially smaller than was the case in previous estimates. This latter finding serves to illustrate the quantitative impact trade related factors have on productivity growth, which can be seen to be marginal at best compared to traditional, microeconomically, defined factors of the production function.

6.3 Learning-by-exporting or capacity utilization effects

Despite the fact that in the different specifications of the model that were tested thus far the effects of market conditions on productivity growth seem to be quite robust (with

some noted exceptions), the question remains whether the tests employed have been sufficient to dispel all doubts about the existence of learning-by-exporting. The question we have been trying to answer so far has been whether exporting firms that were (more extensively) engaged in highly competitive markets grew faster than their counterparts. Relying solely on the competition effect on productivity growth may not provide the complete story with regards to the existence of learning effects. For this reason, we present estimates of difference-in-differences matching estimation (Table 7), which by employing propensity scores to match first-time exporters with non-exporting (domestic) firms enables the analysis of the pairwise differences in the growth rates between exporting and non-exporting firms.

Table 7: Productivity improvements of new exporters relative to domestic firms [firm level analysis with difference-in-differences matching]

Model	Static w/ bs	sys-GMM w/o bs
ry_{it-1}		*** -0.950 (-9.6)
rk_{it-1}	-0.103 (-1.6)	** 0.119 (0.1)
$D\_exp\ (s=0)$	* 0.336 (1.9)	** 0.611 (2.0)
$D\_exp\ (s=1)$	-0.165 (-0.9)	0.294 (1.0)
$D\_exp\ (s=2)$	0.081 (0.5)	0.350 (1.2)
$D\_exp\ (s=3)$	0.025 (0.1)	-0.218 (-0.6)
$D\_exp\ (s=4)$	** 0.312 (2.1)	-0.054 (-0.2)
$D\_exp_{s=0} * markets_{t_0}$	-0.073 (-1.4)	** -0.217 (-2.6)
$D\_exp_{s=1} * markets_{t_0}$	* 0.087 (1.8)	-0.078 (-1.0)
$D\_exp_{s=2} * markets_{t_0}$	0.001 (0.0)	-0.086 (-1.1)
$D\_exp_{s=3} * markets_{t_0}$	0.019 (0.4)	-0.008 (-0.1)
$ExSh_{TOTAL}$	0.469 (0.6)	-0.140 (-0.4)
$ImSh_{TOTAL}$	-0.566 (-1.5)	-0.256 (-0.6)
$OFDI_{EU}$	-0.269 (-0.9)	-0.292 (-0.5)
$\Delta r \sum_{j=1}^{m} ExSh_{ijt} * N_{jt}$	0.002 (0.0)	0.008 (0.1)
$Sec.Dummies$	NO	NO
$Time\ Dummies$	YES	YES
N	484	488
$adj.R^2$	0.07	
$Hansen\ \chi^2[p]$		87.9 [0.537]
$AR(1)$		** -2.12
$AR(2)$		0.52

Notes: Dependent variable is $\Delta ry_{it}^{Treatment} - \Delta ry_{jt}^{Control}$. t-statistic in parentheses; ***, **, and * indicate significance of coefficients at 1, 5 and 10 per cent, respectively

Given that we are attempting to establish the presence of general "learning effects", the specification of the model analyzed in Table 7 differs substantially from those employed in previous estimations. The emphasis in this latter version of the model is to also capture the temporal features (or lack thereof) of the learning-by-exporting phenomenon. In order to ascertain the duration of the perceived benefits from exporting difference-in-differences analysis is employed in the matching framework, whereby the temporal effects are captured by a series of dummy variables. The time line of the model is rescaled so that at time $s = 0$ a first time exporter starts to export. Dummy variable $D\_exp\ (s = 0)$ (to $D\_exp\ (s = 4)$) therefore equals 1 in the year the exporter starts exporting (four years

after it started exporting), on the other hand, the interaction terms should help answer the question whether exporters that export to more demanding markets reap additional productivity gains compared to domestic firms. Given the small size of the samples[34], we used bootstrapped standard errors (1000 repetitions) in the first estimation. The results are quite telling, as learning by exporting effect are present only in the period when a firms first starts exporting, but this effects dissipate in years to come. Whereas the initial effect of exporting is seemingly fairly robust, the static estimates also reveal significant positive effects in the fourth year after the firm started to export (this effect is not significant in the dynamic model). The static estimation also confirms that firms exporting to more competitive markets experienced a very small (but significant) improvement a year after they commenced with exporting. Quantitatively, the effects of the first year dominate the other factors in the static specification, while the dynamic specification is dominated by the effects of the lagged relative productivity on the difference in the relative growth between the matched exporter and domestic firms. Surprisingly, in the dynamic specification, the effects of the initial year of exports are diminished somewhat in the case where firms choose to engage in exports in very competitive markets. In summation, the effects of learning by exporting exist and are fairly significant in either a dynamic or static specification of the model, but they are only observable in the year when the firm started to export (this finding is in line with Damijan et al. (2004), while De Loecker (2004) finds support for a somewhat longer duration of learning effects[35]). These results are confirmed using total factor productivity in place of the relative value added per employee (see Appendix D).
The fact that the learning effects of productivity are far from permanent or even long lasting seriously weakens the credibility of the learning-by-exporting argument as an explanation for these effects. Were the learning effects significant, then one would expect to observe them in latter periods (allowing time for the effects to be absorbed and implemented) and last for a longer period of time. A different explanation of this one-time short lasting productivity improvements may be needed in order to fully explain the observed hike in productivity in the initial year of exporting. One may claim that the initial productivity hike is solely a consequence of a scale effect, where the firm takes advantage of a larger market to place its additional output. Put simply, a firm manages to reduce its average costs by increasing its output

$$\frac{\partial AC}{\partial q} < 0 \quad \text{where } AC = F/q + c$$

where F are fixed costs[36], c marginal costs and q is output. The reduction in average costs would, in turn, be reflected in higher value added (relative value added per employee) compared with non-exporting firms. In essence, the hike in productivity therefore reflects only the fact that firms can take advantage of their spare capacity (the fixed costs that are already sunk) in the new markets. To explore the topic further we present Table 8 in which relative sales of new exporters are compared with the growth and levels of relative productivity, relative capital intensity and relative size in years before and after entering the export markets.

[34]This was caused by the restrictions of the matching process and the requirements (for the length of the observation period) of the estimated model.

[35]It should be noted that neither Damijan et al.(2005) nor De Loecker (2004) use similar estimation procedures in atteining their results.

[36]There is no need to differentiate between firm (F) and plant fixed costs (G) here.

Table 8: Changes in relative value added, growth of relative value added, relative size, relative capital intensity and relative sales

Firms exporting to the EU								
year	rq_{it}	Δrq_{it}	ry_{it}	Δry_{it}	$rtfp_{it}$	$\Delta rtfp_{it}$	rk_{it}	rl_{it}
$t-2$	0.573	-0.011	0.961	-0.052	0.996	-0.013	0.657	0.630
$t-1$	0.562	0.025	0.909	0.010	0.983	0.006	0.599	0.620
t	0.587	0.099	0.919	0.126	0.989	0.010	0.576	0.614
$t+1$	0.686	0.100	1.045	0.005	0.999	0.001	0.627	0.639
$t+2$	0.786	0.040	1.050	0.016	1.000	0.001	0.725	0.734
$t+3$	0.826	0.019	1.066	-0.001	1.001	0.004	0.774	0.781
$t+4$	0.845	–	1.065	–	1.005	–	0.772	0.792
Firms exporting to ex-Yugoslav markets								
year	rq_{it}	Δrq_{it}	ry_{it}	Δry_{it}	$rtfp_{it}$	$\Delta rtfp_{it}$	rk_{it}	rl_{it}
$t-2$	0.568	-0.018	1.006	-0.102	0.998	-0.019	0.646	0.616
$t-1$	0.550	0.005	0.904	0.071	0.979	0.013	0.586	0.606
t	0.555	0.089	0.975	0.084	0.992	0.005	0.539	0.554
$t+1$	0.646	0.095	1.059	0.001	0.997	0.001	0.586	0.591
$t+2$	0.741	0.052	1.060	0.012	0.998	0.001	0.691	0.682
$t+3$	0.793	0.018	1.072	-0.019	1.000	0.002	0.736	0.749
$t+4$	0.811	–	1.053	–	1.002	–	0.740	0.762

Source: Authors' own calculations

where rq_{it} are the relative sales (with respect to other firms within the 3-digit NACE sector), Δry_{it} is the growth (change) in relative productivity, Δrq_{it} the change in relative sales, $rtfp_{it}$ depicts the relative total factor productivity and $\Delta rtfp_{it}$ the change in the relative total factor productivity. Table 8 reveals the correlation between productivity growth and the relative sales of the firm. As can be seen, both firms exporting to EU markets as well as those exporting to former Yugoslav countries experience only a one-time increase in their productivity the year after they start exporting, which is accompanied (and preceded) by a substantial increase in sales. The point is compounded the relative total factor productivity, which is more or less stagnant over the observed time interval.[37] Interestingly, the start of exporting also triggers an increase in relative firm size (increase in employment) and an increase in relative capital intensity. Based on the evidence presented in table 8, it can be concluded that the majority of the productivity growth can in fact be attributed to the initial utilization of excess capacity (conclusive evidence on this proposition, though, would rely on the availability of capacity utilization data[38]). The effect of the productivity hike diminishes quickly as firms proceed to increase their size to accommodate the increased sales.[39] The observed productivity improvements are hence primarily a reflection of the growth in inputs.

[37] Appendix G reveals that the majority of the initial period increase in the vale added per employee can in fact be explained by the growth in capital intensity.

[38] Data on stocks (of intermediate and final goods), although illustrative, does not help in resolving the issue. Namely, excess capacity would have been internalized soon after it occured (it therefore would not be reflected in stock levels).

[39] This fact becomes evident when relative sales are plotted against relative productivity measures and relative size (measured in labor and capital) (Appendix F).

7 Conclusion

This paper contributes to the recent theoretical and empirical literature on firm heterogeneity, foreign trade and the firm performance. As already noted by Damijan et al. (2004) data on Slovene manufacturing firms complements the evidence from developed countries in that firms tend to self-select into exports and multinational production based on their previous performance. Taking advantage of a very complete data set for Slovenia in the period between 1994 and 2002, we employ stochastic dominance test to confirm the proposition that more productive firms in fact choose to export or engage in outward FDI, less productive firms, on the other hand, choose to service only their local markets. In addition we propose a test of the "learning-by-exporting" hypothesis, by presenting a very basic model that could serve to generate learning effects for exporters engaged in highly competitive foreign markets. We show that using fairly general specifications of the demand elasticity function, the model could be used to show that firms facing intense competition in their export markets have an incentive to improve their productivity. Testing the proposed effects, we present several alternative empirical specifications that by and large confirm the positive effect of initial levels of market competition on the productivity growth. This, though, does not provide conclusive evidence that exporting causes permanent productivity improvements. Indeed, by matching new exporting firms to similar non-exporters and using the difference-in-differences approach it is revealed that productivity improvements although present are far from permanent and tend to dissipate shortly after initial entry. This findings, which are in line with Damijan et al. (2004) and Greenaway and Kneller (2004) on UK data, along with the evolution of relative sales growth by new exporters lead us to conclude that the initially experienced productivity hike may be explained by something other than learning-by-exporting (such as capacity utilization caused by the firm market expansion allowing firms to utilize excess capacity). One possible reason for the lack of evidence on the learning effects may be that there has to be a greater gap in development between the importing country and exporters' home country for there to be effective learning as suggested by Blalock and Gertler (2004).

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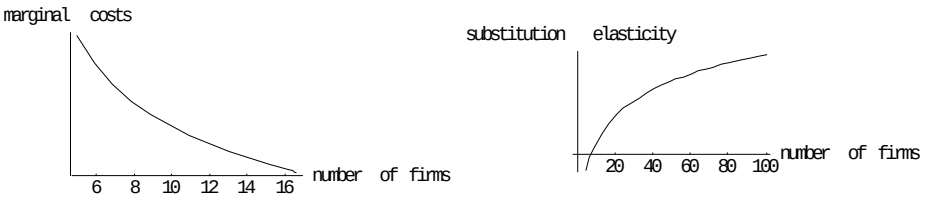
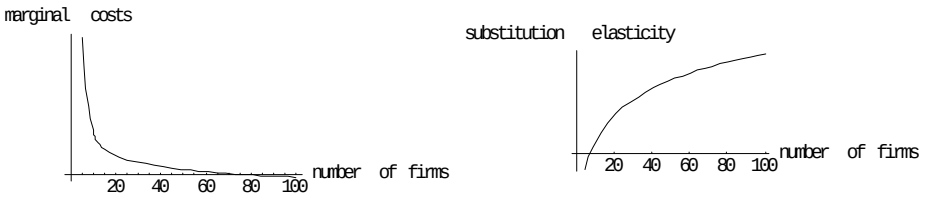
A Appendix

Figure 2: Simulated response of exporter break-even costs to an increase in the number of competitors with the logarithmic elasticity specification

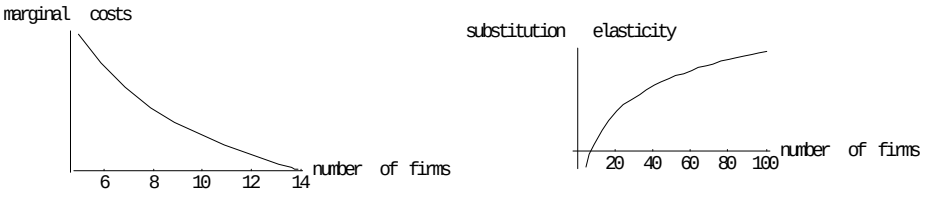
2a: Changing the distribution function of firms to $N(4, 1.5)$



2b: Changing the distribution function of firms to $U(1, 5) \sim$ uniform



2c: Changing parameter values to $t = 1.5$, $F = 4, \beta = 0.8$



B Appendix

Productivity improvements of exporting firms with respect to market concentration [OLS in First Differences, dependent variable Δry_{it}, 1995-2002]

Model	FD all exporters	FD new exporters	FD new exporters
ry_{it_0}	-0.079 (-1.5)	** -0.111 (-2.0)	* -0.067 (-1.8)
rl_{it_0}	-0.004 (-1.3)	-0.007 (-0.8)	0.002 (0.2)
Δrk_{it}	*** 0.362 (3.3)	*** 0.492 (5.8)	*** 0.360 (3.6)
$r\sum_{j=1}^{m} ExSh_{ijt} * HHI_{jt_0}$	* -0.020 (1.9)	* -0.009 (-1.7)	0.002 (0.2)
$\Delta r\sum_{j=1}^{m} ExSh_{ijt} * HHI_{jt}$			-0.025 (-0.7)
$ExSh_{EU}$	0.046 (0.8)	-0.026 (-0.5)	-0.030 (-0.4)
$ImSh_{TOTAL}$	-0.0001 (-0.8)	0.00004 (0.5)	0.00005 (0.4)
No_exp	0.002 (1.3)	0.0012 (0.2)	0.002 (0.3)
$OFDI_{EU}$	-0.100 (-1.4)	*** -0.414 (-3.8)	*** -0.494 (-3.2)
$OFDI_{YUG}$	0.040 (0.9)	0.0422 (0.4)	-0.070 (-0.6)
D_IMP_{EU}	* 0.068 (1.7)	0.038 (0.8)	-0.020 (-0.3)
D_IMP_{YUG}	0.025 (0.7)	0.087 (1.3)	0.036 (0.5)
$emp100 * market_{it_0}$	0.977 (1.4)	-0.362 (-0.5)	0.038 (0.04)
sectoral dummies	YES	YES	YES
time dummies	YES	YES	YES
N	3239	1573	952
adjusted R^2	0.20	0.34	0.17

Notes: t-statistic in parentheses; ***, **, and * indicate significance of coefficients at 1, 5 and 10 per cent, respectively

C Appendix

Results of the system GMM estimation of equation 22 [dependent variable: logarithm of value added]

Model	sys-GMM
y_{it-1}	0.065* (1.6)
k_{it}	0.222* (1.7)
k_{it-1}	0.099 (0.4)
l_{it}	0.765** (2.2)
l_{it-1}	-0.230 (-1.3)
Sec. Dummies	Yes
Time Dummies	Yes
N	11.103
Hansen $\chi^2[p]$	34.6 [0.626]
$AR(1)$	***-5.45
$AR(2)$	0.04

Notes: t-statistic in parentheses; ***, **, and * indicate significance of coefficients at 1, 5 and 10 per cent, respectively

D Appendix

Matching with Olley-Pakes total factor productivity

Model	dynamic
$rtfp_{it-1}$	*** -0.198 (-13.2)
rl_{it_0}	-0.0025 (-1.3)
$D\_exp\ (s=0)$	*** 0.0174 (3.4)
$D\_exp\ (s=1)$	-0.0046 (-1.2)
$D\_exp\ (s=2)$	-0.0065 (-1.6)
$D\_exp\ (s=3)$	-0.0005 (-0.1)
$D\_exp\ (s=4)$	0.0017 (0.3)
Sec. Dummies	YES
Time Dummies	NO
N	5088

Notes: Dependent variable is $\Delta rtfp_{it}^{Treatment} - \Delta rtfp_{jt}^{Control}$. t-statistic in parentheses; ***, **, and * indicate significance of coefficients at 1, 5 and 10 per cent, respectively

Matching with Olley-Pakes total factor productivity (with exporting status as an additional state variable)

Model	dynamic
$rtfp_{it-1}$	*** -0.0429 (-5.7)
rl_{it_0}	0.0003 (0.9)
$D\_exp\ (s=0)$	*** 0.0589 (11.3)
$D\_exp\ (s=1)$	-0.0049 (-1.6)
$D\_exp\ (s=2)$	0.0042 (1.5)
$D\_exp\ (s=3)$	0.0037 (1.2)
$D\_exp\ (s=4)$	0.0008 (0.2)
Sec. Dummies	YES
Time Dummies	NO
N	4842

Notes: Dependent variable is $\Delta rtfp_{it}^{Treatment} - \Delta rtfp_{jt}^{Control}$. t-statistic in parentheses; ***, **, and * indicate significance of coefficients at 1, 5 and 10 per cent, respectively

E Appendix

Productivity improvements of new exporters relative to domestic firms for all enterprises[40] [difference-in-differences matching]

Model	static	dynamic w/ sys-GMM
ry_{it-1}		*** -0.7331 (-11.8)
rl_{it_0}	0.0007 (0.5)	* -0.2436 (-2.8)
$D\_exp\ (s=0)$	*** 0.4215 (5.0)	-0.4759 (-0.7)
$D\_exp\ (s=1)$	0.0004 (0.1)	-0.4351 (-0.7)
$D\_exp\ (s=2)$	0.0020 (0.3)	-0.2956 (-0.6)
$D\_exp\ (s=3)$	0.0084 (1.3)	-0.1153 (-0.3)
$D\_exp\ (s=4)$	** 0.0148 (2.0)	0.0839 (0.2)
$OFDI_{t-1}$	-0.0219 (-1.3)	1.5472 (1.1)
$IFDI_{t-1}$	*** -0.1690 (-5.6)	-1.1774 (-1.21)
Sec. Dummies	YES	YES
Time Dummies	YES	YES
N	74614	2179
$adj.R^2$	0.07	
Hansen $\chi^2[p]$		72.2 [0.865]
$AR(1)$		** -4.87
$AR(2)$		0.79

Notes: Dependent variable is $\Delta rtfp_{it}^{Treatment} - \Delta rtfp_{jt}^{Control}$. t-statistic in parentheses; ***, **, and * indicate significance of coefficients at 1, 5 and 10 per cent, respectively

[40] Including firms with less than 10 employees.

F Appendix

Figure 3a: Changes in relative values of sales, value added, TFP, capital and labor inputs for new exporters with respect to the moment they start exporting

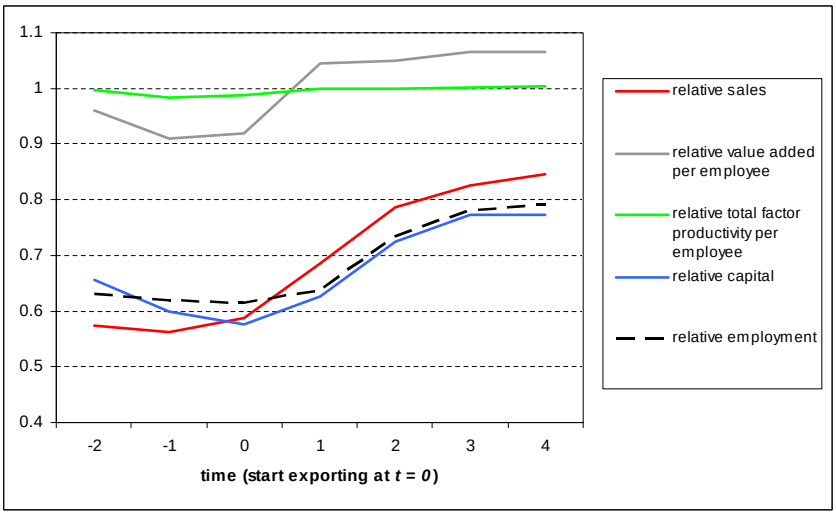
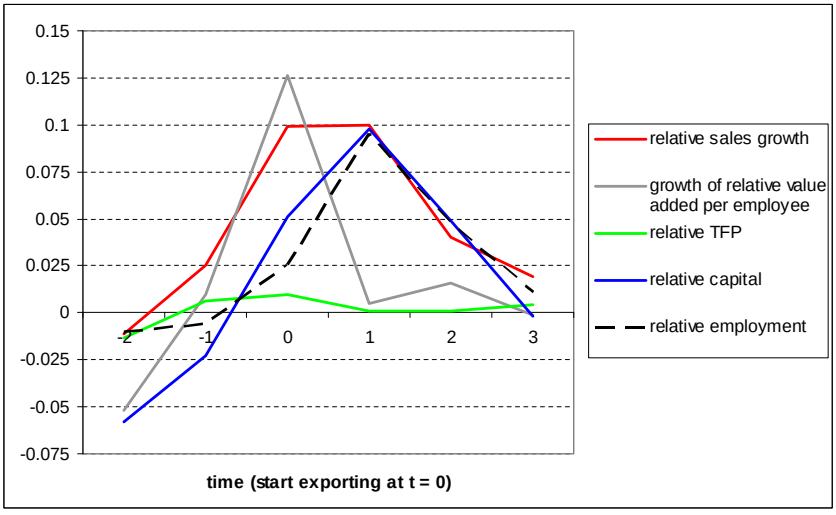


Figure 3b: Changes in relative growth rates of sales, value added, TFP, capital and labor inputs for new exporters with respect to the moment they start exporting



G Appendix

Productivity improvements of new exporters relative to domestic firms for all enterprises[41] [difference-in-differences matching]

Model	FE	dynamic w/ sys-GMM
ry_{it-1}		-0.115 (-0.8)
rl_{it_0}	0.0003 (0.3)	
$D\_exp\ (s=0)$	-0.0076 (-1.0)	1.32 (0.7)
$D\_exp\ (s=1)$	0.0067 (1.2)	1.07 (0.3)
$D\_exp\ (s=2)$	0.0045 (0.7)	0.693 (0.1)
$D\_exp\ (s=3)$	0.0057 (0.9)	-0.233 (-0.1)
$D\_exp\ (s=4)$	-0.0011 (-0.1)	0.760 (0.4)
$D\_exp_{s=0} * rk_{is}$	*** 0.0004 (3.0)	0.004 (0.3)
$D\_exp_{s=1} * rk_{is}$	-0.0001 (-0.4)	-0.244 (-0.2)
$D\_exp_{s=2} * rk_{is}$	0.0001 (0.3)	-0.001 (-0.3)
$D\_exp_{s=3} * rk_{is}$	0.000002 (0.02)	0.052 (0.2)
$D\_exp_{s=4} * rk_{is}$	*** -0.002 (-7.7)	0.143 (0.5)
$OFDI_{t-1}$	-0.088 (-3.7)	-2.419 (-0.1)
$IFDI_{t-1}$	0.154 (1.2)	-2.494 (-0.6)
Sec. Dummies	YES	YES
Time Dummies	YES	YES
N	28968	2181
$adj.R^2$	0.004	
Hansen $\chi^2[p]$		6.58 [0.923]
$AR(1)$		0.87
$AR(2)$		0.10

Notes: Dependent variable is $\Delta rtfp_{it}^{Treatment} - \Delta rtfp_{jt}^{Control}$. t-statistic in parentheses; ***, **, and * indicate significance of coefficients at 1, 5 and 10 per cent, respectively

[41] Including firms with less than 10 employees.