Exports and Productivity of Russian Firms

– In Search of Causality*

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1 Introduction

The opening up of the Russian economy has increased competition on the domestic market and created new export opportunities. Both these factors are important determinants of firm performance and the present study focus on the relationship between exports and firm productivity. While it has been shown that exports and productivity are closely related, the question of the causality between them remains uncertain. Further, transition economies are different from other industrial countries in the sense that their producers were insulated from foreign competition and exports for a long time. Only a handful of studies on the relation between exports and productivity in transition economies have been conducted and with the notable exception of Damijan et al (2004), the effect of reorientation of exports on productivity has not been analysed.

The purpose of this paper is to analyse the differences in productivity between exporting and non-exporting firms in Russia. More specifically, we investigate the relationship between exports and productivity in a large panel of Russian firms over the period 1996–2002. In addition, we investigate the importance of the geographical direction of exports in fostering transmission of knowledge.

The studied period is characterised by increasing total industry productivity.[3] This could be attributed to both inter-industry reallocation of resources, increased production as cost decreased as a result of the rouble devaluation in 1998 and improvements in the production technology. The devaluation could be expected to increase productivity in exporting firms in the short run as revenues increase relative to the costs. The reduction of competitive pressure on the domestic market also gives domestic firms an opportunity to increase sales but the result will not be as immediate as for exporting firms. The devaluation in 1998–1999 has been followed by an appreciating real exchange rates and increasing unit labour costs. That has worsen the position of exporting firms on the world market while aggregated industry output

[3] For a discussion on Russian industry restructuring and productivity see Ahrend (2004).

continued to increase. This combined with the decreasing industry employment in 2002–2003 resulted in increasing productivity.

Empirical evidence suggests that exporting firms are more productive than non-exporting firms. This could be a result of more productive firms becoming exporters, or export activity increasing productivity. Distinguishing between these two hypotheses has important policy implications. If more productive firms self-select into the export market, as suggested by numerous previous studies, policies targeted on stimulating competition on the domestic market will improve export performance. If, on the other hand, exports per se increase productivity, there is a case for supporting exporting firms and efforts should be made to reduce the cost of exporting. The factors behind differences in productivity between exporting and non-exporting firms might vary between countries and presumably, between industries. In the case of transition economies the learning effects from exporting should be comparatively large. However, in the case of Russia the learning effect might be smaller than in other transition economies since a large part of the Russian exports consists of raw materials.[4] The importance of the learning effect is also expected to depend on the export market. Transmission of knowledge is more likely from a developed market economy than from a developing country or countries within the former Soviet Union. The scope for transmission of knowledge is also, likely, affected by the specialisation of the country studied.

The paper is organized as follow: Section two discusses theoretical considerations briefly, previous empirical studies and introduces the data. Section three sets out to establish whether exporters outperform non-exporters. The following two sections analyses the cause of differences between exporters and non-exporters, namely if exporters self-select into the export market and if exports boost productivity. The sixth section analyses the effect of direction of exports on exporters' productivity and section 7 concludes the paper.

[4] In 2003 the export share of petroleum, petroleum products and Gas (SITC, rev 3 code 33, 34 respectively) exceeded 50 % (Ahrend 2004)

2 Background and data

2.1 Theoretical Considerations

There is a substantial amount of empirical evidence on the differences between exporting and non-exporting firms, suggesting that the former are larger both in terms of employment and sale, and more productive than the latter. Several theoretical models supporting these empirical evidences have been developed recently.[5] The basic theoretical framework is monopolistic competition and heterogeneity among firms. A key assumption made is some kind of fixed or sunk cost of exporting, explaining why export firms and non-exporting firms can coexist. The costs imposed on exporters are higher and only the more efficient firms can profit from exports, while less efficient firms produce for the domestic market.

In the model developed by Clerides et al (1998) entry into the export market is induced by increased productivity, since only more productive firms will find exports profitable. On the opposite side firms exiting from the export market will experience a negative evolution of productivity prior to exit. If there is a learning effect from exporting, modelled independently of the volume of exports, the dispersion of the productivity of exporting firms will be larger than if there is no learning effect.[6] The intuition behind this is that the existence of learning effects increases the incentives to remain in the export market even if productivity temporarily decreases.

Melitz (2003) adapts Hopenhayn's (1992) model of dynamic industries to monopolistic competition among heterogeneous firms in a general equilibrium setting in order to analyse the role of inter firm reallocation within industries resulting from trade liberalization. The aggregated outcome of the model is similar to that of representative-firm models, but it explains how the aggregated productivity level and average firm profit level are endogenously determined. Further, in the representative-firm models, changes in aggregated productivity come from changes in the level of

[5] See, for example, Helpman et al (2004), Melitz (2003) and Clerides et al (1998).
[6] The dispersion of exporting firms' productivity will also be affected by the size of the sunk entry costs.

technology common to all firms.[7] In the Melitz (2003) model the aggregated productivity changes come from reallocations among firms. Less productive firms are forced to closedown while more productive firms engage in exports and gain sales and profits.

Jean (2002) developed a model in which firms differ in terms of marginal cost and exporters have to pay a fixed cost and tariffs in order to export. This fixed cost has to be paid each period by exporters, but the exporter can freely opt to leave the export market. In contrast to models with sunk cost, firms have no incentives to stay in the export market if productivity temporarily decreases. As in Melitz (2003), this model predicts efficiency gains from trade liberalization through expansion of the most efficient firms and exit of the least efficient.

2.2 Previous empirical studies

The empirical evidence in support of higher productivity among exporters is convincing. Further, self selection of more productive firms into the export market is supported by a wide range of studies.[8] The evidence of export activity increasing productivity, that is learning-by-exporting, is mixed. Evidence supporting learning-by-exporting is however found in the case of Slovenia (De Loecker 2004), Korea (Hahn 2004), UK (Girma et al 2004), and Italy (Castellani 2002). But there are also several studies rejecting the hypothesis, covering developed countries, newly industrialised countries, and developing countries as well.[9] The opportunity for learning-by-exporting is relatively good in the case of transition economies with a relatively skilled workforce and a diversified industrial structure as compared to many developing countries. Moreover, firms in transition economies have more to learn from the most efficient producers in each industry than firms in developed economies, which are on

[7] For examples of representative firms models see Helpman and Krugman (1985).

[8] For a summary of most previous studies on export and productivity on firm level data, see Greenaway et al (2003).

[9] Examples are Greenaway et al (2003), Bernard and Jensen (1999a), Delgado et al (2002) in the case of developed countries. Clerides et al (1998), and Blalock and Gertler (2003) cover developing countries. Newly industrialised countries are analysed by Aw and Hwang (1995), and Aw et al (2000), among others.

the technical frontier, or small open economies. With the exception of Djankov and Hoekman (1997), Bleaney et al (2000), Damijan et al (2004), and De Loecker (2004) the issue of exports and productivity on the firm level in transition economies has not been studied as far as we know. Bleaney et al (2000) use employment as an indicator of firm performance to study differences between exporting and non-exporting firms in a small sample of firms in Russia, Ukraine, and Belarus 1996 and 1997. They conclude that there is a significant learning effect from exporting. De Locker (2004) and Damijan et al (2004), using firm level data from Slovenia, find support for the learning by exporting hypothesis. In addition, they highlight the importance of direction of export in this context. Only firms exporting to developed markets (OECD) have higher productivity growth than non-exporters. The importance of the direction of trade was also illustrated by Djankov and Hoekman (1997), who studied how geographical reorientation of trade towards the OECD affected productivity in Bulgarian firms. They found that export reorientation had a significant positive impact on productivity.

2.3 Data

Our database consists of a census of Russian industrial firms and covers the period 1996–2002. We have excluded the electricity, the fuel, chemicals and metals sectors, since they are not comparable to other sectors, leaving a sample of manufacturing firms.[10] The sample period is limited to the period after 1996 due to lack of firm-level data on exports for earlier years. The industrial structure of the database is illustrated in Table 1. The table illustrates that we do disregard a substantial part of the industry, in terms of employment; by excluding raw-materials sectors and that a large part of the remaining industry employment is concentrated to machinery. Calculations, based on our regression sample, not reported in the table, also show that exporting firms and non-exporting firms are concentrated to different sectors. In the medical sector, for

[10] Transfer pricing and price regulations makes it difficult to assess the productivity in the electricity and fuels sectors. The metal sector is heavily dependent on natural resources and the chemical sector is linked to the oil industry.

example, almost 88 % of the workers are employed in an exporting firm, while in the food sector exporting firms' employment is slightly less than 33 % of total sector employment in 1997; hence it is important to control for differences between sectors comparing exporters to non-exporters. The last column in Table 1 illustrates the coverage of our sample in relation to total worker employment in each sector. The coverage is fairly good and the coverage are basically the same in all sectors studied.

Table 1 Sector structure of the database and representative ness of the sample

Sector (OKONKh)	% of total employment in the database			Coverage of the sample*
	1996-1998	1999-2002	1996-2002	1997
Electric power (111)	6,9	9,1	8,1	n.i.
Fuels (112)	7,1	7,7	7,3	n.i.
Ferrous metals (121)	6,3	7,4	7,0	n.i.
Non-ferrous metals(122)	4,6	3,0	3,5	n.i.
Chemical & petrochemical (130)	6,4	7,2	7,0	n.i.
Machinery and metal cutting (140)	36,8	28,6	31,2	42,6
Forestry (150)	7,1	7,9	7,7	31,0
Construction materials (161)	4,8	5,3	5,2	39,0
Glass and ceramics (165)	0,8	1,0	0,9	-
Light industry (170)	6,3	6,9	7,0	36,7
Food industry (180)	9,1	11,5	10,7	43,0
micro-biology (191)	0,2	0,2	0,2	-
Grain processing (192)	0,8	1,0	0,9	-
Medical (193)	0,9	1,2	1,1	-
Typographical (194)	0,7	0,9	0,8	-
Others	1,2	1,2	1,5	n.i.

*Percent of total sector worker employment, as reported by IMF (1999), calculations are based on our regression sample. n.i not included in sample, - data available.

The data on firm performance comes from the Russian Enterprise Registry Longitudinal Database (RERLD) and its sub-sample known as GNOZIS.[11] These are yearly enterprise censuses conducted by the Russian Statistical Agency (Goskomstat). The registry contain firm-level information on output, number of employees, book value of capital, total costs, exports and imports (for some years), and some other variables. The RERLD includes all Russian industrial firms except for firms with fewer than 100 employees that are more than 75% privately owned. Both datasets were cleaned of outliers, and, data permitting, missing values were replaced by the

[11] For a more detailed discussion of the databases and their limitations see Bessonova et al (2003)

corresponding values from censuses of subsequent years. Some missing values, as well as missing enterprises, were obtained from the statistical part of the GNOZIS database.[12] As a result of this future of the data we can only study productivity of medium and large sized firms if they are not small and state owned.

Firm-level data on exports by direction and commodity was partly extracted from the GNOZIS database (1996-1997), and partly from CEFIR (1998-2002). The databases include all exports, done by industrial firms themselves. Unfortunately, there is no data about possible exports through intermediaries. Hence, given that intermediaries are quite widespread in some Russian industries exports recorded in our database might understate the true exports of the included firms.

Table 2. Descriptive statistics, mean over the time periods, of the regression sample

Indicator	*firm type*	*1996-1998*	*1999-2002*	*1996-2002*
Employment	Exporters	1044	919	971
	Non-exporters	199	184	189
Sales (th. roubles)	Exporters	72744	285764	197383
	Non-exporters	13936	36155	28706
Labour productivity (RVA/L)	Exporters	18	28	24
	Non-exporters	13	14	14
K/L-ratio	Exporters	152	187	173
	Non-exporters	123	131	128
# Observations	Exporters	8059	11365	19424
	Non-exporters	25708	50973	76681

Note: The descriptive statistics in the table is based on our sample and not the entire database. Calculations of real value added are described in the appendix.

Table 2 reports descriptive statistics for our regression sample. The descriptive statistics shows that exporters, on average, are larger, more productive and more capital-intensive than non-exporters. However, despite favourable conditions for exports after the 1998 crisis, the number of exporting firms is falling in our sample. The share of exporting firms' falls from just below 28% in 1996 to 15% in 2002. This could be a result of increasing use of intermediates in the Russian exports, decreasing

[12] GNOZIS is a database, which includes statistical and balance sheet information on Russian firms. Coverage of firms in GNOZIS is similar to that in the Russian Enterprise Longitudinal Database.

number of manufacturing firms conducting exports or exporting firms stop reporting.[13] The difference within the two groups of firms between the two sub-periods is substantial. The main explanation for this is the financial crises in Russia 1998 resulting in a significant devaluation of the currency altering the conditions for both exporting and non-exporting firms. Exporting firms competiveness increased as relative production costs decreased. On the domestic market, on the other hand, producers had the opportunity to increase market shares as foreign competition decreased, but this might not immediately show up in increasing sales since domestic demand also decreased. This have two effects: first observed productivity increase as increasing sales might lead to better capacity usage, second relatively low productive firms might be able to stay in business, decreasing the observed productivity. Table 2 confirms that the value of sales increased for both firm types, but that average labour productivity of exporting firms increased more than that of non-exporting firms, as a result of the former decreasing its labour force.

3 Are exporters different from non-exporters?

We expect exporters to be more productive since, among other things, competition on the world market is fiercer than on the domestic market; hence only the most competitive firms will be able to export. Moreover, export firms have to pay some additional costs in order to export. The descriptive statistics in section 2 indicate that exporters are different from non-exporters in terms of performance. To analyse these differences in detail we estimate the export premium, using the following measures of firm performance: real sale, number of employees, total factor productivity (TFP), and labour productivity (real value added/number of employees).[14] The export premium is estimated by OLS and by fixed effects applying the following empirical specification (OLS with size controls):

[13] The use of intermediates when conducting exports is rather common in Russia as pointed out by seminaries participants at CEFIR. Unfortunately we cannot control for that, hence we prefer not to use export-shares, but rather a simple dummy variable indicating export status.

[14] Calculations of the productivity measures and real value added are described in the appendix.

Eq. 3.1 $\ln Y_{it} = \alpha + \beta_1 \mathrm{Exp}_{it} + \beta_2 \ln \mathrm{emp}_{it} + \delta_j + \theta_{ter} + \varepsilon_{it}$

where Y_{it} is a performance indicator (sale, employment, TFP, labour productivity and K/L-ratio respectively) of firm *i* at time *t*. Exp_{it} is a dummy variable equal to one if firm *i* exports at time *t*, and $\ln emp_{it}$ is the natural log of the number of employees included as a measure of the size of the firm.[15] δ_j, θ_{ter} are industry (3 digit OKONKh), and location (for each *oblast*), dummy variables. The OLS estimation is conducted year by year and the results reported in Table 3 is the weighted (by the number of observations) averages over the indicated period. The within estimation is conducted with fixed time- and individual (firm) effects; hence the time invariant dummy variables are not included in that regression.

Our main interest is the estimated coefficient of the export dummy variable indicating the difference between exporting and non-exporting firms. If exporters are larger and more productive as indicated by previous studies, using data from other countries, the coefficient of the export dummy variable will be positive. Since the dependent variable is in logarithms, the estimated coefficient has been transformed to indicate the difference in percent between exporters and non-exporters.[16]

The results presented in Table 3 clearly illustrate the large significant difference between exporting and non-exporting firms. This difference is evident in terms of all the performance indicators. Export firms are on average both larger (sales and employment) and more productive. Testing for poolability we have found that the pooled (OLS) model with industry and time dummy variables is not appropriate, but it

[15] We have tried including other firm characteristics such as workers share of total employment and K/L-ratio, but the estimated coefficients were non-significant and the data quality is poor. Therefore, they have been omitted in our selected specification.

[16] Since the standard transformation is likely to be biased, we apply the formula suggested by Garderen and Shan (2002) To derive the % effect of the relevant dummy on the dependent variable and its standard errors:

$\hat{p}_i = 100\left[\exp\left(\hat{c}_i - \frac{1}{2}\hat{v}(c_i)\right) - 1\right]$ and $\hat{v}(\hat{p}_i) = 100^2 \exp(2\hat{c}_i)\left[\exp(-\hat{v}(\hat{c}_i)) - \exp(-2\hat{v}(\hat{c}_i))\right]$ where $\hat{p}_i$ is the transformed coefficient to calculate; $\hat{c}_i$ is the estimated coefficient belonging to the relevant dummy variable; $\hat{v}(\hat{c}_i)$ is the estimated variance of the same dummy variable.

is included since several previous studies estimates a similar equation by OLS, on a single cross-section (e.g. Bernard and Jensen 1999a) or a pooled sample (e.g. Hansson and Lundin 2004).[17] The large differences between the two models indicate that many of the differences between exporters and non exporters are explained by firm characteristics other than the export activity and not controlled for in the OLS regression. But even after controlling for some of the differences among firms, by using fixed effects, the difference between exporting and non-exporting firms remains significant. The estimated export premium on TFP is over 100 %, which is large compared to Sweden (Hansson and Lundin 2004) and the USA (Bernard and Jensen 1999a).[18] But De Loeckeer (2004), investigating Slovenia, found differences between exporting and non-exporting firms that are of the same order of magnitude. We have not controlled for differences in human capital due to lack of reliable data. Failing to do so might bias the export premium, estimated by OLS, upwards, assuming that the labour force are more skilled in the export sector.

Table 3 Export premium in percent

Indicator	**Without size controls**		**With size controls**	
	OLS	Within	OLS	Within
Real sale	574.1 (40.4)	22.3 (2.1)	51.0 (5.9)	13.7 (1.8)
Employment	244.0 (15.0)	9.5 (1.1)	- -	- -
Total factor productivity	106.9 (9.4)	7.2 (2.4)	44.7 (7.1)	7.2 (2.4)
Labour productivity*	76.6 (7.6)	6.2 (2.4)	43.5 (6.8)	7.6 (2.4)
K/L-ratio	61.3 (8.0)	-0.7 (1.4)	27.3 (6.9)	5.1 (1.5)

*The regressions include the K/L-ratio. The estimates indicate the difference in percent between exporting and non-exporting firms. Ln(employment) is included in the regressions with size controls. The OLS regressions include industry and location dummy variables and are conducted year by year. The estimates presented are weighted (by the number of observations) averages. The fixed effect model is estimated with fixed individual (firm) and time effects. Parenthesis gives robust standard errors.

[17] Hanson and Lundin (2004) control for heterogeneity among firms by including in their regression additionally K/L-ratios and skill-ratios as independent variables. Further, they include time dummy variables and the export share of total shipment.

[18] The estimated export premia (TFP) in Sweden is less than 11.1 % (Hansson and Lundin 2004).

4 Do more efficient firms enter the export market?

Russian exporting firms are in general larger and more productive, which is in line with the predictions of the theoretical models; that is, only more productive firms will be exporters. But do more productive firms self-select into the export market? The theoretical model predicts that only firms with relatively high productivity will enter the export market. The higher productivity before entry could, for example, be a result of restructuring of the production or product development. But increasing productivity prior to entry into the export market could also be a result of knowledge transfer from foreign partners prior to export; hence a learning effect. Further, it is plausible to assume that a firm becoming more productive might not be able to start exporting at once, but might need some time to gather knowledge about foreign markets and search for customers; hence firms' productivity might increase some time before engaging in export activities. In order to investigate whether Russian firms entering the export market were more productive then other non-exporting firms *s* years before becoming exporters, we estimate the following equation, by OLS:

Eq. 4.1 $$\ln \mathrm{TFP}_{ijt} = \alpha + \beta_1 \mathrm{Exp}_{it+s} + \beta_2 \ln \mathrm{emp}_{it} + \delta_j + \theta_{ter} + \lambda_t + \varepsilon_{it}$$

on a sub-sample of firms not changing export status more than once and that do not export in *s* years before *t*.[19] $\ln\mathrm{TFP}_{it}$ is the natural logarithm of the total factor productivity of firm *i* at time *t*. Exp_{it+s} is a dummy variable, indicating the export status of firm *i* in period *t+s* and $\ln emp_{it}$ is the natural log of the number of employees at time *t*. δ_j, θ_{ter} are industry and location dummy variables; λ_t is a year-dummy variable.

As we expect future export firms to be more productive before entering the export market, we would expect the estimated coefficient of Exp_{it} to be positive.

Table 4 Total factor productivity prior to exporting

Years before entry		OLS		Within
3	0.131			
	(0.099)			
2		0.17		0.057
		(0.013)		(0.509)
1			0.297	0.178
			(0.000)	(0.026)
# Obs.	27839	68047	68517	68517

The regressions includes ln(employment) and industry, location and time dummy variables not reported. The P-values are based on robust standard errors

The regression results presented in Table 4 show that future exporting firms are more productive than firms in the same region and industry that will not engage in export activities. All the OLS-coefficients, presented in Table 4 (columns 1–3), are significant (only on the 10 % level 3 years prior to entry); indicating that relatively productive firms become exporters.[20] The difference in productivity between exporters and non-exporters three years and one year before entry is rather large, indicating that the higher productivity might be important when a firm decides to enter the export market. If high productivity induces firms to enter the export market, we would expect increasing productivity in the periods prior to entry as indicated by our estimates. However, the opposite might be true if the export decision is taken several years before entry. Firms preparing to enter the export market might divert resources away from production to information collection, searching for partners and so on; hence productivity might fall prior to entry. Failing to control for firm heterogeneity might bias the OLS results. Therefore, we control for firm characteristics that are basically constant over time, such as management, firm specific knowledge and the range of products by re-estimating the model with fixed effects.

Eq. 4.2 $$\ln \mathrm{TFP}_{\mathrm{it}} = \alpha + \beta_1 \mathrm{Exp}_{it+1} + \beta_2 \left(\mathrm{Exp}_{it+2} - \mathrm{Exp}_{it+1} \right) + \beta_3 \ln \mathrm{emp}_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

[19] We use observations from different years (*t)* in the same regression in order to increase the number of observations and to get an estimate of some kind of *normal* effect independent on the year chosen as would be the case if we did not allow *t* to vary.

[20] Eq. 4.1 has also been estimated using labour productivity as dependent variable.. The results are qualitatively the same.

where $\ln \text{TFP}_{it}$ is the natural logarithm of TFP; Exp_{it+1}, Exp_{it+2} are dummy variables, indicating the export status of firm *i* in period *t+1,* and *t+2* respectively and μ_i, λ_t are fixed firm and time effects. In the estimation we restrict our sample to firms not exporting at time *t* and firms not changing their export status more than once. Positive estimates of β_1 and β_2 may be interpreted as indicating that firms eventually starting to export are more productive prior to entry.

The results from estimating Eq. 4.2 are presented in Table 4 (column 4). The results indicate that after controlling for time-invariant firm characteristics there is still evidence of higher productivity in future exporting firms compared to future non-exporting firms one year before entry. We have thus found that future exporting firms are more productive, but this difference should partly be attributable to firm characteristics not controlled for in the simple OLS regression.

Since we have found that exporters are larger both in terms of employment and sales, and have a higher productivity level, these factors might affect the firms export decision. The relative importance of these factors can be tested by estimating a linear probability model or a Probit model, we estimate both and the results are qualitatively equivalent.[21] Following Bernard and Jensen (1999a) we will estimate the, so called, *export decision equation*:

Eq. 4.3 $$Exp_{it} = \phi Exp_{it-1} + \beta_1 \ln emp_{it-1} + \beta_2 \ln TFP_{it-1} + \varepsilon_{it},$$

where Exp_{it} is a dummy variable indicating the current export status of the firm and Exp_{it-1} is the lag of the same variable; emp_{it-1} is the total number of employees at *t-1*, included to control for the size of the firm; TFP_{it-1} is the estimated total factor productivity of the firm at *t-1*

[21] The results from the Probit regression is not reported in the paper to avoid clutter.

Table 5 Export decision

	Within		OLS	
	excl. switch*	incl. switch	excl. switch*	incl. switch
Lag export status	0,386	0,011	0,832	0,593
	(0,000)	(0,260)	(0,000)	(0,000)
Lag employment	0,008	0,025	0,013	0,040
	(0,018)	(0,000)	(0,000)	(0,000)
Lag total factor productivity	0,002	0,006	0,008	0,018
	(0,047)	(0,002)	(0,000)	(0,000)
# observations	54318	64089	54318	64089

All models include time dummy variables and the OLS model adds controls for location, and industry. P-values are based on robust standard errors. *Firms changing export status more than once are defined as switchers.

Table 5 reports the results from estimating the export decision equation by different methods.[22] The model includes a lag of the dependent variable, which means that the OLS and within estimators will be biased. The within estimator produces a downward biased estimate of the coefficient of the lagged dependent variable and OLS produces an upward biased estimate. Estimating the model in first differences applying an instrumental variable (IV) approach result in a consistent but not efficient estimator, but only if the instruments are valid and the variance could be large.[23] The positive significant estimated coefficient of the lagged export variable indicates the presence of sunk entry costs. The total factor productivity during the prior period does not seem to affect the export decision as much as employment and previous export experience, since the within estimate of the coefficient is relatively small though significant and positive. That is, Russian firms starting to export are more productive than non-exporting firms, but the higher productivity itself seem to be of minor importance explaining the entry decision.

[22] We have also tried estimating the model in first differences using the lagged first differences as instruments. The estimates have large standard errors and are highly sensitive to the definition of the sample. In addition, the equation has been estimated by GMM in first differences but no set of valid instruments could be defined; hence the results are not reported.

[23] For a discussion of the properties of the estimators see Baltagi (2001).

5 Does exporting boost productivity growth?

Exporting could promote productivity growth through different channels. One important way it could positively affect productivity is through transfer of knowledge. Exporters have contacts with customers with knowledge about, for example, management and production methods which they could transfer to their suppliers, resulting in higher productivity of the suppliers. A second more debatable channel is the high degree of competition on the world market, forcing exporting firms to be on or at least close to the technical frontier to stay in the export market. It is, however, unclear why a profit-maximising firm does not use the best available production methods even if it does not export. This could, however, be connected to the costs of acquiring knowledge about the best production methods which might be lower for exporters. A third channel is internal economies of scale, which is more important for firms with a small home market. If exporting promotes productivity, exporters will have higher growth rates of productivity than non-exporters. This will be tested estimating Equations 5.1 and 5.2.

Eq. 5.1
$$\Delta \mathrm{TFP}_{it} = \frac{1}{T+1}\left(\ln \mathrm{TFP}_{i(b+T)} - \ln \mathrm{TFP}_{ib}\right) = \alpha + \beta_1 Exp_{ib} + \beta_2 emp_{ib} + \delta_j + \theta_{ter} + \varepsilon_{it}$$
$$b = 1996,\ 1999 \text{ and } T = 3$$

where $\ln \mathrm{TFP}_{ib}$ is the natural log of TFP in the base year; Exp_{ib} is a dummy variable indicating the export status of the firm in the base year; emp_{ib} is the total number of employees in the base year and δ_j, θ_{ter} are industry, and location dummy variables respectively.

Our main interest is the coefficient of the export dummy variable. A positive coefficient would indicate that the productivity of firms exporting in the base year have grown faster than in firms not exporting.

The estimation results presented in Table 6 (columns 1–2) show that exporters and non-exporters growth paths differ. In the first period exporters' productivity growth exceeds that of non-exporters'. But in contrary to what one might expect, if firms are

learning-by-exporting, the productivity of exporters decreased relative to non-exporters, as shown in Table 6. Analysing labour productivity instead of total factor productivity does not change this picture significantly.[24] Interpreting these results one has to keep in mind the August 1998 financial crisis in Russia, resulting in a significant devaluation of the Rouble, affecting both exporters and non exporters, but not necessarily equally. Another drawback of this way of estimating the productivity growth of exporters, as compared to non-exporters, is that some of the firms exporting in the base year exit from the export market and some of the firms not exporting in the base year enter the export market. This flow of firms in and out of the export market is not controlled for in the equation above.

To get a clearer picture of how exporting affects firm performance, we control for the flows of firms in and out of the export market, which are rather important (see Table 7). This way we will also gain interesting knowledge of the productivity of firms leaving or entering the export market.

The method used to compare productivity growth of different types of firms are similar to the one used above comparing exporters and non exporters, with the important difference that we includes dummy variables to control for flows in and out of the export market. Further, we exclude firms not reporting for all years in the relevant period.[25] More formally the estimated equation is:

Eq. 5.2

$$\Delta \ln TFP_{ijt} = \alpha + \beta_1 Exp_i + \beta_2 Start_i + \beta_3 Stop_i + \beta_4 switch_i + \gamma_1 \ln emp_{ib} + \delta_j + \theta_{ter} + \varepsilon_{it}$$

$$\Delta \ln TFP_{ijt} = \frac{1}{T+1}\left(\ln \ln TFP_{ib+T} - l \ln \ln TFP_{ib}\right),\ b = 1996,\ 1999\ \ T = 3$$

where we have added a set of dummy variables, $Exp_i, Start_i, Stop_i, switch_i$, indicating the type of firm, to Eq. 5.1. Exporters are firms exporting all years; start indicate firms start exporting while stop indicate firms stop exporting once during the period; Switch is firms changing export status more than once during the relevant period.

[24] Results from estimating the Equations 5.1 are available from the corresponding author, on request.
[25] A description of the number of observation of each firm type in the periods used can be found in appendix table A1.

The estimated β indicates the difference in performance between the relevant group and firms not exporting at all during the period. The results are presented in Table 6 (columns 3–4).

Table 6 Productivity growth of export firm types compared to non-exporters

	1996-1999	*1999-2002*	*1996-1999*	*1999-2002*
Exporter	0,018	-0,027	0,057	-0,035
	(0,050)	(0,000)	(0,000)	(0,000)
Entry			0,056	0,037
			(0,000)	(0,023)
Exit			-0,006	-0,03
			(0,645)	(0,003)
Switch			0,017	-0,021
			(0,147)	(0,021)
Employment	0,013	-0,004	0,009	-0,004
	(0,000)	(0,068)	(0,012)	(0,152)
# observations	6741	9596	6741	9596

Industry and geography dummy variables included in regressions, but not reported. P-values reported in parenthesis. Only firms reporting for all years of the sub-period is included in the regression.

Firms that start exporting experience higher productivity growth than non-exporters in both periods. This could indicate that productivity growth induces entry or that entry is coupled with learning effects. Except for that finding, the results presented in Table 6 are unclear and depend on the time period studied. The results also show the importance of controlling for flows in and out of the export market when analysing the relation between exports and productivity.

Table 7 Entry and exit of firm to/from the export market

year	Non-exporters	Exporters	Entry	Exit	Switch	Total
1996	6607	2105	n.a.	n.a.	1371	10083
1997	9532	2341	105	590	2092	14660
1998	6139	1322	51	142	1370	9024
1999	10908	1986	66	183	2355	15498
2000	11791	2041	71	210	2384	16497
2001	12072	1997	100	184	2291	16644
2002	9882	1499	153	277	1888	13699

Entry (Exit) only includes firms reporting no export (export) at t-1 and reporting export (no export) at t, where t-1 and t are two consecutive years. Firms change export status more than once are coded as switch all years. Non-exporters and exporters reported excluding exit and entry the year of exit and entry, respectively.

Table 7 illustrates the magnitude of these flows in and of the export market and the relative weight of the different firm types in the sample. The numbers of exporting firms are small compared to non-exporting and the firms stopping to export outnumber firms starting to export each year, implying a decreasing number of exporters. The flows in and out of the export market are large, for example, in 2002 about 1/3 of the exporters decided to exit from the export market.

The analysis above, however, do not indicate whether the differences between exiting and entering firms is a result of increasing (decreasing) productivity before or after entry (exit). To illustrate how productivity of the firm types, defined above, evolves over time we follow Bernard and Jensen (1999b) and Hansson and Lundin (2004) and estimate:

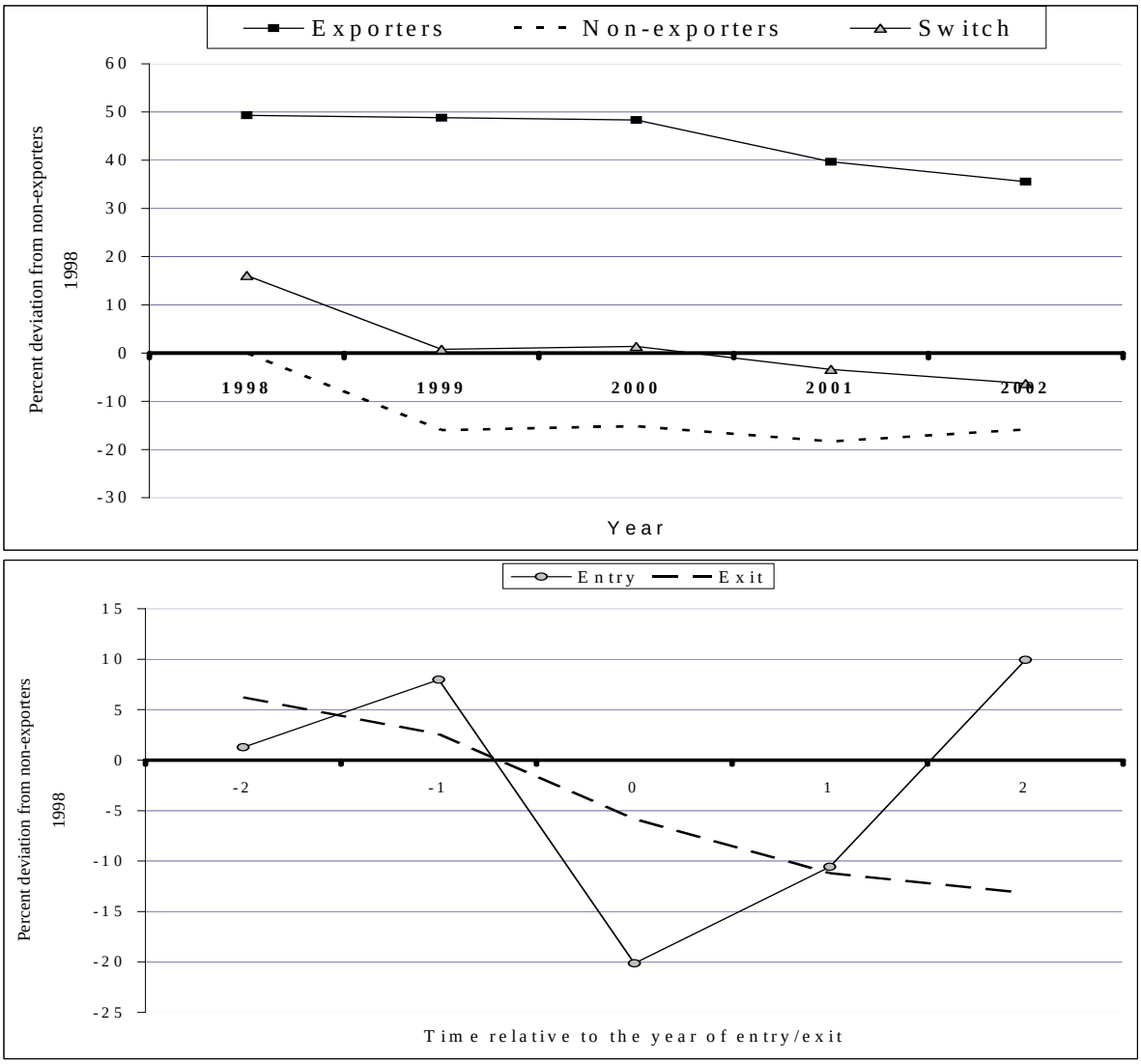
$$\text{Eq. 5.3} \quad \ln \text{TFP}_{ijt} = \alpha + \sum_{e \in E} \sum_{p \in P} \beta_{ep} \left(d_{ie} * d_{it}^{p} \right) + \gamma_1 \ln emp_{ib} + \lambda_t + \delta_j + \theta_{ter} + \varepsilon_{ijt} \quad -2 \le P \le 2$$

on the sub-period 1998–2002 and a sub-sample of firms operating (reporting) for all of these years. The index *e* on the dummy variable indicates which of five groups (exporting all period, non-exporting, start exporting, stop exporting, and switching export status more than once) the firm *i* belongs to. The index *p* indicates the relative relation between the time period *t* and the point in time when a firm started/stopped exporting or the relation between time period *t* and year 2000 in the case of *switch* as well as *exporters* and *non-exporters*. The estimated dummy variables indicate deviations from non-exporting firms and the year 1998. The path of productivity (TFP) is graphed in figure 1 (estimated coefficients and p-values are reported in appendix table A2).

Figure 1 confirms that exporters are, indeed, more productive than other firms. Moreover, the productivity of firms that starts exporting increase after entry; hence indicating that exporting promotes productivity. Firms leaving the export market, on the other hand, experience decreasing productivity before and after exiting. Besides, their productivity is significantly lower than firms staying in the export market even

before they leave the export market; hence our findings support the predictions of the theoretical models that less productive firms will exit from the export market.

Figure 1 Evolution of TFP before and after entry/exit



Exporters are firms exporting for all years 1998–2002; *Non-exporters* are those not exporting at all for the same time period and *Switch* are those changing export status more than once; *Entry* and *Exit* are firms starting (stopping) to export once in the period 1998–2002. Industry, time, and location dummy variables included in regression, but unaccounted for in the diagrams above.

Our findings, presented in figure 1, do not, in contrast to the results in Table 4, seem to support the idea that only more productive firms enter the export market. Productivity in future exporting firms does not increase significantly prior to entry, as indicated by figure 1, and the productivity of entrants is lower than productivity of non-exporting firms in 1998 at the year of entry. But the productivity of non-exporting

firms decreases between 1998 and 1999, as a result of the 1998 crises; hence comparing productivity in firms starting exporting with productivity of non-exporting firms in 1998 might be misleading. If future exporters are not different from non-exporters their productivity should also decrease between 1998 and 1999 and as we have no observations of entry in 1998, by construction, comparing non-exporters and firms that starts exporting it is reasonable to use the productivity of non-exporting firms in 1999 or later. However, firms that start exporting are still not more productive. The results in Figure 1 are sensitive to the time period studied, while the results in Table 4 compare exporters to non-exporters at the same year for all years.

Figure 1, in addition, sheds some light on the results presented earlier (Tables 6). We found that exporters' productivity grew faster than non-exporters between 1996 and 1999, but not in the period 1999–2002. The figure shows that productivity of exporters was relatively high the years following the depreciation of the Russian currency in 1998 and 1999, as could be expected, while productivity of non-exporters decreased. In the years 2001 and 2002 with a real appreciation of the currency productivity of exporters decreased and productivity of non-exporters increased slightly; hence the 1998 crises seem to have affected exporters and non-exporters differently and this have affected our results, when comparing productivity growth of exporters and non-exporters, presented in Table 6.

6 Learning by exporting: volume, direction and composition of exports

We expect the potential of knowledge transfers to be larger from firms in developed market economies than less developed CIS markets, because, among other reasons firms in the more industrialised countries are believed to have superior knowledge of organisation and production and because trade with such countries give the exporters better access to international capital markets and intermediate goods. Indeed, the destination of export seems to affect the potential of learning from exporting, according to previous studies; hence we will distinguish between export flows to developed market economies (OECD) and exports to countries within the former

Soviet Union (commonwealth of independent states henceforth – CIS) and other countries.[26] If there is a learning effect, we expect it to appear in firms mainly exporting to developed market economies. The learning effects might be realised either before a firm starts exporting or while it is exporting. It is, however, likely that possible knowledge transfer and other forms of spillovers before exporting will appear rather close to the time of engaging in export activities.

The first question to answer, however, is whether there is a difference between firms exporting to developed market economies and firms exporting to other countries. Once again we use the export premium equation, but with the addition of separate dummy variables for exports to the three groups described above.

Eq. 6.1 $$\ln \mathrm{TFP}_{it} = \alpha + \beta_g Exp_{igt} + \gamma \ln emp_{it} + \delta_j + \lambda_t + \theta_{ter} + \varepsilon_{it}$$

where $\ln \mathrm{TFP}_{it}$ is the natural logarithm of TFP of firm *i* at time *t*. Exp_{igt} is a set of dummy variables equal to one if firm *i* exports mainly (over 50 % of its exports) to the country group *g* at time *t*, and $\ln emp_{it}$ is the natural log of the number of employees included as a measure of the size of the firm. The industry and location dummy variables δ_j, θ_{ter} are wiped out by the within transformation, but are included in the OLS regression. λ_t is a set of time dummy variables.

The coefficients of the export dummy variables will indicate the difference between firms exporting, to the indicated group of countries, and non-exporting firms, and the differences between the export dummy variables whether the direction of export matters. The relative size of the coefficients should not be used to draw conclusions on whether there is a positive learning effect from exports to developed market economies, since the presence of learning effects and sunk costs could induce firm experience temporary negative productivity shocks to stay in the export market.

[26] As noted above Damijan et al (2004) showed that firm productivity depends on the direction of exports and Djankov and Hoekman (1997) found that reorientation of exports improved productivity

Table 8 Export premium and the characteristics of the export market

Dependent variable ln(TFP) Direction of exports	OLS	Within
OECD	0,422	0,075
	(0,000)	(0,000)
CIS	0,334	0,074
	(0,000)	(0,000)
Other	0,341	0,055
	(0,000)	(0,004)
Employment	0,288	-0,002
	(0,000)	(0,873)
# Observations	96105	96105
R-squared	0,199	0,741
Wald test oecd=cis	20,631	0,001

Regressions include time dummy variables. In addition, the OLS regression includes industry and location dummy variables. P-values in parenthesis are based on robust standard errors.

Exporters are more productive than non-exporters independently of the direction of exports and the estimation technique. According to the OLS estimates, presented in Table 8, firms exporting mainly to developed market economies (OECD) are significantly more productive than their contra parts exporting mainly to the CIS or other countries. However, after controlling for firm specific factors by applying fixed effects the difference in TFP is no longer significant.[27]

To study whether the higher productivity among firms exporting to developed market economies is an effect of learning by exporting, we retain the country groupings from above, but focus on productivity growth. The sample is divided into two four-year periods, with the base years 1996 and 1999 and then the equation below is estimated on the sub-samples. Firms changing export status are excluded from the sample used and firms changing direction of exports during the period are classified as *Others*.

Eq. 6.2 $$\Delta \ln \mathrm{TFP}_{ijt} = \frac{1}{T+1}\left(\ln \mathrm{TFP}_{ijb+T} - \ln \mathrm{TFP}_{ijb}\right) = \alpha + \beta_g Exp_{igb} + \gamma_1 emp_{ib} + \delta_j + \theta_{ter}$$

in Bulgarian firms.

[27] Labour productivity is higher in firms exporting to OECD than in firms exporting mainly to CIS The results are available from the corresponding author on request

Positive learning effects from exporting to developed market economies imply a larger (positive) estimated coefficient of the OECD export dummy variable than the other export dummy variables. The coefficients themselves indicate deviations of the group from non-exporting firms. The results are presented in Table 9.

Table 9 Productivity growth and direction of exports

Time-period	OECD	CIS	Other	Employment	# Observations (R-squared)
1996-1999	0.139	0.02	0.056	0.01	5258
	(0.000)	(0.204)	(0.000)	(0.008)	(0.077)
1999-2002	-0.089	-0.028	-0.003	-0.005	7886
	(0.000)	(0.035)	(0.830)	(0.034)	(0.048)

Only firms reporting and exporting or not exporting all years in the relevant period are included in the regression. Industry and location dummy variables included in the regressions. P-values based on robust standard errors in italics.

Firms exporting mainly to developed countries (OECD) have a higher productivity growth than firms mainly exporting to CIS or other countries and non-exporting firms during the first period. However, during the second period their productivity decreases relatively to non-exporting firms as well as CIS exporters. Therefore, the evidence on learning from exporting to developed markets is inconclusive. Having Figure 1 in mind, it seems like 1999 was a year with rather high productivity of exporting firms and low productivity of non-exporting firms; hence the unclear results. Firms exporting to CIS countries, on the other hand, do not significantly differ from non-exporting firms in the first period, but have slower productivity growth in the second. There is no learning effect from exporting to CIS countries.

7 Summary

This study reports the results from a study of the relation between productivity and exports in Russian manufacturing firms. We have benefited from an extensive database on Russian firms giving us the opportunity to investigate not only the causality between exports and productivity, but also whether the direction of exports

affects productivity. The interpretation of the results is, however, complicated by the financial crises in Russia 1998, causing a large devaluation of the currency, affecting exporters and non-exporters asymmetrically. There is conclusive evidence that exporters are larger and more productive than non-exporters. Moreover, firms exporting to developed market economies are more productive than firms exporting to other countries, but it seems to be an effect of firm specific characteristics rather than of export activity per se. Firms leaving the export market are less productive than exporters and firms that start exporting are more productive, than non-exporters, before entry and their productivity increase the years subsequent to entry. However exporters do not seem to experience higher productivity growth than non-exporters even after controlling for the geographical direction of exports. That is more productive firms self-select into the export market and exports improve their productivity for some time after entry.

Unlike previous studies of transition economies (eg. Damijan et al 2004 and Djankov and Hoekman 1997) we come to the conclusion that the geographical direction of exports has a limited affect on productivity. The productivity difference between firms exporting to OECD and CIS countries is significant but small when estimating the export premium by OLS, but disappears when we control for firm characteristics by fixed effects. The evidences on learning effects from exporting to developed market economies are inconclusive. Productivity growth is higher in firms exporting mainly to OECD in the period up to 1999, but lower in the period after 1999. This seems to be an effect of the 1998 crises.

The absence of learning effects might be explained by the industrial structure in the economy. Raw materials contribute to over 75 % of Russia's exports 2003 according to figures presented in Ahrend (2004), and learning effects should be more important in more technically advanced industries. Our study does not include firms in some raw materials sectors but still a large share of our sample consists of firms in raw material based sectors.

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Appendix

Table A1 Number of types of firms in two sub-periods

	Non-exporters	**Exporter**	**Entry**	**Exit**	**Switch**
1996-1999	3970	1018	266	661	556
1999-2002	6302	1175	297	840	982

#observations on firm-types, included in the regression of Eq. 5.2. The result from estimating the equation is presented in Table 6**.**

Table A2 TFP relative to time of entry/exit

t	**Export Type**				
	Never	Exit	Switch	Entry	Exporter
-2	0,00 n.a.	0,06 (0,40)	0,15 (0,00)	0,03 (0,87)	0,40 (0,00)
-1	-0,17 (0,00)	0,03 (0,71)	0,01 (0,85)	0,08 (0,46)	0,40 (0,00)
0	-0,16 (0,00)	-0,06 (0,38)	0,02 (0,78)	-0,21 (0,15)	0,40 (0,00)
1	-0,20 (0,00)	-0,12 (0,19)	-0,03 (0,55)	-0,10 (0,46)	0,34 (0,00)
2	-0,17 (0,00)	-0,14 (0,18)	-0,06 (0,26)	0,11 (0,48)	0,31 (0,00)

In respect to: firms exporting in all years, exporters; firms changing export status more than once between 1998 and 2002, switch; and firms not exporting, never; t = 0 is defined as 2000. Regression includes location, industry, and time dummy variables not reported. P-values in italics are based on robust standard errors. The results presented in Figure 1 have been transformed according to the formula presented in footnote 16.

Table A3 Productivity *s* years after entry (preliminary table)

Years after start	s=1		s=2		s=3	
	Entry	P-value	Entry	P-value	Entry	P-value
1997	0.45	0.000	0.47	0.000	0.41	0.000
1998	0.41	0.000	0.45	0.000	0.39	0.000
1999	0.40	0.000	0.38	0.000	0.46	0.000
2000	0.22	0.001	0.35	0.000		
2001	0.23	0.007				

Calculations of the TFP

i. Value added is calculated as: sale - costs + wage bill. Value added is deflated by output price index at 5 digit industry level.

ii. We estimate a Cobb-Douglas production function on 3-digit industry level (about 47 industries) using one-way fixed effect (separately for each industry). The estimated equation is:

$\ln Y_{it} = \beta_k \ln rK_{it} + \beta_L \ln L_{it} + \mu_i + \varepsilon_{it}$

Y_{ijt} real value added of firm i at time t

$\mathrm{rK}_{\mathrm{it}}$ real capital of firm i at time t

L_{it} number of employees of firm i at time t

iii. Calculate TFP of each firm as $TFP_{it} = \ln Y_{it} - \left(\alpha + b_{jk} \ln rK_{it} + b_{jL} \ln L_{it}\right)$

where $b_{j.}$ are the estimated coefficients from the Cobb-Douglas production function in industry *j*.