How Innovativeness Affects Internationalisation? –

Empirical Study of Russian R&D Oriented Companies

ABSTRACT

This paper investigates on the role of innovations in internationalisation of companies in transitional economies. Internationalization is measured on the base of export data and is linked directly to the innovation activities of a company. The key research question is what drives internationalization from the perspective of the role of innovations in firm's development – do innovators internationalize more actively? The study aims to identify the clusters of companies according to their export and R&D expenditures data and fulfil in-depth analysis innovations-related determinants that could explain the structure of the clusters.
The study is based on an innovation survey of R&D oriented companies located in the two most developed areas of the country (St. Petersburg and Moscow, Russia).

Key words: Internationalisation, Innovation, Export intensity, R&D intensity, competition, Russia

INTRODUCTION

The main transformation happening in the countries in transition is a change from domestic (closed) economy towards market (open) economy. The change occurs on all levels of economy and society: for country as a whole (political, economic, technology, social changes), for companies (competition, restructuring, technologies, cooperation, internationalisation, etc.) and for individuals (the most important is change in the mentality from communist thinking to market values).

Existing social and economic research conducted is this cross-discipline area investigates the most significant factors influencing this transformation process. One of most important factors that could contribute to understanding of market players changing behaviour is firm's attitude to innovations, technology development, technology transfer and commercialisation of innovations. The opening borders of post-communist countries was highly expected by people and companies, however, together with obvious benefits of free trade, investments and economy development, there is a number of threats for domestic companies which have to be taken into consideration. In

the communist system, domestic companies did not have to put much effort on the improving quality of products and services, personnel training, innovation and marketing research, because they had been enrolled in the direct sales, barter system, or had guaranteed governmental orders. The centralised research institutes were in charge for conducting research and providing technology development opportunities. The supply of technology was not often in balance with a demand of the enterprises. This not balanced connection between research institutions and companies still remains the weakest link in countries in transition, like Russia.

Market liberalisation had hit existing Russian companies with increased competition from imported goods, foreign direct investments (FDIs) and emerging new effective companies. Companies had to learn to be competitive and find own niche either on the domestic market or on the global one. Globalisation brings opportunities and pressures for domestic firms in emerging market economies to innovate and improve their competitive position (Gorodnichenko, et al., 2008).

Many researchers claim there is interdependency between innovation, competition and decision to internationalise. And there is even more research support on the fact that the internationalised companies tend to transfer their experience from the international operations into increased innovativeness on the domestic market.

Authors agree with the statement that “these two features (internationalisation and innovation process) reinforce each other to the extent that today’s economic analysis has to consider both of them simultaneously when trying to account for new dynamic of the firms operating at the international level” (Molero, 1998).

The innovation is a wide concept and, it is not guaranteed, that innovation successfully commercialized in one country, would be as successful in another country, and vice versa.

In this paper we study how firms in transitional economies decide on innovation-internationalization challenge, how innovativeness is reflected on export intensity, and how competition matters in this context.

THEORETICAL FRAMEWORK

Innovations are recognised worldwide as a tool that supports local firms in staying or becoming competitive on the global market. Transitional countries should be the most dramatic beneficiaries of globalization, especially from the transfer of capabilities of FDIs (Sutton, 2007). Competition caused by foreign companies should strengthen domestic companies.

Many researchers (Aghion et al., 2005, Kamien & Schwartz, 1972) hypothesized that there is inverted U shape relationship between intensity of product market competition and extent of innovation. However, research related to transition economies has proved that competition has a negative effect on innovation. There was not support found for the inverted U effect of competition on innovation (Gorodnichenko, et al., 2008). As a factor of competition innovation contributes to explaining heterogeneity in export behaviour (Basile, 2001). According to Lopez and Garcia (2005), technological resources can generate a double competitive advantage for a firm: in lowering costs by creating new and more efficient production processes and in differentiation by means of product innovations.

Innovations can also be seen as one of the main factors facilitating entry to international markets (Basile, 2001). Internationalization itself can be regarded as an innovation for the firm (Andersen 1993, Casson 2000), whereas knowledge is a vital source (Bilkey & Tesar 1977). Some researchers claim innovation perspective be the only approach to internationalization (Hurmelinna-Peltomäki, 2003).

An empirical test of the prediction of product-cycle models of international trade (Vernon, 1966, Krugman, 1979) shows that innovation drives exports of firms in industrialized countries. There

is substantial research evidence on a dual relationship between innovation and internationalisation. Having entered foreign markets by selected entry modes, firms have acquired specific product and market knowledge that enable them to implement more technological innovations (Filipescu, 2007). Thus "innovation has moved from an international reality dominated by the idea of technology transfer, where agents develop knowledge and transfer it to other countries, to a much more complicated situation where, although, that reality has not disappeared, there are also new way of developing innovation in which the international ambit also affects the creation of knowledge stage and which multinational companies acquire new protagonism" (Molero, 2008).

Innovations and R&D plays important role in overcoming barriers to internationalization, but being conditional on having entered export market, R&D does not increase export intensity level when such R&D is treated as endogenous (Harris & Li, 2008).

There are many *factors influencing the dual relationship between innovation and internationalisation, including* firm's heterogeneity and internationalization modes, relationship between (economic and innovative) performances and a further mode of internationalization (Castellani & Zanfei, 2006), influence of innovation characteristics on firm's behavior and relationship between trade and innovation on firm level (Wakelin, 1998), size of the company, innovativeness and export (Wakelin, 1998), influence of a firm's technological capacity on both its decision to export and its export intensity (Lopez Rodriguez & Garcia Rodriguez, 2005). Many factors on the firm-level allow classifying them as domestic, exporting, controlling non-manufacturing activities abroad and manufacturing abroad (Castellani & Zanfei, 2006), or exporter vs. non-exporters (Filipescu, 2007, Wakelin, 1998), non-exporting, low exporting, high exporting (Lachenmaier & Wössmann, 2006).

The results of the theoretical studies, reviewed by authors show that:

1) more productive firms are more likely to be engaged into internationalisation activities, and, firms with high engagement in foreign activities also exhibit better economic and innovative performances (Castellani & Zanfei, 2006);

2) innovating and non-innovating firms behave differently in terms of the probability of export and the level of export. Thus the capacity to innovate fundamentally changes the behavior of the firm. Large innovating firms do more exports. Small innovating firms are more domestic (Wakelin, 1998);

3) non-exporting and low export shares are prevalent among non-innovating firms. Innovators showed export share at 12.6 % higher than non innovators (Lachenmaier & Wössmann, 2006);

4) product innovations, patents and process innovations positively and significantly affect both the decision to export and the export intensity. Technological capacity of the firm is the key factor in its international competitiveness, providing it with greater capacity to enter and sell products in foreign markets. R&D spending is only positive on export intensity (Lopez Rodriguez & Garcia Rodriguez, 2005);

5) absorptive capacity also plays role in overcoming entry barriers, but mostly indirectly through significant impact on R&D, which then directly lowers entry barriers (Harris & Li, 2008).

HYPOTHESES DEVELOPMENT

Summarizing the results of theoretical analysis, a number of hypotheses were developed for this study, based on our conclusions from previous research and aiming to cover the key points of dual relationship between innovations and internationalization of the firm.

H1 There is a relationship between innovation and internationalization

The key research proposition assumes existence of a dual relationship between firm's innovative activity and the level of its engagement in international operations, which are understood as higher or lower exporting. Technology and innovation are the main factors contributing to

facilitate entry to international markets, at the same time as boosting the firm's export performance (Basile, 2001). We also assume that innovative companies are more active with international operations (Harris & Li, 2008, Lachenmaier & Wössmann, 2006). The R&D expenditures thus should also contribute to the level of export intensity. This relationship could be explained not only by the fact of conducting R&D, but by the level of R&D operations in the firm.

H1.1. There is positive relationship between innovations and international operations. Companies with higher R&D expenditures have higher export intensity

The connections between competition and innovation was proven to exist by many researchers (Aghion et al., 2005, Kamien & Schwartz, 1972, Gorodnichenko, Svejnar et als, 2008), and it has more probably negative effect, however the character of this connection is unclear and depends on many factors. Acquiring technological innovations is a significant competitive advantage when entering international markets (Filipescu, 2007, Molero, 2008).

H2. Competition has rather negative effect on innovations

H2.1. Competition has stronger effect on non-exporting companies and companies with low export intensity

The more productive firms are more likely engaged into internationalisation activities (Castellani & Zanfei, 2006).

H3. The more productive companies are more export oriented

Size of the company and its innovativeness positively influence exporting activity. Large innovating firms have more exports and mall innovating firms are more domestic oriented (Wakelin, 1998).

H4. The larger innovative companies are more export oriented, the small innovative companies are more domestic oriented

Product innovations, patents and process innovations positively and significantly affect both the decision to export and the export intensity (Lopez Rodriguez & Garcia Rodriguez, 2005).

H5. Product innovation and patents have positive effect on export intensity

DATA AND METHODOLOGY

The study is based on the survey of 176 R&D oriented Russian enterprises. The survey was conducted in a period from the beginning of December 2007 to the end of February 2008. The sample was drawn on the base of secondary information sources on companies that have shown remarkable growth over the last three years as well as having innovation activities or representing an industry with high innovation intensity. Thus the sample was based on expecting these firms to be innovation-oriented and emphasizing R&D as a source of their long-term competitive advantage.

There are significant difficulties by obtaining the data in transitional economies due to low readiness of firms to disclose information, higher opportunism and strict knowledge-protection policies, in particular in the innovation-active industries. The procedure of data collection had to be made with guarantees of confidentially of all the data gathered and limited opportunities to present the details of the companies taken part in the study in reports and further publications. The data gathering was conducted as follows. At the first stage of collecting the information the interviewer was approaching those companies by the phone and allocated the qualified respondent. Usually the respondent represented the top management body. Then the interviewer offered him/her to answer the questions. Totally, 176 forms were filled for the survey, the response rate equalled 17%. Innovativeness indicators, such as R&D expenditure, new product development, and patenting activity are used to evaluate the innovative capacity on the firm level.

An important advantage of our study is that we have combination of data on R&D expenditures (officially reported) and data on innovation activities and patents, reported by companies in out interviews. This approach allows avoiding the common method bias. Concerns about the common method use arise when both dependent and independent variables are measured by the same key informant (Luo, Slotergaaf, and Pan, 2006; Podsakoff et al., 2003).

Most studies use just patents data and R&D expenditures, which is problematic. Patents have several weakness because they measure inventions rather innovations, they are very industry, country and process dependant / specific, and companies often use other methods to protect their inventions. Using R&D expenditures can also been problematic, because not all innovations are generated by R&D expenditures, R&D not necessary lead to innovation, and formal R&D measures are biased against small firms (Michie, 1998, Archibugi & Sirilli, 2001).

To achieve generalizable results a number of industries and regions was included in the sample. Survey of Russian companies was conducted on the regions having the highest impact of foreign direct investment and highest innovation sector development, mainly in St. Petersburg and Moscow. In the sample (Table 1), there are biggest number of service companies (27.8 %), then, machine building (22.7 %), ICT and electronics (both 14.2 %), energy, oil and gas industry (7.4 %), construction (6.3 %).

Table 1. Industries and R&D expenditures

	Number of companies	Share, %	Sales, %	R&D exp./sales%
Machine building	40	22.7	29.8 %	3.3 %
ICT	25	14.2	24.3 %	0.6 %
Energy, Oil and Gas	13	7.4	19.7 %	2.0 %
Electronics	25	14.2	10.0 %	5.6 %
Services	49	27.8	9.5 %	1.6 %
Construction	11	6.3	2.3 %	0.6 %
Others	13	7.4	4.4 %	1.1 %
All	**176**		**100.0 %**	**2.3 %**

However, when we consider share of sales in certain industries, machine building is leading (30 %), then goes ICT (24 %), energy, oil and gas industry (20 %), electronics (10 %) and services (9.5 %). The industrial composition of the sample indicates companies' R&D orientation. The average share of R&D expenditure in sales is 2.3 % if we consider all companies (and 6.5 %, if we analyse companies, having R&D expenditures). The highest share of R&D is in electronics (5.6 %) and in machine building (3.3 %).

Enterprises are classified on exporting and non-exporting in order to analyse link between the internationalisation and the innovative capacity of Russian companies. The share of exporting companies (80) is quite high – 45.5 % (Table 2). By number of companies, the most export intensive is ICT sector (64 %), then machine building (57.5 %) and electronics (52 %), the last are services (36.7 %) and other sectors (30.8 %). By share of export in total sales, the leading industry is electronics (40 %), then machine building (20.3 %) and ICT (12 %).

Table 2. Industries and export

	Exporters	Exporters / total, %	Exporters, % in industry	Export /sales %
Machine building	23	13.1	57.5	20.3
ICT	16	9.1	64.0	11.9
Energy, Oil and Gas	6	3.4	46.2	10.9
Electronics	13	7.4	52.0	39.7
Services	18	10.2	36.7	10.3
Others	4	2.3	30.8	20.7
All	**80**	**45.5**	**45.5**	**17.0**

The basic financial indicators of exporting and non-exporting companies are presented in Table 3. The average sales per company of exporting companies are slightly lower (59.9 million euros) than non-exporting companies (60.3 million euros). Productivity (sales per employee) of exporting companies is higher – 17.5 thousands euros per employee against 15.8 thousands euros per employee for non-exporting companies. There are 15 % of foreign companies among exporters, and 10.4 % among non-exporters.

Table 3. Financial indicators

	Exporting	Non-exporting
% of total	45.3 %	54.7 %
Sales/company, mln €	59,937	60,320
Employees/company	3431	3805
Productivity (Sales/employees)	17,467.90	15,852.87
% of Foreign companies	15 %	10.4%

For the research purposes, we consider R&D companies separately (Table 4). The most R&D intensive industries are machine building and ICT. However, the share of R&D expenditures in the total sales is higher for R&D companies in electronics, machine building and energy, oil and gas sectors. The share of exporters is higher for R&D companies than for other companies (21.7 % against 17 %).

Table 4. Industries and R&D companies

	Share, %	R&D /sales%	Export %	Number
Machine building	32.9%	4.8%	21.9%	16
ICT	31.0%	0.7%	14.8%	11
Energy, Oil and Gas	13.4%	4.9%	14.7%	5
Electronics	10.8%	8.5%	60.2%	11
Services	6.4%	4.0%	2.7%	8
Others	4.4%	1.8%	29.0%	2
Construction	1.1%	2.1%	0.0%	0
All	**100.0%**	**3.7%**	**21.7%**	**55**

Variables

As our *dependent variables* we measure export activity of firm i as (a) whether firm i exported in a given year t ($EXPORT_D$), (b) a volume of export by a given firm (*EXPORT*), and (c) export as a share of sales of firm i in a given year t ($EXPORT_S$). See Table 5 for definitions of variables used in the study to explore the data and test the hypotheses formulated in the previous part of the paper. Our key *independent variables* are linked to the field of innovation activities of the firms in the sample, and cover R&D expenditures of the firm (*R&D*, $R\&D_D$ and $R\&D_S$), number of technologically new or significantly modified products introduced (*NPD*), labour productivity

(*PRODUCTIVITY* and *PRODUCTIVITY$_{RD}$), and number of patents (PATENTS, PATENTS$_E$ and PATENTS$_{RDE}$).* We also consider the role of the competition from the side of the imports on the key product/service line in domestic market for the firms in our sample *(COMPETITION).* We also analyze the role of the size of the firm by proposing the variable *SIZE* that is based on splitting the sample into sub samples of small/medium sized and large firms.

Table 5. Variable definitions

Variable	Description
EXPORT	Export of a firm in year t
EXPORT$_D$	Dummy variable equals 1 if company i exports in year t
EXPORT$_S$	Export as a share of sales
R&D	R&D expenditure of a firm in year t
R&D$_D$	Dummy variable equals 1 if company i has R&D expenditure in year t
R&D$_S$	R&D expenditure as a share of sales
R&D$_{RDE}$	Ratio between the R&D expenditure of firm i and the number of R&D employees
COMPETITION	Importance of competition from imports in the market for the main product line/service in the domestic market
PRODUCTIVITY	Labour productivity, euro/person
PRODUCTIVITY$_{RD}$	Labour productivity of R&D employees, euro/person
SIZE	Size of firm in terms of a number of employees (small and medium sized – less than 200 employees, large – more than 200 employees)
EMP$_{R\&D}$	Number of R&D employees in the firm i
NPD	Number of technologically new or significantly improved products introduced by firm i during the last 3 years
PATENTS	Number of patents that the firm i has applied for the last 3 years
PATENTS$_E$	Ratio between the number of patents the firm i has applied for over the last 3 years and the number of employees
PATENTS$_{RDE}$	Ratio between the number of patents the firm i has applied for over the last 3 years and the number of R&D employees

RESULTS

The key idea of the study is linking the firm's innovativeness and the level of internationalization (measure through export activities). Table 2 shows the share of exporters across the industries in our sample. The highest share of exporters can be found in ICT sector, electronics, machinery and energy, oil and gas (Table 2).

The interaction effects are tested separately for each dependent variable by applying the methods corresponding with the level of measurement (cross-tabulation, T test for independent samples, ANOVA, linear regression analysis and GLM univariate test).

The distribution of the firms in the sample according to our key variables – $EXPORT_D$ and $R\&D_D$. is presented in Table 6. This distribution allows splitting the sample into 4 clusters:

Cluster 1: Non-exporting innovators (R&D, but no export (29%)

Cluster 2: Non-innovating exporters (export, but no R&D (14%)

Cluster 3: Non-exporting non-innovators (no export, no R&D (25,6%)

Cluster 4: Exporting innovators (both export and R&D (31,3%)

Table 6. Export and R&D Expenditure*

	No R&D expenses	**R&D expenses**	**Total**
No Export	***Cluster 3*** 45 (25.6%)	***Cluster 1*** 51 (29%)	96
Export	***Cluster 2*** 25 (14%)	***Cluster 4*** 55 (31.3%)	80
Total	70	106	176

** Pearson chi square = 4,447 (0,035)*

The relationship between clusters and sales of the companies is presented in the Table 7. When describing the clusters, we see that there is no significant difference in total sales of the firms. The description of cluster structure represents the % of firms by industry in each cluster (Appendix 1).

Table 7. Cluster – Sales relationship (€ mln)

	No R&D expenses	**R&D expenses**
No Export	55,43* (108,28**)	64,63 (157,03)
Export	64,66 (142,28)	57,78 (102,7)

*F=0,058 (p=0,982) * Mean ** Std.deviation*

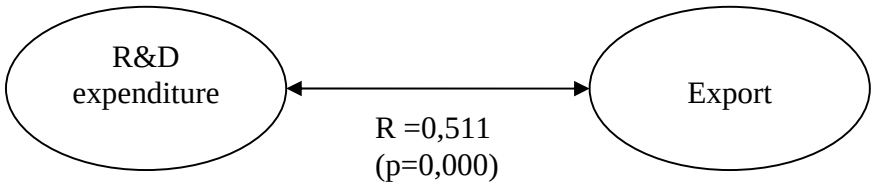
Hypotheses testing

While testing our research hypotheses, the main emphasis was put on understanding the mechanisms, underlying both internationalization and innovation decisions. As theory implies (Basile, 2001, Harris & Li, 2008, Lachenmaier & Wössmann, 2006, Aghion et al., 2005, Kamien & Schwartz, 1972, Gorodnichenko, et al, 2008, Filipescu, 2007, Molero, 2008, Castellani & Zanfei, 2006, Wakelin, 1998, Lopez Rodriguez & Garcia Rodriguez, 2005)., there can be a link between firm's innovation activities and its internationalization. There is no clear research evidence, in particular when considering transitional economies. The research question thus stays open and requires further investigation. Distribution of sample firms across the clusters assumes plurality of motivations underlying both internationalization and innovation decisions. We limit our research to a number of key variables, all linked to firm's innovation activities.

Testing relationship between innovation and internationalization

As Table 6 shows, there is statistically significant relationship between export and innovation activities by the firms in a sample. The main four clusters were defined and described in the previous part of the paper: R&D, but no export (29%), Export, but no R&D (14%), No export, no R&D (25,6%), and Both export and R&D (31,3%).

Figure 1. Correlation between R&D and EXPORT



As seen on the Figure 1, there is a correlation between the R&D expenditure (*R&D*) and export (*EXPORT*). When looking in depth of the export-innovation relationship on example of the sample firms, we may find a statistically significant relationship on the level of export and R&D

expenditures as share of sales (export and R&D intensity). In total, 60% of firms (n=106) have R&D expenditures, while only 45% (n=80) are exporting. The detailed distribution of firms when analyzing both R&D expenditures and export as a share of sales are presented in the Table 8.

Table 8. Export ($EXPORT_S$) – R&D expenditure ($R\&D_S$) relationship

			R&D expenditures as % of sales				Total
			0	less than 5%	5-9%	more than 10%	
Export as % of sales	0	Count	45	25	11	15	96
		% of Total	25,6%	14,2%	6,3%	8,5%	54,5%
	from 1 to 25%	Count	11	4	5	1	21
		% of Total	6,3%	2,3%	2,8%	0,6%	11,9%
	from 26% to 50%	Count	10	17	7	2	36
		% of Total	5,7%	9,7%	4,0%	1,1%	20,5%
	from 51% to 75%	Count	2	2	3	3	10
		% of Total	1,1%	1,1%	1,7%	1,7%	5,7%
	from 76% to 100%	Count	2	8	2	1	13
		% of Total	1,1%	4,5%	1,1%	0,6%	7,4%
Total		Count	70	56	28	22	176
		% of Total	39,8%	31,8%	15,9%	12,5%	100,0%

Pearson Chi-Square = 24,490 (p=0,017)

This relationship is again statistically significant (p=0,017), and implies that there is a strong link between innovativeness and export behavior of the firm. Just 15 firms in a sample have R&D expenditure more than 10% of sales, and the majority of innovators spend not more than 5 % on research and development. At the same time, this relationship does not seem to really stimulate export as we see from the Table 8.

The existing relationship between exporting and innovativeness, revealed by our data, is not easy to explain. We need to address the variables that were selected as independent ones, to try to explain the selection mode of the firms in a sample between the spending on R&D and making decision to go international, since in many cases this seems to be a matter of compromise.

When comparing R&D expenditure, there are no significant differences between exporting and non-exporting companies (Table 9). The share of R&D of the total sales is 3.7 % for exporting

companies and 3.8 % for non-exporting companies. Similarly there are surprisingly few differences between exporting and non-exporting companies in the structure of R&D spending. Exporting companies spend 3 % more for acquisition of machinery and equipment and 0.5 % more for acquisition of external knowledge. Non-exporting companies spend 2.7 % more for internal R&D and 1.7 % more acquisition of external R&D.

Table 9. R&D operations

	Export	**NoExport**
Share companies with R&D	69%	53%
R&D expenditure/Sales, %	3,7 %	3,8 %
R&D expend./R&D pers.	4565.9	3541.7
R&D expenditures. TOP4, %		
Internal R&D	19,9%	22,6%
Machinery & equipment	21,8%	18,0%
Acquisition of external knowledge	15,3%	14,8%
Acquisition of external R&D	10,6%	12,3%

Testing the role of competition in domestic market

Competition is one of the factors that we could use as explanation for both driving the innovation and export activities. We measure competition as perceived importance of competition from the side of import. But at the same time, there are some significant differences in perception of the level of competition by firms from different clusters (Table 10). For the defined clusters, we can see statistically significant differences in terms of perceived competition.

Table 10. Competition perceived by clusters (mean (std. deviation))

	No R&D expenses	**R&D expenses**
No Export	2,63 (1,41)	2,42 (1,26)
Export	3,08 (1,25)	3,41 (1,29)

F = 6,832 (0,000)

There is the highest level of competition perceived in the case of exporting firms with R&D expenditure, while as the lowest level of competition is perceived by non-exporting firms with R&D activities.

The explanation for this difference is not in the influence on the level of R&D expenditure. We have not found significant results by running the regression with COMPETITION as independent variable, influencing R&D. While the impact of COMPETITION on $EXPORT_S$ was significant (Table 11).

Table 11. Impact of competition on the share of export in sales

Dependent variable: $EXPORT_S$			
R^2 = 0,072	**T value**	**B coefficient**	**Sig.**
COMPETITION	-3,672	,268	,000

Thus the stronger the competition in the home market, the more will be the firm inclined to export. The same is not true for the level of the R&D expenditure of firms.

To understand the differences deeper, we present the distribution of firms across the sample in the Table 12.

Table 12. Distribution of firms across the sample

How important is competition from imports in the market *(from "not important" to "extremely important")*		**R&D and Export - Cluster Number of Case**				**Total**
		Cluster 1	**Cluster 2**	**Cluster 3**	**Cluster 4**	
		R&D, no export	Export, no R&D	No export, no R&D	Export + R&D	R&D, no export
not important	*number of firms*	15	3	12	4	34
	%	*8,5%*	*1,7%*	*6,8%*	*2,3%*	*19,3%*
slightly important	*number of firms*	14	6	11	9	40
	%	*8,0%*	*3,4%*	*6,3%*	*5,1%*	*22,7%*
fairly important	*number of firms*	9	3	7	12	31
	%	*5,1%*	*1,7%*	*4,0%*	*6,8%*	*17,6%*
very important	*number of firms*	9	10	7	11	37
	%	*5,1%*	*5,7%*	*4,0%*	*6,3%*	*21,0%*
extremely important	*number of firms*	3	2	6	13	24
	%	*1,7%*	*1,1%*	*3,4%*	*7,4%*	*13,6%*
these products cannot be imported	*number of firms*	1	1	2	6	10
	%	*,6%*	*,6%*	*1,1%*	*3,4%*	*5,7%*
Total	*number of firms*	51	25	45	55	176
	%	*29,0%*	*14,2%*	*25,6%*	*31,3%*	*100,0%*

Pearson chi square = 27,663 (0,024)

There is a statistically significant relationship between the level of competition as perceived by the given firm, and the cluster the firm belongs to. As we see from the regression results above, these differences are largely explained by the driving power of competition that is influencing the export activity of the firm. Due to our cluster approach, we see that the most firms, perceiving the competition as a serious factor, are combining the R&D and exporting activities.

Testing the role of productivity in influencing firm's export activity

When testing the research hypothesis we measure both overall labor productivity and productivity of R&D employees. This hypothesis can be just partly supported, since there is a significant positive impact from the side of the productivity of the R&D employees, while the overall labor productivity has a significant, but negative influence on the export of a given firm (Table 13).

Table 13. Influence from productivity and productivity of R&D employees on Export

Dependent variable - *EXPORT*			
R square = 0,107	**T value**	**B coefficient**	**Sig.**
Labour productivity, euro/person	-2,173	-,239	,033
Labour productivity (R&D employees), euro/person	2,522	,278	,014

Testing the size effect on both innovations and internationalization of the firm

The size of the firm may have a crucial role in firm's innovating and exporting activities. The relationship between the size of the firm and the cluster the firm belongs to was proved to be insignificant. Then we made a t-test for independent samples across a number of variables that could help us explaining the differences in innovative and exporting activities according to the size (Table 14). Indeed, as we see from the Table 14, smaller firms are more limited in terms of R&D expenditures, have less employees, and less export. But they are over-performing the larger firms in terms of higher labor productivity, higher share of R&D spending as % of sales and

higher number of patents per employee and per R&D employee. These innovation activities, though, do not lead directly to higher export sales.

Table 14. Results of testing the difference between small/medium sized and large companies

Size of the firm by the number of employees		All sample	
		Mean	**Std. Deviation**
EXPORT	SME	**1151832,791*** **	1334983,2590
	LSE	**39874664,903*** **	46900918,6148
PRODUCTIVITY	SME	**37539,195*** **	16220,1458
	LSE	**31176,803*** **	13174,8124
R&D	SME	**202230,859*** **	229884,5340
	LSE	**3640291,565*** **	5873241,4924
$R\&D_S$	SME	**,0897** **	,09570
	LSE	**,0484** **	,04624
$R\&D_{EMP}$	SME	**15,81*** **	20,951
	LSE	**573,69*** **	1312,426
$R\&D_{RDE}$	SME	24775,0618	51062,74785
	LSE	40295,8503	79133,44190
PATENTS	SME	19,07	24,935
	LSE	14,00	9,266
$PATENTS_E$	SME	**,40018*** **	,741290
	LSE	**,01808*** **	,028480
$PATENTS_{RDE}$	SME	3,6409	8,77868
	LSE	,2107	,29686
NPD	SME	6,6500	3,85630
	LSE	6,1429	2,82468

*** *p <0.001, ** p< 0.01*

At the same time, when analyzing the innovators only, the export results by large innovators seem to be even higher than in the whole sample (Table 15).

Table 15. Size effects on export by innovative firms (controlled for R&D)

EXPORT (Controlled for firms with R&D expenditures)		
N	Mean	Std. Deviation
22	**1534128,822*** **	1542650,1594
33	**41554594,145*** **	47113306,6500

Testing the role of product innovation and patents on export intensity

The basic indicators of new product development (NPD) are presented in Table 16. 28.8 % of exporting companies have introduced new products in the last three years compared with 26 % of non-exporting companies. NP was mainly developed by own company – 91.3 % of exporters and 88 % of non-exporters. Non-exporters are more likely to co-operate with external partners in the product development phase. The sales mix is also doesn't represent big differences between exporters and non-exporters.

Table 16. New product development (NPD)

	Export	**NoExport**
New product introduced in the last 3 years	28.8%	26.0%
New product developed by:		
Own company	91.3%	88.0%
In cooperation with others	8.7%	12.0%
Turnover, 2006, distributed %		
New product	21.1%	17.2%
Significantly improved	44.4%	43.0%
Unchanged	34.5%	39.8%
Average duration of NPD from idea to market (months)	13.86	13.56

The final regression model is testing a hypothesis about the role of product innovation (*NPD*) measured as a number of new technological products or significantly modified products introduced by the firm over the last 3 years and number of patents (*PATENTS*) in enforcing the exporting activities of the firm (Table 17). Following the results of previous analysis we also have included into model R&D expenditures of the firm (*R&D* and $R\&D_S$).

Table 17. Linear regression model

Dependent variable - *EXPORT*			
R square = 0,800	**T value**	**B coefficient**	**Sig.**
NPD	2,592	,477	,041
$R\&D_S$	-1,491	-,273	,186
R&D	4,007	,749	,007
PATENTS	,061	,012	,953

The regression test shows that export is influenced by the number of new products (*NPD*) and total R&D expenditure (*R&D*). From the previous test we know that R&D are significantly higher by the larger firms (Table 14). The number of patents has no direct influence on export activity that may be explained by some limitations of our study (industries selected, stage of internationalization and innovation activities of the firms in a sample). Development and introduction of new technological products or significantly modified products seems to be one of the drivers underpinning higher internationalization activities in Russian firms, while correlation with the level of R&D expenses was already supported by previous tests. It is interesting that the share of the R&D expenditures has no significant effect on export, while it the share of the R&D is slightly (insignificant) higher in smaller and medium sized firms. Nevertheless, this factor has not proved to be significant determinant in export development and is one more explanation for easier internationalization of larger companies.

CONCLUSIONS

Testing relationship between innovation and internationalization

Results proved that there is a statistically significant relationship between export and innovation activities by the firms in a sample. There is a correlation between the R&D expenditure (*R&D*) and export (*EXPORT*). When looking in depth of the export-innovation relationship on example of the sample firms, we may find a statistically significant relationship on the level of export and R&D expenditures as share of sales (export and R&D intensity). This relationship is again statistically significant (p=0,017), and implies that there is a strong link between innovativeness and export behavior of the firm.

Testing the role of competition in domestic market

We measure competition as perceived importance of competition from the side of import. But at the same time, there are some significant differences in perception of the level of competition by

firms from different clusters. For the clusters defined we see statistically significant differences in terms of competition perceived. There is the highest level of competition perceived is in case of exporting firms with R&D expenditure, while as the lowest level of competition is perceived by non exporting firms with R&D activities.

There is a statistically significant relationship between the level of competition as perceived by the given firm, and the cluster the firm belongs to. As we see from the regression results above, these differences are largely explained by the driving power of competition that is influencing the export activity of the firm. Due to our cluster approach, we see that the most firms, perceiving the competition as a serious factor, are combining the R&D and exporting activities.

Testing the role of productivity in influencing firm's export activity

When testing the research hypothesis we measure both overall labor productivity and productivity of R&D employees. This hypothesis can be just partly supported, since there is a significant positive impact from the side of the productivity of the R&D employees, while the overall labor productivity has a significant, but negative influence on the export of a given firm.

Testing the size effect on both innovations and internationalization of the firm

The size of the firm may have a crucial role in firm's innovating and exporting activities. The relationship between the size of the firm and the cluster the firm belongs to was proved to be insignificant. Then we made a t-test for independent samples across a number of variables that could help us explaining the differences in innovative and exporting activities according to the size.

Indeed, smaller firms are more limited in terms of R&D expenditures, have less employees, and less export. But they are overperforming the larger firms in terms of higher labor productivity, higher share of R&D spending as % of sales and higher number of patents per employee and per R&D employee. These innovation activities, though, do not lead directly to higher export sales.

At the same time, when analyzing the innovators only, the export results by large innovators seem to be even higher than in the whole sample.

Testing the role of product innovation and patents on export intensity

The final regression model results have revealed that export is influenced by the number of new products (*NPD*) and total R&D expenditure (*R&D*), while number of patents and share of R&D expenses have shown insignificant relationship.

The results received in the study are subject to limitations due to the cross-sectional nature of the survey, selection of pro-innovation oriented sectors and limited number of regions presented in the study.

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Appendix 1. Cluster structure description by industry (% of firms in each cluster)

	Cluster 1	**Cluster 2**	**Cluster 3**	**Cluster 4**
	RD,0	EX, 0	0	RD,EX
Avionics	2.0	4.0	2.2	1.8
Bank product	13.7	4.0	6.7	
Chemical				1.8
Construction	7.8	4.0	15.6	
Electronics	9.8		15.6	23.6
Energy	3.9	4.0	4.4	5.5
Food	9.8		4.4	
ICT	3.9	4.0	4.4	3.6
Logistics	3.9	24.0	6.7	9.1
Machinery building	15.7	28.0	20.0	29.1
Oil & gas	2.0		4.4	3.6
Service	7.8	8.0	13.3	1.8
Software	5.9	16.0		10.9
Telecom	2.0		2.2	5.5
Transportation	11.8	4.0		3.6
Total (100%)	29%	14%	25,6%	31,3%