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The effect of internationalization on innovation in the manufacturing sector

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Abstract

This paper examines how Russian manufacturing firms respond to international trade with product innovations, R&D expenditures and technologies' upgrade. The discussion is guided by the theoretical models for heterogeneous firms engaged in international trade which predict that as more productive firms generate higher profit gains, therefore they are able to afford high entry costs, while trade liberalization encourages the use of more progressive technologies and brings higher returns from R&D investments. We test the theory using a panel of manufacturing Russian firms surveyed in 2004 and 2009, and use export and import entry indicators to identify the causal effects on various direct measures of technologies' upgrade. We found that probability of the firm to invest in R&D depends on the prior experience in international trade – both export and import. Importing tends to have stronger learning effects than exporting. Imported input stimulates R&D less than machinery import. Continuous traders are more likely to introduce all three types of innovation. However, we cannot identify any impact of government or foreign ownership on learning-by-exporting or importing effects. Firm location in the border region is irrelevant for the power of links between trade and innovation behavior.

Keywords: Export, import, technological innovations

JEL Classification: F14, O31, O33, P23

EXECUTIVE SUMMARY

The goal of this paper is to examine if the increased participation in international trade can explain changes in firm's decisions to innovate. We use the panel survey data, obtained in the two rounds of manufacturing firms monitoring conducted in 2005 and 2009.

A review of literature in section 2 of the paper suggests from theoretical and empirical perspective that it is reasonable to postulate exporting and importing learning effects in the Russian manufacturing industry in spite of relatively low, though growing participation in the global trade. Exporting firms may acquire knowledge as they interact with their foreign clients. Export helps the firm to increase its market share and returns to scale, which, in turn, would reduce R&D unit costs. Importing firms may acquire knowledge through reverse engineering of products; by learning technologies embodied in foreign intermediates and machinery; and having access to better quality and larger variety of products and services. Section 3 and 4 provide some important statistical evidence and stylized facts about Russia' participation in world trade, describes the data sources and provides descriptive statistics of main variables included in the analysis.

The first set of econometric tests (section 5) is designed to present a self-selection model. The results are consistent with the existing academic literature and show that firms enjoyed productivity and size advantages prior to export- and import entry. Comparing the results for export and import model we see that self-selection effects are much stronger for export than for import. Other factors such as ownership indicators, competition also have more impact on export activity than on the decision to import. Continuous trades are always larger and more productive.

The second econometric study (section 6) investigated the role played by export entry in the firm decision to innovate. We found that continuous exporters are more likely to innovate, while export entry is not associated with immediate changes in technological decisions of the firm. Self-selection based on the firm's past productivity is a significant cause of a firm decision to invest in R&D. However, this effect is not relevant for the decision to introduce the new product or new technology. We found out that the imported capital equipment determines two types of innovations – R&D and new technology introduction - while for the new products it is not relevant.

The next section 7 presents the estimation of learning-by- importing effects. The estimation results suggest that among the studied types of innovations import is mostly associated with R&D expenditures. In most specifications both continues importers and new importers of raw materials and of equipment more often start spending money on R&D, compared to two other groups –

former importers and non-importers. Learning effects for equipment importers are in most of cases stronger that for importers of raw materials and components.

The paper concludes with the discussion on challenges and key policy implications of the findings.

1. INTRODUCTION

Russian manufacturing firms stay low in the rankings of companies active in technological upgrade and product innovations. The reasons behind technological gaps range from demand-side imperfections (low competitive pressure and low demand from industrial consumers) to supply-side weaknesses. The inadequate level of integration of the Russian economy into the global trade, supply and production chains is not often quoted as a reason for weak innovative performance. Though there is much reason to believe that this argument has significant grounds, and trade integration may become an important source of incentives to innovate.

Russia's WTO accession, which was completed in mid 2012, has drastically changed the trade and competitive environments for Russian producers, in both the domestic and international markets. The benefits of trade liberalization are apparent for the resource and other primary sectors, but it is unclear how these changes may impact Russia's manufacturing industries. Reasonable concerns have been raised about the low competitiveness of many firms in this sector with respect to costs and product quality, and on their capacity to embrace modern management and process technologies, punctuated by their inadequate skills in building effective client and supplier relationships. It is not yet clear how these firms would respond to soaring competitive pressures, and whether they have access to the instruments and resources that would allow them to address new challenges through management enhancements and the effective adoption of new technologies, managerial practices, expertise and knowledge. The existing empirical evidence suggests that trade liberalization lead to exit by domestic firms under the increased pressure of import competition (Tybout, 2003). Will Russian manufacturing firms be able to take advantage of trade liberalization and learn lessons from globalization? If so, what would the transmitting mechanisms be? What types of firms benefit the most from trade incentives? In what aspects are learning-by-exporting and learning-by-importing effects most pronounced? How much do Russian companies differ in their abilities to learn from international trade by their counterparts in other transition economies that are more globally integrated and involved?

Effects caused by entry into the export are extensively discussed in the economic literature, while learning effects of import and two-way trade turns less attention of empirical studies. However,

the most quoted papers seem to have a somewhat different focus from ours: is there any evidence at all to support the existence of learning-by-exporting and importing effects per se? Many authors argue that we may be wrong to make conclusions about the nature of such effects when we discuss general regularities observable across the world; specifically, that exporters and importers tend to be more productive, more inclined to innovate, better organized and managed than firms with only domestic, or, all the more so, local orientations. It is argued that in most cases international traders possessed all of these qualities before they entered global markets, and that their high performance and propensity to innovate induced them to enter international markets rather than the other way around (see Greenaway, D. and Kneller, R. (2004), Bernard el al, (2011), for a review of the literature).

In this working paper, we join this discussion and look for self-selection effects to exports and imports, i.e., when the most productive firms self select into international markets, in Russia's manufacturing sector. Than we proceed further and assume that once a Russian manufacturing firm has entered an export market or started importing input and machinery, it is essential for it to learn through a process of global engagement. Faced with more tense competition, choosy customers, and getting advantage from better quality of input materials and advanced technologies, the firm improves more quickly and to a greater extent than other market participants that are still guided by the perception that weak domestic competition and access to administrative resources can make up for their languid performance in the market. We attempt an empirical assessment of learning-by-exporting and learning-by-importing effects, as we interpret learning as post-entry changes in firm innovative behavior following its entry into global markets.

The working paper is organized as follows. First, we review the global theoretical and empirical literature predicting and testing key regularities related to our subject of analysis. Than we survey the overall setting of the Russian manufacturing sector from the perspective of its exporting and importing activities and examine possible effects caused by entry into international markets. We describe the dataset used in the study and present the descriptive statistics for the variables we use to test our hypotheses. Next two sections elaborate the model for learning-by-exporting and learning-by-importing effects. In the conclusion, we report and discuss the estimation results.

2. THEORETICAL AND EMPIRICAL FRAMEWORK

As mentioned above, self-selection effects — i.e., when more productive firms self-select into export markets - have been hypothesized, simulated and supported by extensive empirical evidence. The learning-by-exporting and learning-by-importing effects are more controversial, with less conclusive evidence and more diverging views. It may be of note that innovations in the

context of exporting are usually discussed as mechanisms or links that generate productivity enhancements as a result of exposure to export markets (Aw et al., 2011; Castellani and Zanfei, 2007). Moreover, convincing evidence is available that interactions between investments in exporting strategies and innovations make such firms more competitive on a sustainable basis (Ito, Lechevalier, 2010). Therefore, innovations may be interpreted as a condition for productivity gains that result from the firm's entry into export markets.

The underlying theoretical model used to explore learning-by-trade participation effects is the Melitz and Bernard model for heterogeneous firms engaged in international trade (Melitz, 2003, Bernard et al., 1999), which predicts that because more productive firms generate higher profit gains they are able to afford high entry costs. This would lead to inter-firm reallocations toward more productive firms, resulting in aggregate industry productivity growth. In a more recent paper, (Helpman, Melitz, and Yeaple, 2004) provide a ranking of firms based on their engagement in globalization; these authors predict that the most productive firms choose to engage in FDI, the less productive are active in the domestic market as well as in foreign markets, still less productive firms choose to serve only the domestic market, while the least productive have to exit altogether.

We are interested in the extensions of Melitz's model that postulate technological choice and predict productivity growth in the economy, not only as a result of driving non-productive firms out, but also because trade liberalization encourages the use of more progressive technologies and brings higher returns from R&D investments. In their new model, Constantini and Melitz, 2008 show how market size may affect a firm's choice in favor of exports or innovations, and prove that a firm's productivity growth is endogenous and influenced by its decision to innovate. Meanwhile, the firm's performance in foreign markets is determined by its new competences and technological advancement, yet irrelevant for the domestic market. Hallak and Sivadasan, 2009 use their theoretical model to show that exporters are more likely to sell higher quality products at higher prices than non-exporters.

Therefore, the theoretical work has proven that export status and innovations are at least complementary (if not that there are direct learning-by-exporting effects), when one investment decision (to export) becomes a condition for another investment decision (to innovate), and vice versa. Complementarities are largely achieved because both exports and innovations provide potential opportunities for new knowledge (Castellani and Zanfei, 2007), and because of possible links between product and process innovations (Damijan et al., 2008). Quite often, a firm's decision to introduce a new product would precede its decision to engage in exporting, while subsequent export proceeds allow the firm to start more expensive process innovations, leading to

an increase in productivity. Sutton, 2007 predicted learning-by exporting-effects for exporters in transition economies via vertical knowledge transmission in multinational value chains.

Complementarities between exporting and innovations make it possible to establish a performance ranking, with the exporting and innovative firms being the best-performing, followed by the innovative firms, exporting firms, and then firms that do not participate in either activity (Ito, Lechevalier, 2010). Admittedly, some works argue against complementarities in a situation of heavy resource constraints, when the firm has to choose between exporting and innovations, and these decisions would be more competitive (replacement effect) than complementary. Specifically, Wakelin (1998) found that innovative firms are less likely to export than non-innovative firms, while large, innovative firms are more likely to be exporters than small innovative firms. The author accounts for the above replacement effect by arguing that resource constraints do not allow simultaneous investments in innovations and in exporting.

Empirical tests of the interaction between exporting and innovations produce mixed results. Wagner (2007), the author of the most exhausting review of works in this area, indicates that the empirical literature provides a great deal of evidence supporting the self-selection hypothesis, while research substantiating the learning-by-exporting hypothesis is virtually absent or produce indecisive results. For example, Aw et al (2008), show the interdependence in the firms' choice of export status and R&D investment. They argue that probability of investing in R&D is increased by prior export market activity. However, in the later work Aw et al (2011), reported that plant productivity evolves endogenously in response to the choice to export or to invest in R&D, and high productivity firms self-select into both activities – exporting and R&D. Though the interdependence of the two activities is not a very important factor in the plant's decisions.

Empirical studies utilizing data from emerging and transition economies seem to stand out, as they show that global engagement tends to intensify the innovative activities of firms. Thus, Bustos (2011), in her study of the implications of Brazil-Argentina bilateral trade liberalization, provides convincing evidence that exporting increases the firm's revenues and its propensity to invest in technology upgrading. Therefore, on the national scale, benefits from trade liberalization tend to exceed entry costs because more firms would attempt to invest in advanced technologies.

Gorodnichenko et al. (2010), using data from 27 emerging market economies, provide evidence that exports, imports and involvement in the supply chains of multinational corporations result in intensified innovative activities. Moreover, the stronger a firm's market position, the stronger the learning-by-globalization effects would be.

However, globalization provides a chance, but in no way a guarantee, of overcoming a technology gap. The question of who has better chances – firms lagging the furthest behind or those closer to the leaders – receives a variety of answers in the literature. Some authors believe that the bigger the gap the better the firm's chances for learning-by-trading and for catching up with the leader (Gershenkron, 1962, Fagerberg, 1994, Julan Dua et al, 2010). Other authors, building on the empirical evidence from East European transformations, argue that the learning-by-exporting effects are likely to be stronger for firms closer to the technology frontier (Aghion, Bessonova, 2006).

Our primary focus in this study is to discover how international trade impacts innovations. The literature most often refers to such export-related incentives for innovation as competition and knowledge transfer from importers to exporters. Specifically, in their overview, Greenaway and Kneller (2007) identify three types of mechanisms to encourage innovative behavior in the context of international trade: interaction with foreign competitors, greater economies of scale and enhanced competition. Human capital enhancements are also often mentioned, due to increased requirements for product quality in international markets. Below we discuss papers exploring these transmission channels between exporting and technology and business innovations.

The most simple mechanism is based on the complementarities between exports and innovations. I.e. the accumulation of export revenues provides funds for innovations, while the latter, in their turn, provide a basis for export changes and help to drop the no-win strategy of price competition. For example, Kandogan (2004) explores the drivers behind the growing role played by transition economies in global trade between 1992 and 1998. The author demonstrates that most of the countries in the panel began exporting with low-price products of relatively substandard quality. However, as export revenues accumulated and enterprises restructured, products improved as a result of upgraded production technologies. It is of note that the Central European countries improved 40 percent of their exports between 1992 and 1998, while the performances of the Baltic States, Russia, Belarus and Ukraine were somewhat less impressive. Fabrizio, Igan, and Mody (2007), found similar results and showed that the key drivers behind the increased shares of global trade held by transition economies were improved quality of exports and switching from competition by price to competition by quality.

Another relatively unsophisticated mechanism for exporting to impact innovations is via direct borrowing of new knowledge, technologies and business models. As exporters interact with their foreign clients, they obtain know-how, embrace better management practices and gradually increase their productivity. Foreign buyers frequently transfer the so-called informal knowledge to their suppliers, ensuring goods of acceptable quality. Grossman and Helpman (1991), in particular,

showed that more advanced importers often transfer finished production models to exporters ready for replication, and provide advisory and engineering services. Greenaway and Kneller (2004) argue that export entry changes the innovative behavior of firms. Even if exporters were initially more innovative than domestic firms, their international engagement modifies the nature of their innovative activities, making them opt for the most cutting-edge technologies, including foreign design and developments.

Still another mechanism of boosting innovations via increased market power of exporters is derived from the Shumpeterian model, which predicts that larger firms with resources available for innovative activities are more likely to innovate. Exporting helps the firm to increase its market share and returns to scale, which, in turn, would reduce R&D unit costs and other innovation expenses.

The degree to which innovations are induced by increased competitive pressures on an export starter may be more ambiguous question. This issue is addressed in the literature exploring the effects of competition on firms' innovative behavior. Those papers argue that competition generally serves as an incentive to innovate (Arrow, 1962). However, large companies in concentrated markets may use their monopoly rents to generate innovations (the Shumpeterian School), while firm responses to increased competition pressures would at a minimum be heterogeneous, depending on their initial distance to the technological frontier (Shumpeter's theory as developed in works by Aghion et al. (2004, 2005). Therefore, we may argue (with some caution) that increased exposure to competition as a result of export market entry may spur innovation, especially for firms with enough market power that are initially closer to the technology frontier.

Finally, we should discuss the limitations of learning-by-exporting effects. The authors note varying, sector-specific firm responses. For example, Julan Dua et al. (2010), using a dataset from China's manufacturing industries, prove that exporting has virtually no effect on firm behavior in mature, low-technology sectors (food, textiles, and garments), while learning-by-exporting effects are more pronounced in medium- and high-technology industries (electronics, telecommunication equipment and pharmaceuticals). Moreover, the adoption of cutting-edge technologies takes time and special effort; therefore, learning effects may not be seen immediately, but rather with a lag.

The literature on how decision to import influences the individual firms' decision to innovate is less extensive than that about export effects. Theoretical predictions are also scarce. We should mention the growth literature that provided a foundation for linking trade and growth at a country level (Romer, 1990, Markusen, 1989), and at the level of individual firms (Grossman and

Helpman, 1991). The literature predicts that the firm which is not directly involved in knowledge generation may benefit from the technical progress. Trade contributes to international technology transfer, and the country (firm) which imports intermediary goods can learn from R&D investments made by trade partners and embodied in imported good. Keller (2002), presented the R&D-driven growth model, showing that technology is transmitted in the form of product design and created through R&D is transmitted to other sectors being embodied in differentiated intermediate goods.

Another important strand of literature refers to product cycles (for example, Vernon, 1966, Bernard, Jensen, and Schott, 2006), where high quality products are first produced by technologically advanced countries (firms), than imported and copied by less advanced economies with the lower production costs. Increased import competition may be also a mechanism to cause firms to introduce innovations and raise productivity (Sutton, 2007). The recent review of theoretical and empirical papers by Keller (2004), came to the conclusion that foreign technology embodied in imported inputs and machinery is the main source of productivity growth.

Empirics on learning-by importing effects emerged only recently, as Bernard et al (2007) showed, since new trade data enriched our understanding of import effects. These authors argue that in general firm importing is relatively rarer than firm exporting, and there is a strong correlation between industries with high shares of importing firms and those with high shares of exporters. Moreover, the authors observed similarity of importer and exporter premia: basic firm characteristics – like size, productivity, skill- and capital intensity – are positively related to participation in international trade, whether importing or exporting.

The productivity advantage of importing firms prior to import entry is linked to additional costs, associated with the search for trade partner, contracting procedures, testing and certification, as argued by Andersson, Loof and Johansson (2008). Custom duties also matter (Castellani, Serti and Tomasi, 2008). Import prices are higher than domestic prices, even for the same input category in the same plant in the same year (Kugler and Verhooven, 2009). In contrast to selection into import market, only few papers report post-entry productivity growth. Thus Kasahara and Rodrigue (2005), studying the Chilean manufacturing industry, found plant-level evidence that imported intermediates and materials improve a plant's productivity. Stone and Shepherd (2011) report significant post-entry import productivity growth, using data of the World Bank enterprise surveys in 115 mostly developing and transition economies: a firm that increases import of its inputs and capital goods is significantly more productive than one that increases inputs and capital investments from domestic sources only. The result is positive though insignificant for R&D spending. Seker (2009), showed that two-way international traders from the developing countries

increase productivity more dynamically that non-trading firms. He argued that the export premia is overestimated if we do not account for the imported input.

However, many works deny productivity improvements as the results of imported input, for example (Van Biesebroeck, 2003). Others claim that the learning-by-importing effects depend on the sector, country of origin, or on the specific qualities of imported good. Thus, Kim et al (2007), argued that import of capital goods and consumables, especially from technologically more advanced countries, improve TFP, though intermediary's import does not.

Referring to interdependence between import and innovations, the findings of the majority of empirical studies show that these effects are linked to technology spillovers as a result of import participation. Thus, Keller and Yeaple (2009) showed technological spillover effect in the U.S. manufacturing industry caused by FDI and import, the first being more evident that the last. Goldberg et al (2010) estimate gains from access to new imported inputs in India. They found that lower input tariffs account on average for 31% of the new products introduced by domestic firms mainly due to increased firm access to new input varieties that were unavailable prior to trade liberalization. Damijan and Kostevc (2010), using Spanish microdata, reported sequencing between imports, exports and innovation. They argue that firms learn primarily from import links, which enable then to innovate products and processes and to get prepared for starting exporting. Exporting, in turn, may assist firms to innovate further. They also claim that firms that are closer to technological frontier benefit more from international trade. Halpern, Koren and Szeidl (2011) report larger effects of imported inputs on the productivity of firms in Hungary. Xu and Wang (1999) suggested technological spillovers from imported machinery. Bloom et al (2011), found that Chinese import competition account for around 15% of European technology upgrading between 2000 and 2006, though it also led to falls in employment, profits, prices and skill share.

Thus we may expect that importing firms may acquire knowledge through reverse engineering of products; by learning technologies embodied in foreign intermediates and machinery; and having access to better quality and larger variety of products and services. Importing firms become more productive when they use more advanced production technologies. The learning effect may also be generated through complementarity between adopted foreign knowledge and domestic competences. Import competition increases incentives to innovate.

In sum, a review of the literature suggests that it is reasonable to postulate that exporting and importing may boost firm innovative activities for Russian manufacturing firms. We recognize, of course, that international trade is not the only incentive to innovate, and may not be the primary one. However, trade and innovations combined are very likely to affect a firm's competitiveness.

3. EXPORTING AND IMPORTING IN RUSSIAN MANUFACTURING: STYLIZED FACTS

Since 1995 Russia had a positive balance of trade due to exporting of primary resources (fuels and mining in particular) and products with low value-added like iron and steel while export base in manufacturing has been shrinking relative to other sectors. Crude oil, petroleum products and natural gas accounted for more than 60% of the total exports in the year of 2011. Extractive oil industries and iron and steel are the only sectors where Russia reports RCA (relative comparative advantage). The share of high-tech exports is relatively small (9%) and is dominated by defense industry (Correa and Pajovic, 2011).

However, in the Russian case, relative indicators may be misleading because the current prices for Russian resource and commodity products are so high that their momentum obscures changes in exporting activities by non-resource companies. Even given the current (viewed as humiliating for an industrially developed country) product composition of trade demonstrated by Russian industry, it should be acknowledged that absolute export volumes surged in all of the manufacturing industries (excluding textiles) in the 2000s. The overall manufacturing export expansion, from US$ 46 bn in 2000 to almost US$ 115.7 bn in 2010 (about 2.5 times in current prices), indicates significant changes in the profiles and behavior of Russian manufacturing companies.

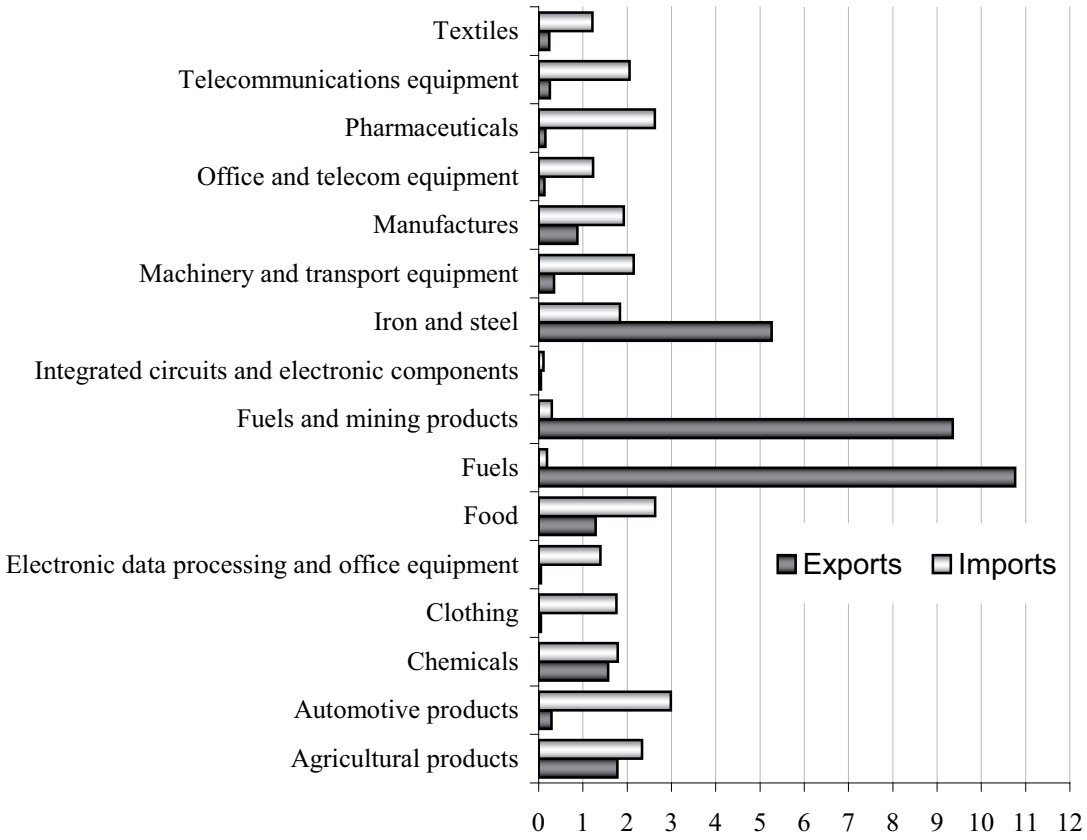
Considering manufacturing goods the product structure of Russia's foreign trade in 2011 indicates much larger shares of the country in the global import than in global export (

Figure 1). Between 2000 and 2008-2010 import was growing very fast, much quicker than export. After a short shock decline during the financial crisis international trade returned to the growing path (Figure 2, **Ошибка! Источник ссылки не найден.** and Figure 4 for selected commodities).

Russian manufacturing goods cannot compete on costs with goods from low-cost economies, while, on the other hand, they are undercut on quality in the high-cost segment. Additionally, Russian companies are not yet widely engaged in global value chains controlled by multinationals; therefore, this mechanism to expand manufacturing exports that is widely utilized by East European counterparts is not yet fully operational. As a result, the product structure of export is dominated by obsolete products and targets shrinking traditional markets. A decomposition of the sources of the growth in Russian exports from 2000–2008 shows that during this period, firms mostly tended to expand their traditional exports to traditional markets, or at most penetrated new

markets with their old products; offering new products, either to traditional and/or new markets, was insignificant (Correa and Pajovic, 2011).

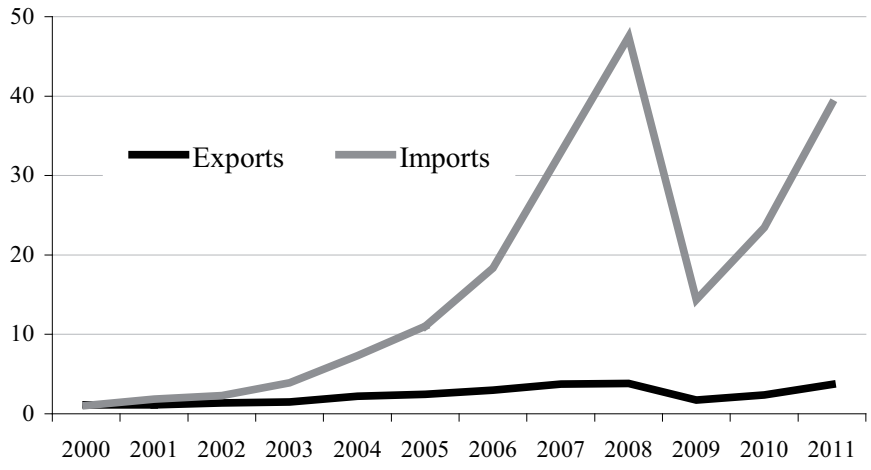
Figure 1. Russia's share in global exports and imports in 2011, %



Source: World Trade Organization. International Trade Statistics

http://stat.wto.org/Home/WSDBHome.aspx?Language=

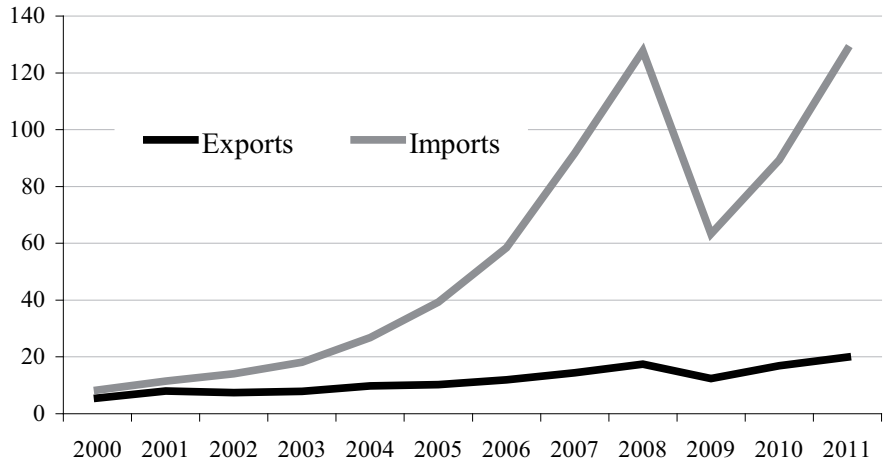
Figure 2. Russian export and import of automotive products in 2000-2011, in US$ bn, actual prices



Source: World Trade Organization. International Trade Statistics

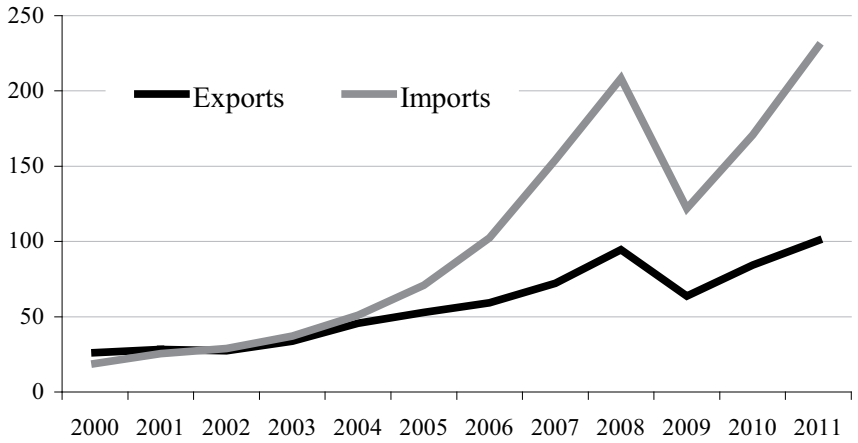
http://stat.wto.org/Home/WSDBHome.aspx?Language=

Figure 3. Russian export and import of machinery and transport equipment in 2000-2011, in US$ bn, actual prices



Source: World Trade Organization. International Trade Statistics
http://stat.wto.org/Home/WSDBHome.aspx?Language=

Figure 4. Russian export and import of manufactures in 2000-2011, in US$ bn, actual prices



Source: World Trade Organization. International Trade Statistics
http://stat.wto.org/Home/WSDBHome.aspx?Language=

The structure of Russian international trade is viewed by some economists as a sign of deindustrialization and Dutch disease (Barisitz and Ollus, 2007). The threat on expanding import, especially caused by Russia's current accession to WTO, is a popular topic in Russian media and academic discussions. Yet, some economists stress the necessity to import more capital goods and

better quality input for re-equipment of Soviet-era manufacturing enterprises unable to compete on the global market having outdated equipment, technologies and suboptimal input quality which couldn't satisfy the demanding consumers. The import of investment goods (machinery, equipment and transport means) has not been growing fast enough compared to the challenges of machinery upgrading. (Table 1).

Table 1. Changes in absolute volumes of exports and imports in selected manufacturing industries, in US$ bn, actual prices

	2000		2005		2010	
	Exports	Imports	Exports	Imports	Exports	Imports
Metals, precious stones, fabricated goods	22.4	2.8	40.6	7.7	50.5	16.9
Chemicals	7.4	6.1	14.4	16.3	24.5	34.9
Machines, equipment, transport vehicles	9.1	10.5	13.5	43.4	21.5	44.4
Wood, pulp-and-paper products	4.5	1.3	8.3	3.3	9.6	5.9
Foodstuffs and agricultural raw materials	1.6	7.4	4.5	17.4	8.8	36.4
Textiles, clothing and footwear	0.8	2.0	1	3.6	0.8	14.2

Source: Rosstat 2012 http://www.gks.ru/bgd/regl/b11_12/Iss

WWW.exe/stg/d02/26-08.htm

http://www.gks.ru/bgd/regl/b11_12/IssWWW.exe/stg/d02/26-11.htm

Technological gap is visible in the estimations of Russia's position in WEF Global competitiveness report in 2012-2013 (67 rank out of 144 countries) with extremely low level of technological adoption estimates – 137th, (WEF, 2012). To catch up with advanced and even fast growing developing economies, like China, technological upgrading using modern imported and domestic machinery should be much more extensive, then now (Table 2).

Table 2. **Rankings of Russia and China in WEF Global Competitiveness report 2012-2013**

	Russian Federation	China
Production process sophistication	113	57
FDI and technology transfer	135	77
Availability of latest technologies	129	107
Firm level technology absorption	141	71

Source: WEF Global Competitiveness report 2012-2013

Micro data confirm with some degree of certainty that Russian manufacturing firms are gradually opening up to the world – not only through their exporting, but via other globalization channels,

including resource and intermediate imports, FDIs, international joint ventures, strategic alliances. Indeed, judging by the two surveys of medium-sized and large manufacturing firms conducted by the Higher School of Economics (HSE) in 2005 and 2009, the share of exporting firms in the sample increased from 51% to 55%, importing of intermediate input remained almost stable, while the shφre of firms importing machinery doubled – from 27% to 54%. Therefore, if a considerable number of Russian manufacturing firms are, one way or another, involved in international markets and this involvement is substantial in value terms, there is every reason to examine carefully learning effects of exporting and importing.

4. DATA AND EMPIRICAL STATISTICS

Data for the empirical analysis in this study comes from two rounds of manufacturing firms monitoring conducted by the National Research University – Higher School of Economics in 2005 and 2009.

The stratified random sample of manufacturing enterprises from 8 aggregate types of economic activity is representative for a population of enterprises employing between 100 and 10,000 people. However, it is biased toward better performers due to the time of the last survey — right in the midst of the financial and economic crisis of 2009. Accordingly, our sample excludes non-viable firms that failed to survive through the peak of the crisis. The data includes firms located in 48 Russian regions and 357 cities. Regional identifier gives us an opportunity to construct a dummy-variable “border region” and link it to the survey answers. This allows us to explore the role of geographical proximity and cross-border cooperation in the innovative activities of the firms.

The panel includes 499 observations, with the panel structure adequately reflecting the structure of the total sample and general population of manufacturing firms (Table 3).

Table 3. Descriptive statistics of firms surveyed in two monitoring rounds, % of total respondents

	2005	2009	Panel
Sample structure by types of economic activity			
Food	24.8	24.6	21.8
Textiles and clothing	9.2	9.3	10.6
Timber and woodworking	8.4	8.5	9.0
Chemicals	8.8	9.2	10.2
Metals and metal-working	10.3	10.2	8.4
Electrical equipment	14.2	12.2	13.8
Transport equipment	9.0	9.0	10.2
Machines and equipment	15.5	17.0	15.8

TOTAL	100	100	100
Sample structure by firm size			
Under 250 employees	43.8	45.0	47.7
251–500	25.6	24.1	22.0
501–1000	15.9	16.5	15.4
Over 1000 employees	14.7	14.4	14.8
TOTAL	100	100	100
Number of observations	1002	957	499

Source: data from two rounds of a manufacturing business survey conducted by the National Research University - Higher School of Economics, Institute for Industrial and Market Studies (IIMS)

The dataset includes key company data: employment, sales value, ownership type, industrial sector, affiliation with holding structures, data of incorporation and regional location. The survey data permit us to explore the effects of pressure from import competition using responses originally measured in 1-4 scale from “no influence” to “strong influence”. We constructed a dummy-variable where 1 – is a strong pressure (scale 4) and 0 – no pressure at all, little or moderate pressure (scale 1, 2 and 3, correspondingly).

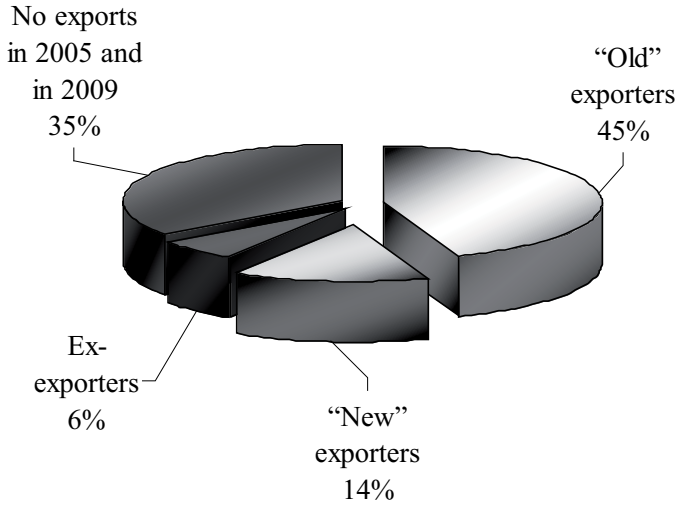
Our respondents are top-managers of the firm who self-report various types of innovation activity, including development of a new product, adoption of new technology and undertaking of corporate R&D expenditures[1]. The last measure is appropriate in our case as we deal only with medium and large firms, so it doesn’t suffer from bias against small firms (Archibugi and Sirilli, 2001). Both rounds of the survey asked identical questions.

The survey questionnaire allows export products of the firm to be described in terms of their availability (export status), quantity (share of total firm sales), composition (raw materials, semi-finished goods, finished goods, services) and destination (CIS and non-CIS countries). In this paper we are only looking at export status during 2002–2004 and 2005–2008, irrespective of export level and destinations.

In terms of exporting status we distinguish four groups (Figure 5): companies without any export activity in 2005-2009 (35% of the panel), continuing exporters (45%), new exporters (who reported exporting for first time in 2009 – 14%) and “former exporters” (firms that were exporters in 2005 but stopped their exporting activity in 2009 – 6%). This grouping covers all of the possible choices of company exporting strategy in terms of operating in either local or global markets in the period surveyed.

[1]The questions about innovation activities were formulated in accordance with OECD guidelines (Oslo manual..., 2005)

Figure 5. Exporting status of the firms in 2005-2009



Source: survey data

Summary statistics by the firm exporting status are presented in Table 4.

Table 4. Summary statistics of the panel structure by the firm exporting status in 2005-2009

	No exports in 2005 and in 2009	"Old" exporters	"New" exporters	Ex-exporters	Statistical significance *
Number of employees in 2005	275 (17)	937 (80)	470 (72)	573 (110)	0.000
Labor productivity in 2005, thou rubles	153(11)	242(20)	286(81)	162(19)	0.000
Labor productivity above industry average,%	34,7	60,3	46,0	65,5	0,000
Members of integrated business groups in 2005,%	28.2	32.0	27.8	9.7	0.082
Foreign ownership in 2005,%	1.7	9.5	6.9	0.0	0.005
Government ownership in 2005,%	10.3	12.2	8.3	6.5	0.674
Firm established before 1991	76.4	72.1	66.7	67.7	
Firm established between 1992-1998	13.8	17.6	25.0	25.8	0.405
Firm established after 1998	9.8	10.4	8.3	6.5	
Competition with import 2005	17.8	30.1	26.4	45.2	0.045
R&D spending 2005, % of responded firms	43.1	76.5	53.1	67.9	0.000
R&D spending 2009, % of responded firms	17.8	53.2	38.9	32.3	0.000
R&D spending 2005, thou rubles	641(128)	3397(413)	1094(280)	2375(900)	0,000
R&D spending 2009, thou rubles	679(243)	2580(366)	1540(512)	1528(1242)	0,000
Introduction of a new product 2005, %	43.1	54.5	50.0	41.9	0.124
Introduction of a new product 2009, %	39.7	58.1	48.6	32.3	0.001
Introduction of a new technology 2005, %	28.2	42.8	23.6	38.7	0.003
Introduction of a new technology 2009, %	25.3	47.3	34.7	25.8	0.000

Share of imported raw materials in purchases of materials in 2005, %	15.7(2.1)	20.6(2.0)	20.3(3.8)	18.5(5.0)	0.000
Share of imported equipment in purchases of equipment in 2005, %	16.4(2.4)	28.9(2.5)	19.9(3.9)	33.0(7.7)	0.000
Food industry	43.1	6.3	20.8	16.1	
Textiles and light industry	13.8	7.2	12.5	12.9	
Timber and woodworking	7.5	10.8	5.6	12.9	
Chemicals	3.4	14.9	12.5	9.7	0.000
Metals and metal-working	4.6	13.5	5.6	0.0	
Electrical equipment	12.6	12.6	12.5	32.3	
Transport equipment	5.2	13.1	15.3	6.5	
Machines and equipment	9.8	21.6	15.3	9.7	
Border region	23.6	35.6	36.1	35.5	0.172
Number of observations	174	222	72	31	

Note: standard errors in parenthesis.

To estimate the significance of the variance we used Pearson's chi-squared test and the Kruskal-Wallis test to compare the averages

It is apparent that incumbent exporters are considerably larger than new export entrants and quitters, as well as non-exporters. The highest level of labor productivity in 2005 is reported by new exporters (i.e. before they started to export). We may assume that this reflects the self-selection effect as in Melitz (2003)[2].. Differences among groups (statistically significant at 5 percent level) are primarily observable in the firms' ownership structures. Thus, in 2005, foreign ownership was reported by both old and new exporters, while non-exporters and export quitters had practically no foreign owners at all. The highest share of firms which experience pressure from imports' competition is in the group of export quitters (45.2%) while firms with no export in both rounds of monitoring seem to work in the niches where import is not dominating (these differences are significant at 5%). Though the share of any kind of exporters is higher in border regions, this correlation is not statistically significant.

Summary statistics from our dataset reveals a correlation between shares of importing inputs (both raw materials and equipment) and exporting status (significant at 1 percent level). Table 2 shows that non-exporting firms are also importing less than other groups. For example, share of firms, which reported import of equipment in the groups of "old" and former exporters is twice higher than in the group of non-exporters.

Cross-sector differences are also highly significant (at 1 percent): in the group of incumbent exporters, machine and equipment producers account for the largest share (21.6 percent), while food enterprises have the smallest share (6.3 percent). Meanwhile, in the group of new exporters, the latter dominate in 2004–2008.

[2] We explored empirically the self-selection for export in our earlier paper (Golikova et al., 2012), though in this paper we'll use somewhat different specification of the model and include additional factors.

Differences among export-related groups in their level of innovative activities are statistically significant at 1 percent level, with the only exception for the new product introduction in 2005. “Old” exporters in all industries maintain their leadership in the level of innovative activities in both survey years. New exporters innovate on a smaller scale, but show positive developments in implementation of new technologies. The share of firms, which reported R&D expenditures within the group of new exporters, reduced from 53 percent to 31 percent due to the crisis of 2008-2010. However, continuous R&D spenders have significantly increased the level of expenditures.

Both groups of active exporters, in spite of the crisis as of 2008–2009, increased their participation in product and technology innovations, while the group of non-exporters and ex-exporters decreased their innovative activities. Ex-exporters quitted from innovation more often than other groups of surveyed firms.

Import status data is also available for the both periods of monitoring. The data gives us an opportunity to analyze two indicators of imported intermediate inputs: (1) importing of raw materials and components (2) and importing of equipment. The data about imports allows measuring the share of import materials in purchases of intermediates and a share of import equipment in purchases of equipment.

Similarly to export status group, we distinguish four groups in importing of raw materials (**Figure 6. Import of raw materials status in 2005-2009** and equipment **Figure 7**): companies without any import activity in 2005-2009, continuing importers, new importers and import quitters.

Figure 6. Import of raw materials status in 2005-2009

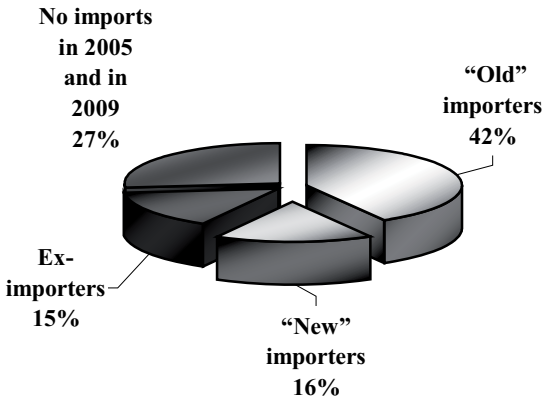
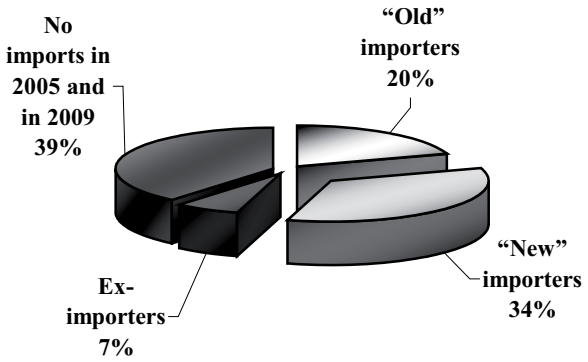


Figure 7. Import of equipment status in 2005-2009



Source: survey data

More than half (58%) of Russian medium and large manufacturing firms use importing raw materials and components in their production process (**Figure 6**), and among them 42% reported this type of import throughout two rounds of monitoring. The total share of importers of capital goods is almost the same - 54% (**Figure 7**), but the share of new importers of equipment is two times higher than the share of new importers of raw materials (34% and 16%, correspondingly). This may be explained by the active equipment upgrade at a company level during the growth period, when companies accumulated resources and invested a lot. Descriptives show that contrary to expectation location in border regions has no effect on both types of importing.

Significant differences at 1% level in labor productivity and size (Table 5 and Table 6) might be an indication of possible self-selection effect into importing of raw materials, components and capital goods as well. All indicators of technological innovation in 2009 suggest that continuing importers of both types of inputs are more innovative in all measured indicators - share of firms involved in R&D, introduction of new product and technology.

Table 5. Descriptive statistics of the panel structure by the firm importing status in 2005-2009 (importing of raw materials)

	No imports in 2005 and in 2009	"Old" importers	"New" importers	Ex-importers	Statistical significance *
Number of employees in 2005	306(23)	795(72)	648(107)	641(121)	0.000
Labor productivity in 2005, thou rubles	171(33)	251(21)	166(13)	195(27)	0.000
Labor productivity above industry average, %	40.1	67.4	50.0	48.4	0.000
Members of integrated business groups in 2005,%	23.1	42.7	16.1	18.2	0.707
Foreign ownership in 2005,%	3.0	6.8	8.5	5.3	0.341
Government ownership in 2005,%	12.9	6.8	9.8	18.4	0.031
Firm established before 1991, %	75.0	71.5	76.8	67.1	
Firm established 1992-1998, %	11.4	18.8	14.6	28.9	0.024
Firm established after 1998, %	13.6	9.7	8.5	3.9	
Competition with import 2005, %	21.2	31.4	24.4	22.4	0.151
R&D spending 2005, %	45.6	67.4	67.2	65.3	0.001
R&D spending 2009, %	17.4	52.7	23.2	46.1	0.000
R&D spending 2005, thou rubles	556(93)	3321(426)	1784(497)	1549(396)	0.000
R&D spending 2009, thou rubles	409(150)	2568(380)	1508(590)	1844(565)	0.000
Introduction of a new product 2005, %	28.0	40.1	32.9	28.0	0.140
Introduction of a new product 2009, %	21.2	47.3	32.9	38.2	0.000
Introduction of a new technology 2005, %	31.8	59.4	51.2	48.7	0.000
Introduction of a new technology 2009, %	31.8	66.2	35.4	44.7	0.000
Share of import raw materials in	0	31.8(2.1)	21.7(2.9)	2.9(1.4)	

purchases of materials in 2005, %					0.000
Share of import equipment in purchases of equipment in 2005, %	10.5(2.2)	32.5(2.8)	28.5(4.2)	15.4(3.4)	0.000
Food industry	28.0	17.9	23.2	21.1	
Textiles and light industry	6.1	15.9	8.5	6.6	
Timber and woodworking	18.2	3.9	8.5	6.6	
Chemicals	3.8	15.0	13.4	5.3	0.000
Metals and metal-working	10.6	5.8	12.2	7.9	
Electrical equipment	10.6	16.9	11.0	13.2	
Transport equipment	8.3	9.7	7.3	18.4	
Machines and equipment	14.4	15.0	15.9	21.1	
Border region	28.0	34.8	25.6	34.2	0.540
Number of observations	132	207	76	82	

Note: standard errors in parenthesis.

To estimate the significance of the variance we used Pearson's chi-squared test and the Kruskal-Wallis test to compare the averages

Preliminary analysis of descriptive statistics suggests that we may expect learning-by-importing effects in the group of continuing importers of material inputs and capital goods while the evidence about new importers is mixed. New importers of raw materials are not more active in innovation in the second round of monitoring while new importers of equipment despite the crisis increased the introduction of new products and technology. This may indicate a different role of imported material inputs and capital goods in promoting technological innovations. Being used together, imported raw materials of better quality and new (or, at least, more advanced) equipment could provide a synergetic effect on innovations and we might expect more pronounced learning-by-importing effect.

Table 6. Descriptive statistics of the panel structure by the firm importing status in 2005-2009 (importing of equipment)

	No imports in 2005 and in 2009	"Old" importers	"New" importers	Ex-importers	Statistical significance *
Number of employees in 2005	369(29)	1119(150)	548(53)	892(160)	0.000
Labor productivity in 2005, thou rubles	160(11)	306(37)	212(29)	161(21)	0.001
Labor productivity above industry average, %	40.1	67.4	50.6	48.4	0.000
Members of integrated business groups in 2005,%	24.7	28.0	31.6	38.2	0.294
Foreign ownership in 2005,%	3.1	14.0	4.1	5.9	0.001
Government ownership in 2005,%	11.9	9.0	9.4	14.7	0.688
Firm established before 1991, %	75.3	70.0	71.9	67.6	
Firm established 1992-1998, %	14.9	23.0	18.1	17.6	0.613
Firm established after 1998, %	9.8	7.0	9.9	14.7	
Competition with import, %	24.7	32.0	25.1	23.5	0.538
R&D spending 2005, %	53.4	76.7	58.5	71.0	0.002
R&D spending 2009, %	19.1	58.0	46.8	35.3	0.000

R&D spending 2005, thou rubles	955(204)	3983(651)	1676(304)	4484(1234)	0.000
R&D spending 2009, thou rubles	819(265)	3608(668)	1646(308)	1310(805)	0.000
Introduction of a new product 2005, %	30.4	42.0	32.2	50.0	0.048
Introduction of a new product 2009, %	23.7	50.0	44.4	29.4	0.000
Introduction of a new technology 2005, %	43.3	63.0	48.5	44.1	0.013
Introduction of a new technology 2009, %	35.6	61.0	56.1	50.0	0.000
Share of imported raw materials in purchases of materials in 2005, %	14.6(2.0)	24.9(2.5)	18.4(2.4)	24.0(5.8)	0.005
Share of imported equipment in purchases of equipment in 2005	0	50.4(4.0)	20.0(2.6)	30.4(6.1)	0.000
Food industry	25.8	18.0	22.2	8.8	
Textiles and light industry	8.2	9.0	15.2	5.9	
Timber and woodworking	6.7	9.0	9.9	17.6	
Chemicals	7.7	14.0	10.5	11.8	0.114
Metals and metal-working	6.7	13.0	7.6	8.8	
Electrical equipment	17.0	9.0	13.5	11.8	
Transport equipment	9.3	10.0	10.5	14.7	
Machines and equipment	18.6	18.0	10.5	20.6	
Border region	28.4	38.0	32.2	26.5	0.548
Number of observations	34	100	171	3	

Note: standard errors in parenthesis.

To estimate the significance of the variance we used Pearson's chi-squared test and the Kruskal-Wallis test to compare the averages

Further we will describe our hypothesis, econometric strategy and report findings from the analysis of international trade as a learning source for technological innovations of manufacturing companies in Russia.

5. PRODUCTIVITY ADVANTAGES OF EXPORTING AND IMPORTING FIRMS. THE TEST OF SELF-SELECTION HYPOTHESIS

As it was shown in the literature review above, the contemporary theory on heterogeneous firms predicts and empirical works support the hypothesis that firms self-select for foreign trade participation. As the main factors of self-selection – size and productivity – are the same for both export and import activities we analyse this issue for export and import of Russian manufacturing enterprises using the same methodology framework and estimation techniques. The first two of the research hypothesis are being formulated here jointly for export and import, and the third one is formulated for import activity self-selection only because it compares two different forms of involvement in import: import of intermediaries on the one hand and import of new machinery on the other.

Hypothesis 1. More productive and larger manufacturing firms self-select to start exporting and/or importing input and machinery and continue to use international trade as an instrument to keep their competitiveness.

Hypothesis 2. Newcomers to foreign trade markets are more likely to self-select on the grounds of higher productivity than continuous importers.

Hypothesis 3. The self-selection is more pronounced for import intermediaries than for import of equipment.

Hypothesis 4. The self-selection effects are stronger for exporters than for importers.

The first proposition is a classical one and is based on the assumption of additional costs associated with entry to external markets and was found to be true for both developed and emerging economies. We believe it to be relevant for Russia, where administrative entry barriers to exporting are higher than elsewhere, while long distances and an obsolete transport infrastructure add to the regular entry costs associated with foreign trade. In the 2000s many Russian firms lost cost advantages to low-cost producers both in international and domestic markets, and product quality competition is still difficult for firms distanced from the world technological frontier.

We presume that the newcomers for export/import markets are more likely to self-select on the grounds of high productivity and size, because the first entry to those markets may associate with additional fixed costs the continues foreign traders do not have. The last proposition presumes that the costs for importing equipment are high and often means getting external financing (for example, bank long-term loans) and external financing is cheaper and more available for well-performing and efficient companies. While the choice of import option for raw materials is less financially demanding and may be done without additional financing or with short-term loans.

We believe also that self-selection for export is more important than for import, in particular for new entrants to those markets. Most probably the export entry costs for the Russian firms are higher than import entry costs. In order to enter the import market the firm needs only to overcome additional costs associated with finding new suppliers and overcoming the trade barriers (but the firm continues to work at the same market). While entering export markets means not only finding new customers and overcoming trade barriers, but adjusting to the specific requirements of those new markets as well.

Thus higher productivity and bigger firm size may be the necessary prerequisites for importing and exporting. Yet, we can't exclude other factors being important. First of all, we expect both exporting and importing firms to produce goods that are competitive by price and quality. Though for importers it may not be as important as for exporting firms. If exporters have to compete on the foreign markets both with native producers and with other foreigners, on the Russian domestic market they compete with other domestic firms and with importers which are supposed to be at relative disadvantage meeting with additional entry barriers to the Russian market. Thus importers prior to Russia's WTO accession were sheltered from high competition by high entry barriers (both of tariff and non-tariff nature). We presume that the level of competition with import on the Russian market may be an important factor for a firm to get involved into foreign trade: for exporters because the successful competition with import inside the country may facilitate entry to export market to compete with the same competitors, for importing firm competition with import creates incentives to use import inputs to get quality and price advantages. In other words we presume that the firms which have experience of dealing with strong competition from import are more likely to enter and to be involved in foreign trade.

Another factor that may affect the cost of trade is firm's participation in global supply chains through foreign direct investments. Foreign owners, especially transnational companies may be more willing to import inputs and machinery optimizing logistic chains and/or using the same suppliers in Russia they use in other enterprises all over the world. The possible impact of state ownership on the willingness to export comes from possibility to use administrative pressure to overcome bureaucratic barriers while for import this relationship is of more ambiguous nature. On the one hand state-owned or state-controlled firms may have somewhat lower administrative costs for customs regulation barriers, though the available data on practices of Russian customs as well as our empirical data do not support this fact. On the other hand state-owned firms may have some additional pressure to use domestic suppliers as the economic policy of the government is biased to stimulating import substitution. Anyway, we shall control not only for the presence of foreigners in ownership structure, but for the presence of the state among shareholders (or for the state being an only owner in case of so called unitary enterprises).

Another factor that may have ambiguous impact on the propensity to import (or to export) is belonging of a firm to integrated group of companies. We presume that on the one hand belonging to a holding may serve as some sort of compensation for a firm of not being large enough to facilitate involvement in foreign trade due to ability to use infrastructure existing at the level of a whole group. Also, in case of horizontal integration the use of import supplies may be cheaper due larger volumes being bought for all of the similar enterprises in the group of companies. But it

should be noted that in case of vertically integrated groups this factor – belonging to holding – may work another way around. Firms integrated into the vertical chain of production may be forced to use suppliers from the same group even if they would better turn to import were they independent.

Other factor we'll control for is the age of firm[3]. We use this control mostly because we presume that younger firms, i.e. established after 1991 may be less restricted in their choice of supplier or consumer than the old enterprises established in Soviet time and traditionally included into supply chains inherited from the planned economy and may continue to use them. In other words we control for the possible path-dependence effect. It should be stressed that this effect in terms of import also may work both ways: facilitating the use of traditional domestic suppliers or the use of suppliers from former Soviet Union countries. As we do not have information on the source of import, we cannot verify those path-dependence factors. And we control for sector as the propensity for export or for import depends on the technological nature of production and other unobserved sectoral characteristics.

To check our hypothesis we estimate the baseline multinomial logistic model using panel data from 2005 and 2009 surveys. Below we shall compare results for three models which differ only by independent variable. The first one is for groups of importers of raw material, the second for importers of equipment and the third for general export status of the firm. That's how the model for import of raw material looks like:

$$\mathrm{FT\_status\_raw}_i^{09} = a_1 * LPi^{05} + a_2 * Size_i^{05} + a_3 * Comp05_i^{05} + a_4 * Foreign_i^{05} + a5 * State_i^{05} + \\ + a_6 * Holding_i^{05} + \sum_{j=7}^{j=9} a_j * age_{j-6} + \sum_{j=10}^{j=16} a_{11-j} * Ind_{j-9} + e_i \qquad (1)$$

Where FT_status_raw – is a foreign trade status of a firm - the indicator of a firm belonging to one of four groups of importers described in the previous section, i.e. to "no-traders", "former traders", "new traders" and "continuous traders" pending on their foreign trade activity in both rounds of the survey;

LP – indicator of labor productivity measured as a ratio of firms' labor productivity (measured as value added per employee) and the sector average reported by official statistics for all medium and

[3] It should be noted, however, that we do not have absolutely "new" firms in our panel (those established between the years of the surveying). In this paper we use only panel data for 2005 and 2009 surveys, all our firms have existed for at least 6-7 years prior to the last survey. Our sample may include enterprises that were established in the 90-es through restructuring or bankruptcy of older Soviet entities. We do not have information on the full history of firms and rely on the date of incorporation provided by respondent.

large firms in the sector;

Size – the size of firms measured as the logged number of employees

CompI – Indicator of competition pressure measured as 1 if a firm reported to be seriously influenced by competition from imported goods or goods by foreign firms producing in Russia.

Foreign – indicator of foreign shareholder: dummy equal 1 if there is a foreign shareholder among owners;

State – indicator of government being present among owners;

Holding – indicator of a firm being part of larger integrated group of companies;

Age – period of establishment of a firm: before 1991, between 1992 and 1998, after 1999.

Ind – dummy variable of 8 two-digit manufacturing industries

Indexes of the time periods show which round of the survey they relate to.

All the determinant variables (except age and industry dummies) are lagged ones (i.e. refer to the first round of monitoring in 2005) to avoid possible reverse causality relationships.

The same equation we estimate for the similar groups of importers of equipment and for exporters (Imp_status_eq and Exp_status dependent variables) to allow comparison of results for self-selection model for export and for import activities. The results of three models are reported in Table 7.

Table 7. Multinomial regression results of self-selection effects for importers of raw material, importers of equipment and for exporters

	Model 1 (Imp. of raw mat.)	**Model 2 (Imp. of equip.)**	**Model 3 (Export)**
Continues traders group			
lp05	0.001*	0.002***	0.002**
Size05	0.957***	1.069***	1.465***
CompI_05	0.344	0.186	1.029***
f05	0.774	1.280*	2.020***
s05	-0.733*	-0.287	0.281
Holding05	-0.037	-0.327	-0.151
age2	1.024***	0.668*	0.474
age3	0.124	-0.482	0.163
_cons	-5.756***	-7.883***	-11.168***
New entrants group			
lp05	-0.001	0.001**	0.002**
Size05	0.651***	0.449***	0.794***
CompI_05	0.023	-0.035	0.718*
f05	1.071*	0.091	1.903***
s05	-0.297	-0.200	-0.754
Holding05	0.163	0.171	-0.267
age2	0.353	0.140	0.897**
age3	-0.385	-0.005	-0.049
_cons	-4.170***	-3.107***	-6.914***
“Former” traders group			

lp05	0.000	-0.001	0.001
Size05	0.662***	0.998***	1.038***
CompI_05	0.141	0.108	1.644
f05	0.829	0.054	-12.436***
s05	0.505	0.367	-0.408
Holding05	0.041	0.352	-2.038***
age2	1.459	0.261	1.333***
age3	-0.695	0.431	-0.101
_cons	-4.777	-8.283***	-9.036***
Number of obs.	471	473	473
Pseudo-R2	0.105	0.107	0.250

Note: *** - significant at 1 percent, ** - 5 percent, * - 10 percent. In groups by foreign trade import status, non-traders (importers or exporters) are the reference group. Other reference categories: age1 (established before 1991).The coefficient for industries dummies are significant but are not reported in the table.

Looking at the results we can see that firms involved in foreign trade are definitely self-selected by size, i.e. all groups of either importing or exporting firms (even the group of "former" international traders – firms which used to trade but stopped doing it in between the two rounds of the survey) are significantly larger than firms which were never involved in foreign trade. With the self-selection by efficiency (in our case by relative labor productivity) the evidence is strong in favour of self-selection for export and for importers of machinery. Continuous traders – those who exported or imported materials/equipment in both years - are significantly more productive than non-importers. But the group of new importers of input - firms who started to import between 2005 and 2009 - does not differ by productivity from those who never imported. This fact may have different interpretations. On the one hand it supports our proposition 3 on self-selection effects being stronger for importers of equipment than for importers of intermediaries. On the other hand it should be noted that in the period of 2005-2009 macroeconomic trends facilitated import as it was a period of strong real revaluation trend of Russian currency. Importing of raw materials became cheaper and in some cases import became the better option than buying domestically even for the low productivity firms.

Altogether, while we see definite self-selection effects for exporting activity we cannot be as conclusive about the import of input. At least the newcomers for import market do not seem to need higher efficiency to start importing. There is though some evidence that prior to 2005 importers were self-selected (both by size and productivity): continuous trades are always larger and more productive. There is also evidence that more efficient and larger firms were more ready to start importing equipment. We attribute this to them having better access to finance both due to higher profits and availability of less costly and longer term external financing. Among other results it is worth to mention that we do see some indication of state-owned firms being less ready to use import materials, opposite to foreign owned ones which have higher propensity for

importing. It is consistent with our initial suggestion, though the significance of corresponding coefficients is not high and this evidence should be treated with caution. We have not found any significant impact of foreign competition on import decisions of firms. Belonging to integrated groups also seems to be irrelevant for the decisions to import.

Comparing the results for export and import model we see that self-selection effects are much stronger for export than for import. And other factors such as ownership indicators, competition also have more impact on export activity that on the decision to import. It should be noted that in general the quality of estimation for exporters is much better than for importers. As we wished to compare the impact of the same factors on import and export decisions of firms we have used the similar model specification for both outward and inward trade. But quite probably our model missed some significant factor specific to the choice of import option and additional research is needed here.

6. INCENTIVES TO INNOVATE: EXPORT

This part of the research attempts to look into several issues related to the correlation between a firm's export status and its innovative behavior. Our primary interest is to find out whether exporting impacts a firm's propensity to adopt technological innovations. In our analysis, we first attempt to avoid the direction of causality issue (whether causality runs from exporting to innovations or the other way around) by using lagged export values and other firm characteristics as determinants of the firm's current innovative activities. Second, instead of absolute measures, we estimate their changes over time. In other words, using data from the two rounds of a manufacturing survey (2005 and 2009); we seek to prove that a firm's presence (entry) in export markets encourages it to pursue innovations. Therefore, our next hypothesis reads as follows:

Hypothesis 5. Exporters tend to be more innovative than non-exporters, as they introduce new technologies and new products, undertake/contract R&D.

Another issue we would like to research is whether the length of a firm's presence in export markets impacts the intensity of its learning and innovative behavior. Is the learning effect of a one-off nature or is it prolonged over time? Put differently, does an export starter quickly learn the basics of competition and make appropriate innovative adjustments to its behavior, or does it take time for exporting to have an effect? For the purpose of this study and with regard to the available data, our sixth prediction reads as follows:

Hypothesis 6. A long presence in export markets tends to enhance learning effects. In other words, incumbent exporters learn more quickly than export starters.

The above mentioned hypotheses were already tested in our previous paper (Golikova et al., 2011) using somewhat different specification of the model. We continue to examine the impact of export entry on technological innovations by taking into consideration the starting position of a firm in terms of its involvement in foreign trade. Thus we have to take into consideration the initial technology level of production processes and product quality. Obsolete technical base of many Russian firms, sometimes inherited from the Soviet times, is a significant constraint both for export and innovations. Therefore, we expect that the incentives to get involved in technological innovations are larger, if exporting firm has been importing input and machinery and managed to improve product quality.

Hypothesis 7. The learning effects of exporting are associated with the prior efforts to improve product and processes' technical quality with imported input and machinery.

Both theoretical and empirical literature suggests that there are other determinants impacting decisions to innovate, apart from exporting. In particular, the propensity to innovate may depend on the sector which could be high-tech, mid-tech or low-tech and the firm's size. Apart from these factors, we should control for self-selection effect as it might be that more productive firms self-select for innovations. We also postulate that ownership (specifically, foreign ownership and government ownership) may also have a role[4]. A firm's membership in an integrated group (vertically or horizontally integrated) may also be important. Finally, we control for location of the firm in the border region, meaning that geographical proximity may ease international trade and thus affect the way trade influences innovations.

As a general approach to empirically estimate the export learning effects, we use the following model:

$$\begin{aligned}\Pr(LEf_{2009}=1) = \Pr obit(&a_0 + a_1 LEf_{05} + a_2 Size_{05} + a_3 Foreign_{05} + a_4 State_{05} + \\ &+ a_5 Holding_{05} + a_6 CompI_{05} + a_7 \operatorname{Im} p\_eq\_share_{05} + a_8 \operatorname{Im} p\_raw\_share_{05} + \\ &+ a_9 Interaction \operatorname{Im} p\_raw * \operatorname{Im} p\_eq + a_{10} Border + a_{11} iLP_{05} + \\ &+ \sum_{j=1}^{3} \beta_j Exp\_status_{ji2009} + \sum_{k=1}^{2} \gamma_k Age_{ki2009} + \sum_{l=1}^{7} \delta_l Ind_{li2009})\end{aligned} \quad (2)$$

where LEf_t stands for one of the three innovation measures for 2009 and 2005 respectively, $Imp\_raw\_share_{2005}$ – is a share of imported raw materials and components in 2005, $Imp\_eq\_share_{2005}$ – the share of imported equipments in all newly installed equipment in 2005,

[4] Firms with foreign owner or foreign stake often rely on mother's company R&D capabilities and new product design, thus FDI firms may report less trade-induced product and process innovations compared to domestically owned firms

Exp_status – the indicator of a group by export status, ***Border*** – the dummy which is 1 for firms located in a border regions, iLP_{2005} reflects the relative labour productivity of a firm in 2005 (i.e. above or below industrial average), the rest of the variables are the same as in the previous models.

Table 8. Regression results for the model estimating learning-by-exporting effects

Dependent variable	R&D in 2009				New product in 2009				New technology in 2009			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
LEf05_i	0.29*	0.21	0.25	0.27	0.47***	0.43***	0.43***	0.45***	0.13*	0.16**	0.16**	0.16**
"Old" exporters (export in 2005-2009)	0.53***	0.53***	0.55***	0.54***	0.31*	0.32*	0.26	0.24	0.29*	0.31*	0.29	0.29
New exporters	0.34	0.33	0.36	0.35	0.20	0.20	0.18	0.17	0.26	0.26	0.27	0.27
Ex-exporters	0.03	-0.06	-0.03	-0.03	-0.44	-0.53*	-0.52*	-0.53*	-0.37	-0.39	-0.39	-0.39
Size05	0.27***	0.18**	0.18**	0.19**	0.15**	0.12	0.11	0.12	0.22***	0.19**	0.18**	0.18**
State05	-0.06	-0.03	0.01	0.03	0.15	0.09	0.07	0.09	-0.18	-0.13	-0.10	-0.10
Foreign05	0.10	0.07	0.03	0.05	-0.21	-0.16	-0.14	-0.14	0.07	0.11	0.14	0.14
Holding05	0.06	0.07	0.08	0.10	-0.06	-0.14	-0.08	-0.07	-0.07	-0.10	-0.08	-0.08
Age2	0.19	0.10	0.06	0.06	0.04	0.02	-0.04	-0.04	0.15	0.07	0.07	0.07
Age3	-0.65**	-0.67**	-0.67**	-0.74***	-0.23	-0.25	-0.29	-0.33	-0.44*	-0.54**	-0.52**	-.52**
CompI05	0.19	0.19	0.16	0.18	0.21	0.22	0.23	0.24*	-0.16	-0.16	-0.14	-0.14
Imp_eq_share05		0.01***	0.01***	0.00		0.00	0.00	0.00		0.00**	0.00*	0.00
Imp_raw_share05			0.00	-0.00			0.01*	0.00			0.00	0.00
Inter_impshare_raw_eq05				0.00*				0.00				0.00
ind2	0.11	0.03	0.01	0.01	-0.22	-0.27	-0.37	-0.36	0.04	-0.01	-0.05	-0.05
ind3	0.09	0.01	0.08	0.10	-0.33	-0.31	-0.28	-0.26	0.00	0.02	0.01	0.02
ind4	0.56**	0.61**	0.61**	0.65**	-0.01	-0.02	-0.08	-0.05	0.15	0.14	0.10	0.11
ind5	0.26	0.37	0.44	0.42	-0.34	-0.31	-0.28	-0.29	-0.20	-0.15	-0.15	-0.15
ind6	0.65***	0.71***	0.79***	0.77***	0.06	0.09	0.06	0.06	0.36	0.48**	0.43*	0.43*
ind7	0.45	0.56*	0.72**	0.71**	0.00	-0.10	-0.02	-0.01	-0.11	-0.05	-0.10	-0.09
ind8	0.56**	0.65**	0.73***	0.72***	0.01	0.02	0.03	0.04	0.00	0.03	0.01	0.02
Border	0.10	0.14	0.15	0.13	0.10	0.08	0.07	0.06	0.15	0.12	0.12	0.12
iLP05	0.32**	0.30**	0.26*	0.27*	-0.05	-0.03	-0.03	-0.03	0.15	0.12	0.14	0.14
cons	-3.00***	-2.58***	-2.72***	-2.72***	-1.22***	-1.05**	-1.03**	-1.04**	-1.98***	-1.86***	-1.82***	-1.82***
N obs	436	422	412	412	473	455	444	444	473	455	444	444

Rseudo R^2	0.20	0.21	0.22	0.23	0.08	0.08	0.08	0.09	0.08	0.10	0.10	0.10
L roc	0.79	0.79	0.80	0.81	0.68	0.69	0.69	0.69	0.70	0.72	0.71	0.71

Note: *** - significant at 1 percent, ** - 5 percent, * - 10 percent. In groups by export status, non-exporters (those who did not report exporting in either round of the survey) are a reference group. LEf05_i – values of respective dependent variables in the previous period. Reference categories: non-exporters, age1 (before 1991), ind1

While not all of tested indicators of technological innovations seem to be impacted by export we found significant evidence of learning-by-exporting effects. First, continuous export (firms engaged in exporting activities in both periods of observation) explains well the decision of the firms to have R&D spending in 2009 (at 1 percent significance level in all four models). As we have included lagged values of the dependent variables as predictors, we therefore estimate changes in firm behavior in a dynamic framework from 2005 to 2009. Therefore, this indicates that continuous exporting activities encourage firms to undertake R&D more often than non-exporters tend to do.

As far as new product and new technology introduction is concerned, firms that export in both periods of observation are more likely to report product and process innovation in two models' specifications. However, this link becomes positive though insignificant if we include additional trade-related factors – share of imported input in sales (for the model where the dependent variable is the introduction of new product) and share of imported machinery in sales (for the model where the dependent variable is the introduction of new technology).

It is noteworthy that export starters, unlike incumbent exporters, do not exhibit any visible correlation between export entry and the introduction of a new product or technology. This may suggest that investments in R&D that may have been undertaken following (or simultaneously with) export entry have not yet yielded any results.

As for ex-exporters (i.e., firms that have exited from export markets), they are very similar to non-exporters in their propensity to innovate. However, it should be noted that this group is relatively small in our sample and the result should be treated with caution. Meanwhile, all the coefficients in this group except one are negative, and even three of them are significantly negative at 10% level in the model for new product introduction. Thus we may suggest that exiting firms lose their propensity to innovate, even compared to firms that were never involved in exporting.

As expected and documented in many other empirical surveys in Russia, we didn't find any evidence of the link between innovations and competitive pressure. This can reflect the general low level of competition at the Russian market at least prior to WTO accession.

Contrary to expectations, the estimations have not revealed any significant effect of ownership type or group membership on the propensity to innovate. Belonging to the group of companies (holding) does not affect innovative behavior either. Yet, younger firms established after 1998 economic crisis, innovate less that the reference group of firms established before 1991, when the Soviet Union was dismantled. We may suggest that on the one hand younger firms are better

equipped and do not require immediate technological upgrading as compared to traditional older firms. In addition as a rule new firms are smaller. Control for the size always matters – the larger the firm, the more often it is involved in R&D and technology upgrade, but this is not relevant for the new products.

Larger shares of imported machinery documented in the first period of monitoring in 2005 are associated with R&D activities and new technology introduction in 2009 (significant at 1% and 5% levels, correspondingly), though have no influence on the product innovation. The last is associated (on 10% level of significance) with initial imported input share, suggesting quality improvement prior to product innovations.

Concluding, we suggest that hypotheses H5 and H6 were confirmed, while hypothesis H7 is confirmed less decisively. Continuous exporters are more likely to innovate, while export entry is not associated with immediate changes in technological decisions of the firm. Self-selection based on the firm's past productivity is a significant cause for a firm's decision to invest in R&D. However, this effect is not relevant for the decision to introduce the new product or new technology. We found out that the imported capital equipment determines two types of innovations – R&D and new technology introduction - while for the new products it is not relevant.

7. INCENTIVES TO INNOVATE: IMPORT

In this part of the paper we try to evaluate the impact of import on decisions to innovate. Following the literature we presume that trade participation in any form may facilitate technological innovations. In the above section as well as in our previous research (Golikova et all 2011) we have found some evidence of export activity being important for different types of technological and organizational innovations. The existing literature suggests that involvement in import be it the import of intermediaries or machinery may have positive effects on propensity to innovate, especially in transition countries.

For our empirical estimations it is important to note that importing and innovation are expected to be linked much stronger than the export and innovations. These decisions of the firm are highly endogenous and the model should consider the uncertainty about the causality direction here. Let's consider the decision to introduce new product – widely used indicator of technological innovation – and decision to import some raw material or technological equipment. Which of those decisions comes first? It well may be that the decisions to develop and produce new product affects a firm's decision to start importing new materials or components just because there no domestic supplier available. In this case a firm simultaneously starts importing and producing new

products. On the other hand it may be that the firm starts to import first to produce traditional goods. And then getting access to new or of better quality of inputs starts to develop new products it was unable to produce with domestically supplied materials of lower or unavailable quality. The same is true for introduction of new technologies: the import of equipment may be driven by the necessity to change the technology but it may be that the decision to import equipment is accompanied by the necessity to adjust it to the needs of the market and may push a firm to further technological innovations.

We shall base our analysis on the presumption that on the average all other things being equal the access to import markets (of materials and/or equipment) diversifies the sources of supply and enhances the ability of a firm to innovate by creating new product or new technology options. Thus our hypothesis concerning the relationship between import and innovations is:

Hypothesis 8. The access to import of new material and/or technologies facilitates firm's own innovations, including R&D activity, introduction of new products and/or new technological decisions.

We further presume that even if the initial decision to import was not related to innovation strategy of a firm (it started importing just because the price/quality ratio of imported goods was better), the access to diversified sources of inputs and equipment creates additional incentives to innovate, and the longer a firm is present on the import market, more experienced it is in using new opportunities and the stronger is the impact of import on innovations. In terms of the approach we use in this paper the hypothesis can be formulated as follows:

Hypothesis 9. A long presence in import markets tends to enhance learning-by-importing effects. In other words, incumbent, continuous importers learn more quickly and more often than newcomers.

While we presume that both the import of raw material and equipment have a positive effect on innovation activity, we believe the transfer of technologies to be more important for innovations as it often presumes the transfer of knowledge, the training and the use of more qualified workforce. Thus, we presume that:

Hypothesis 10. Import of equipment has a stronger learning effect on innovations than the import of raw \material and components.

To check the propositions we need to evaluate the difference between new importers, continuous importers, etc. So, to evaluate the impact of different import status of firms on innovation behaviour we include dummies for the groups of importers (described above) as independent variables.

While the involvement in import activity may be the factor for innovations, there are a lot of other factors that may influence innovations and it is not easy to separate the effects of import involvement. To control for at least some of them we shall use additional factors in our model. First of all we include the same control variables we have used in the models for verifying self-selection hypothesis, i. e. indicators for competitive pressure from imported goods[5], on ownership (presence of the state and presence of foreigners among owners), indicator of a firm belonging to integrated group, age categories and industries dummies.

We would like to control for the self-selection for import. So, beside the size of the company we include the indicator of the level of initial relative productivity. It is the dummy variable that equals 1 if the labor productivity of the firm (measured as value added per employee) was above the industrial average in 2005 and 0 otherwise. Thus, we presume that the learning effects may differ for "good" more productive firms and for "bad", i.e. less efficient than average ones. And the last control is for geographical location of a firm. Our supposition is that firms located in regions which have a common border with neighbouring countries may have additional incentives to be involved in import activity (mostly for import of raw materials and other inputs). The indicator is 1 for firms located in border regions of Russia and zero for the rest. Those factors are included in our base specification of the model (Model 1).

We presume further in accordance with our hypothesis that the starting position of a firm in terms of involvement into import activity influences the relationship between import and innovations. More precisely we believe that the higher was the initial level of involvement the more prominent are learning-by-importing effects. As a measure of this initial involvement we use indicators for the initial period of time (2005) of the share of imported equipment in the total purchases of equipment (model 2), we add the indicator of the share of imported raw materials, parts and components in the total material costs for these purposes for the year 2005 (model 3) and in the last specification (model 4) we add the interaction of those two indicators. As dependent variables in those models we use three innovation indicators: dummies for the fact of non-zero expenditures on R&D, the introduction of new product and the introduction of new technology. As we are interested in learning effects we use the value of those indicators for 2009 as dependent variable and the past value (for 2005) of the same indicator as one of the explaining variables. Our dependent variables are equal 1 if the innovation took place and zero otherwise, so we use probit regression to estimate the following model:

[5] In many works including those for Russian manufacturing firms it was shown that it is competition with import which facilitates innovations, while competition with other domestic producers has much weaker impact on innovation behaviour. See, for example, Avdasheva et al. 2007.

$$\Pr(LEf_{09}=1)=\Pr obit(a_0+a_1LEf_{05}+a_2Size_{05}+a_3Foreign_{05}+a_4State_{05}+ \\ +a_5Holding_{05}+a_6CompI_{05}+a_7\,\mathrm{Im}p\_eq\_share_{05}+a_8\,\mathrm{Im}p\_raw\_share_{05}+ \\ +a_9Inter\_imp\_r\_eq_{05}+a_{10}Border+a_{11}iLP_{05}+ \\ +\sum_{j=1}^{3}\beta_j\,\mathrm{Im}p\_status_{ji09}+\sum_{k=1}^{2}\gamma_k Age_{ki09}+\sum_{l=1}^{7}\delta_l Ind_{li09}) \quad (3)$$

where ***LEf*** stands for one of the three innovation measures for 2009 and 2005 respectively, ***Imp_raw_share$_{05}$*** – is a share of imported raw materials and parts in 2005, ***Imp_eq_share$_{05}$*** – the share of imported equipment in all newly installed equipment in 2005, ***Inter_imp_r_eq*** – is an interaction of the share of import of raw materials and of equipment, ***Border*** – the dummy which is 1 for firms located in a border regions, ***iLP$_{2005}$*** reflects the relative labor productivity of a firm in 2005 (i.e. above or below industrial average), the rest of the variables (dummies to control for age of a firm and for industry, and for ownership specifics) are the same as in the previous models. The results of estimations for importers of raw materials are presented in Table 9, and for importers of equipment in Table 10.

The estimation results suggest that for the studied types of innovations import is mostly associated with R&D expenditures. In most specifications both continuous importers and new importers of raw materials and of equipment more often start spending money on R&D, compared to two other groups – former importers and non-importers. Thus, our hypothesis 4 is confirmed at least for R&D measurement of innovations. Nevertheless the impact of raw materials import is less significant than the import of equipment. The imported input increases the likelihood of R&D in the group of continuous importers and less so among the import starters.

Opposite to this in case of imported machinery the impact is highly significant for both groups and the effect is higher for the newcomers, i.e. firms which started importing equipment after 2005. It may indicate that the transfer of technologies in a form of imported equipment has a stronger and quicker stimulating effect on R&D activity of firms. This result fits our expectation that the spill-over effects of technologies embodied in imported machinery should be higher than that of imported input. The higher significance of imported equipment compared to imported input is also confirmed by positive and significant coefficient before the indicators which reflects the initial (2005) share of imported equipment in fixed investments. This indicator is significant for both importers of raw materials and for importers of equipment while the initial share of raw materials has a significant positive effects only for importers of equipment. It may be due to the fact that the most significant impact on innovation activity comes from simultaneous import of equipment and raw materials and components, though our sample is too small to check this hypothesis in a proper way. We have not found any significant impact from other factors except the size (positive as

expected) and the negative and significant impact from the age of a firm: more young firms (established after 1998) seem to be less active in introducing R&D.

Table 9. Estimation of probability of a firm to innovate pending on its status of importer of raw materials and components

Dep. variable	R&D				New product				New technology			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
LRN_05_i	0.27*	0.22	0.25	0.27	0.41***	0.40***	0.40***	0.41***	0.12*	0.16**	0.16**	0.16**
IMP_r_1	0.76***	0.72***	0.72***	0.79***	0.80***	0.77***	0.73***	0.77***	0.56***	0.55***	0.56***	0.58***
IMP_r_2	0.49**	0.47**	0.46**	0.47**	0.17	0.14	0.14	0.15	0.40*	0.45**	0.44**	0.45**
IMP_r_3	-0.02	-0.13	-0.18	-0.08	0.00	-0.05	-0.03	0.03	0.23	0.19	0.27	0.30
Size05	0.28***	0.20**	0.21**	0.21**	0.12*	0.11	0.10	0.10	0.21***	0.20**	0.19**	0.19**
State05	0.01	0.04	0.05	0.09	0.28	0.21	0.16	0.18	-0.12	-0.08	-0.06	-0.05
Foreign05	0.18	0.14	0.13	0.14	-0.13	-0.09	-0.07	-0.07	0.12	0.15	0.19	0.19
Holding05	0.09	0.10	0.09	0.11	-0.02	-0.10	-0.04	-0.02	-0.04	-0.08	-0.06	-0.05
Age2	0.07	-0.02	-0.04	-0.03	-0.08	-0.07	-0.10	-0.09	0.09	0.01	0.02	0.02
Age3	-0.68***	-0.68***	-0.68**	-0.75***	-0.27	-0.29	-0.30	-0.34	-0.45**	-0.55**	-0.52**	-0.53**
CompI_05	0.14	0.14	0.12	0.15	0.16	0.18	0.19	0.20	-0.17	-0.16	-0.14	-0.13
Imp_eq_share_05		0.01***	0.01***	0.00		0.00	0.00	0.00		0.00*	0.00*	0.00
Imp_raw_share_05			0.00	0.00			0.00	0.00			0.00	0.00
Inter_imp_r_eq05				0.00**				0.00				0.00
Border	0.13	0.18	0.21	0.19	0.13	0.12	0.10	0.09	0.20	0.17	0.17	0.17
iLP05	0.22	0.20	0.17	0.17	-0.18	-0.15	-0.13	-0.14	0.06	0.04	0.07	0.07
cons	-3.22***	-2.85***	-2.99***	-2.98***	-1.23***	-1.16***	-1.10***	-1.10***	-2.13***	-2.10***	-2.04***	-2.04***
N obs	434	420	410	410	471	453	442	442	471	453	442	442
Rseudo R^2	0.22	0.23	0.24	0.25	0.12	0.11	0.11	0.11	0.09	0.11	0.10	0.10
L roc	0.80	0.81	0.82	0.82	0.72	0.72	0.71	0.71	0.71	0.72	0.71	0.71

Note: *** - significant at 1 percent, ** - 5 percent, * - 10 percent. In groups by export (import) status, non-exporters(non-importers) - those who did not report exporting(importing) in either round of the survey) are a reference group. Industries are controlled for but not reported in the table. Other reference categories are : non-exporters (non-importers), firms established before 1992 (age1).

Table 10. Estimation of probability of a firm to innovate pending on its status of importer of equipment

Dep. variable	R&D				New product				New technology			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
LRN_05_i	0.27*	0.23	0.28*	0.30*	0.46***	0.44***	0.43***	0.46***	0.13**	0.17**	0.17**	0.17**
IMP_e_1	0.84***	0.68***	0.65***	0.70***	0.61***	0.59***	0.56***	0.59***	0.47**	0.46**	0.45**	0.45**
IMP_e_2	0.86***	0.84***	0.87***	0.87***	0.58***	0.57***	0.57***	0.57***	0.56***	0.57***	0.54***	0.54***
IMP_e_3	0.42	0.28	0.21	0.24	0.31	0.32	0.27	0.29	-0.05	0.16	0.15	0.15
Size05	0.27***	0.21**	0.22**	0.22**	0.12*	0.12	0.10	0.11	0.22***	0.20***	0.19**	0.19**
State05	0.02	0.04	0.08	0.10	0.20	0.12	0.10	0.12	-0.13	-0.09	-0.06	-0.06
Foreign05	0.13	0.11	0.09	0.09	-0.20	-0.15	-0.15	-0.15	0.11	0.15	0.17	0.17
Holding05	0.05	0.05	0.06	0.08	-0.03	-0.11	-0.06	-0.03	-0.04	-0.09	-0.07	-0.07
Age2	0.15	0.08	0.04	0.04	-0.01	-0.01	-0.07	-0.07	0.12	0.05	0.05	0.05
Age3	-0.60**	-0.61**	-0.63**	-0.70**	-0.19	-0.22	-0.26	-0.30	-0.42*	-0.53**	-0.52**	-0.53**
CompI_05	0.20	0.20	0.18	0.20	0.20	0.22	0.22	0.24	-0.16	-0.15	-0.14	-0.14
Imp_eq_share_05		0.01**	0.01**	0.00		0.00	0.00	0.00		0.00	0.00	0.00
Imp_raw_share_05			0.01*	0.00			0.01**	0.00			0.00	0.00
Inter_imp_r_eq05				0.00**				0.00*				0.00
Border	0.09	0.15	0.16	0.14	0.09	0.08	0.06	0.05	0.15	0.13	0.12	0.12
iLP05	0.26*	0.25*	0.20	0.20	-0.12	-0.09	-0.10	-0.11	0.08	0.07	0.08	0.08
cons	-3.37***	-3.15***	-3.33***	-3.31***	-1.33***	1.28***	1.23***	1.22***	2.19***	2.14***	2.08***	2.07***
N obs	436	422	412	412	473	455	444	444	473	455	444	444
Rseudo R^2	0.23	0.24	0.25	0.26	0.10	0.10	0.10	0.10	0.10	0.12	0.11	0.11
L roc	0.81	0.81	0.82	0.83	0.71	0.71	0.71	0.71	0.71	0.72	0.72	0.72

Note: *** - significant at 1 percent, ** - 5 percent, * - 10 percent. In groups by export (import) status, non-exporters(non-importers) - those who did not report exporting(importing) in either round of the survey) are a reference group. Industries are controlled for but not reported in the table. Other reference categories are : non-exporters (non-importers), firms established before 1992 (age1).

Our results for the new product are less strong. First, the general quality of estimation (measured both by pseudo R2 and the lroc post-estimation indicator) shows that we predict the right outcome less often. Still, the results in general are similar to the impact on R&D activity. We see a significant impact on the likelihood of the new product being introduced for continuous importers of both raw material and equipment. For importers of equipment the significant positive impact can be seen for new importers as well and, as in case of R&D indicator the impact is stronger for new entrants than for continuous importers. Thus again the hypothesis 6 is confirmed. The impact of competition with import pressure is positive though insignificant.

One interesting result is a strong positive impact the initial share of imported raw material have on the probability of introduction of new product (model 3) in Table 10 for importers of equipment. While the initial share of imported equipment is insignificant, the import of equipment accompanied with initially high share of imported materials and components significantly increases chances that a firm will start product innovations. Thus, the diversification of suppliers of materials/components and equipment simultaneously seems to enhance the opportunities and to facilitate product innovation. In other words, this points to possible complementarity of raw material and technology imports.

The estimations for the last innovation measure we used - new technology introduction indicator – basically provide similar though somewhat different results. The probability of introducing new technologies is significantly higher for both old and new importers of raw materials, but only for the group of new importers in case of import of equipment. Again we see that the entry on imported equipment market gives a boost to innovation and this supports the presumption that import of equipment has stronger learning effects than import of raw materials and components.

Summarising the findings of this section it can be stated that we have found evidence that involvement in import has a positive impact on probability of technological innovations on Russian industrial firms and get strong support for our proposition 8. The results for proposition 9 – stronger impact on innovation for long-time importers – is more ambiguous. It seems to be true for importers of raw materials has found no support for importers of equipment. In case of equipment importers the effect seems to be stronger for new entrants which may be due to much quicker learning in case of changes in favour of imported technology. The proposition 10 also gets some support – learning effects for equipment importers are in most of cases stronger that for importers of raw materials and components.

We control for initial relative labour productivity of firms as we presumed that more productive firms may learn quicker than less productive ones. But actually some positive effects were found

only for R&D indicator in the models for importers of equipment. For most of specification this factor is insignificant. One of the possible explanation is that more productive companies were initially more active in innovations and "has less to learn" than less productive companies.

We were unable to find any impact of geographical proximity to the border of Russia. While the coefficient before this indicator is always positive it is never significant. Most probably this is due to the inadequate measurements of proximity. Regions of Russia are mostly very large and even if the region has a common border with the other countries it does not mean an easy access to foreign markets for all the firms located there. Another factor may be the availability of transport infrastructure which may have much more important role than the physical proximity.

9. CONCLUDING REMARKS

Official statistics proves that in the 2000s the Russian economy became significantly more open than ever before, restrictions on trade and FDI were reduced in advance of WTO membership. Russian firms have been exporting and importing more extensively, especially in terms of capital equipment import. We found strong evidence that as predicted by the theory, that the Russian manufacturing firms self-select for export and import by size and productivity. Moreover, productivity advantage prior to international trade entry is much stronger for exporters than for importers. Respectively, the self-selection effect is found to be higher for importers of machinery than for importers of intermediary inputs – raw materials and components.

We focus the paper on empirical evidence of learning effects of firms' trade entry, understanding learning as a post-entry shift in firms' behaviour with respect to product and process innovations and R&D spending. Thus we compared the effects for groups of continuous exporters/importers and the groups of newcomers to export and import markets. The econometric analysis of the panel survey data indicates the relevance of the learning effects for continuous exporters: the probability of a firm to start financing R&D and introducing new product/technology is significantly higher for this group than for new entrants and for non-exporting firms. We also found that the learning effects for importing firms are higher than for exporters and seem to be higher for those firms which import technological machinery than for importers of raw materials. These results are consistent with the empirical research for other countries, and show that in general the relationship between import and innovations for Russian firms is similar to what is observable in other market economies. Though our data does not allowed us to investigate properly the interrelations between export and import, we do found some evidence of complementarity between import of raw materials and import of technology. The probability for a firm to introduce new product is higher for firms which had initially high share of imported raw materials and entered import of

machinery. Thus, we see that the import of machinery provides the quickest and the strongest impact on innovations which may have implications for economic policy of Russian government.

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