

Factors of firms' export in non-energy industries in a resource-rich country: new evidence on Russia¹

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Summary: Export activity is a significant challenge for firms and, simultaneously, a "marker" of their efficiency. Both of these circumstances are especially relevant for Russia, as the Russian market is quite large and at the same time is characterised by rather high barriers to entry. In such conditions, Russian firms need an especially strong motivation to enter the world market, as well as high levels of efficiency in order to compete there with the world's leading producers.

The article examines the sectoral characteristics of Russian exports, the factors influencing the export activity of firms, and the relationship of exports to labour productivity. It shows that the aggregate share of the non-energy sector in Russian exports is in a long-term downward trend. At the same time, there is a convergence of export activities of industries in the non-energy sector.

The key factors of export activity of Russian firms are their large size, foreign ownership, availability of quality human capital, and R&D investment. Export is characteristic of monopolistic firms and major market players, which may be explained by the exhaustion of their growth opportunities in domestic markets, as well as by strict anti-monopoly regulation and informal obligations imposed on such firms.

We find a positive relationship of labour productivity with exports and also innovations and, simultaneously, a negative relationship with the combination of both. This may indicate two alternative models of Russian firms' competitiveness. The revealed influence of exports on labour productivity indicates the "learning-by-exporting" effect in Russian firms-exporters.

Keywords: export activity of firms, export factors, innovation, digitalisation, R&D, labour productivity.

JEL Classification: F14, F61, O12.

1. Introduction

The export activity of firms is a very interesting and important phenomenon to study. Exporting firms in foreign markets have to overcome various formal and informal trade barriers and compete with local firms, which are often in a more favourable position. Sometimes they also have to compete with companies - world "champions", leading both in market power and technology development.

Firms' positive export experience is often associated with their *different "quality"* compared to locally oriented firms: *higher innovation activity* (Yuriy Gorodnichenko, Jan Svejnar, and Katherine Terrell 2010; Victoria V. Golikova, Ksenia R. Gonchar, and Boris V. Kuznetsov 2012; Marina Arkhipova and Elena Aleksandrova 2014), significant *investments in fixed assets* (Roberto Basile 2001; Manuel Campa and J. Myles Shaver 2002) and *R&D* (Kiyohiko Ito and Vladimir Pucik 1995; Alessandro Sterlacchini 1999; Jooh Lee and Berhe Habte-Giorgis 2004; Berrin Guner, Jooh Lee, and Harold W. Lucius 2010), *the use of advanced technology and quality human capital* (Joachim Wagner 1995; Eva S. Katsikea and Dionysis Skarmas 2003; Houcine Boughanmi et al. 2007), *high productivity* (John R. Baldwin and

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Wulong Gu 2004; Garrick Blalock and Paul J. Gertler 2004; Johannes Van Biesebroeck 2005; James H. Love and Mica Ariana Mansury 2009; Panagiotis Ganotakis and James H. Love 2012; Sergey M. Kadochnikov and Anna A. Fedyunina 2017), etc. However, the question of the extent to which certain factors and characteristics of firms determine their ability to gain and maintain a position in foreign markets has no unambiguous answer to date. While the relationship between firms' export orientation and their innovation and research activity, as well as the quality of their labour force, can be considered proven (see below), in the case of digitalisation it is not so clear: there is some evidence that digitalisation has a positive effect on firms' exports only when it is combined with innovation - technological or organisational - and human capital development (Asta Tarutė and Rimantas Gatautis 2014; Ernesto Cassetta, Linda Meleo, and Marco Pini 2016). There is also an ongoing debate as to whether the export activity of firms has an impact on labour productivity, or whether there is only "natural selection" – successful exporters are more likely to be the inherently more productive firms.

In this paper, based on the analysis of micro-level data (the results of a large-scale survey of Russian firms) combined with macro-level statistics, the following main issues are considered:

- sectoral peculiarities of the export activities of Russian firms;
- the relationship between Russian firms' exports and their activity in innovation, R&D, as well as digitalisation and human capital quality;
- the impact of firms' export activities on labour productivity.

While there are many foreign studies devoted to issues of this kind (see, in particular, reviews by David Greenaway and Richard Kneller (2005), Joachim Wagner (2005), (2011)), similar studies based on Russian data are extremely rare². Meanwhile, in our opinion, Russia is an extremely interesting field of research in terms of identifying the specifics of non-energy exports in a resource-based economy. Since we consider the period before the introduction of large-scale sanctions against Russia, our results may be relevant at least for other post-communist countries with a substantial resource orientation (Turkmenistan, Azerbaijan, Kazakhstan, etc.).

2. Export activity of Russian firms: conditions, specifics, and long-term trends

The choice of Russia as a field of research is conditioned by several important circumstances:

- Russia's abundance of natural resources, primarily energy, makes the respective industries highly attractive for both public and private investment, while other industries have traditionally been characterised by lower investment attractiveness. In turn, this reduces the chances of companies from non-energy industries gaining international competitiveness and makes it more logical for them to opt for the domestic market;
- The Russian market is quite large compared to the markets of the vast majority of other countries, but at the same time, in most industries, it is much smaller than in such countries as the USA, China, or India;
- In recent years, the Russian government has been implementing a large-scale policy of import substitution support, which includes a significant number of tariff and non-tariff barriers, preferences for Russian producers, programmes to stimulate demand for domestic products, etc. (see more about this, for example, in the review by Yuri V. Simachev et al. (2019)).

Under such conditions, the domestic market is a "safe haven" for Russian non-energy firms³. However, there lurks "the curse of the Russian market": it is big enough for many companies, including large ones, to operate in for many years, but still not enough to be the only place to form major global players. At the same time, competition in the domestic market has strong specifics due to price constraints, formal and informal social obligations of companies, etc., so it does not represent the same competition as in the world market. In other words, the competitiveness of companies in the Russian market does not relate to their global competitiveness.

Thus, exports are more of a challenge for Russian non-energy companies than they are for similar companies in most other countries. Expansion into export markets means leaving their "comfort zone" in the domestic market and, at the same time, serves as a "marker" of their higher efficiency compared to non-exporting firms. For this reason, the export activity of Russian companies from non-energy sectors, in our opinion, is deserving of particularly close attention.

² Some studies look at the dynamics of Russian exports and their structural changes (Marina K. Glazatova and Aleksandr V. Daniltsev 2020; Alexander Yu. Knobel and Alexander S. Firanchuk 2020, 2021), the impact of key macroeconomic factors on Russian export (Nikita I. Evtushenko and Alexandre O. Baranov 2023), Russia's bilateral trade and economic relations with certain countries, and multilateral relations within the EAEU (Andrey N. Spartak and Vitaliy V. Frantsuzov 2018; Timofey V. Bordachev et al. 2019; Spartak 2019); the relationship of exports to firms' innovation activity (Golikova, Gonchar, and Kuznetsov 2012; Arkhipova and Alexandrova 2014) and productivity (Fredrik Wilhelmsson and Konstantin Kozlov 2007).

³ Moreover, the current Ukrainian crisis is likely to further strengthen the focus of Russian firms on the domestic market, as the powerful sanctions pressure from numerous foreign countries makes it extremely difficult (or even impossible) to export to their markets, while the Russian government is responding with new measures to support import substitution and stimulate domestic demand.

A key feature of the structure of Russian exports has traditionally been a significant share of energy commodities (oil, gas, petroleum products, etc.). The aggregate share of non-energy industries in Russian exports over a twenty-year horizon, from 1999 to 2018, showed no upward trend. On the contrary, during this period, the share of the energy industry exports increased significantly, and in recent years accounted for more than half of the total export of goods and services (Fig. 1). Among non-energy sectors, metallurgy plays the main role, but its share in Russia’s exports has more than halved over the past two decades. The contribution of machine-building industries to total exports has also significantly decreased, while the contribution of food production and certain service industries, primarily ICT and construction, has increased.

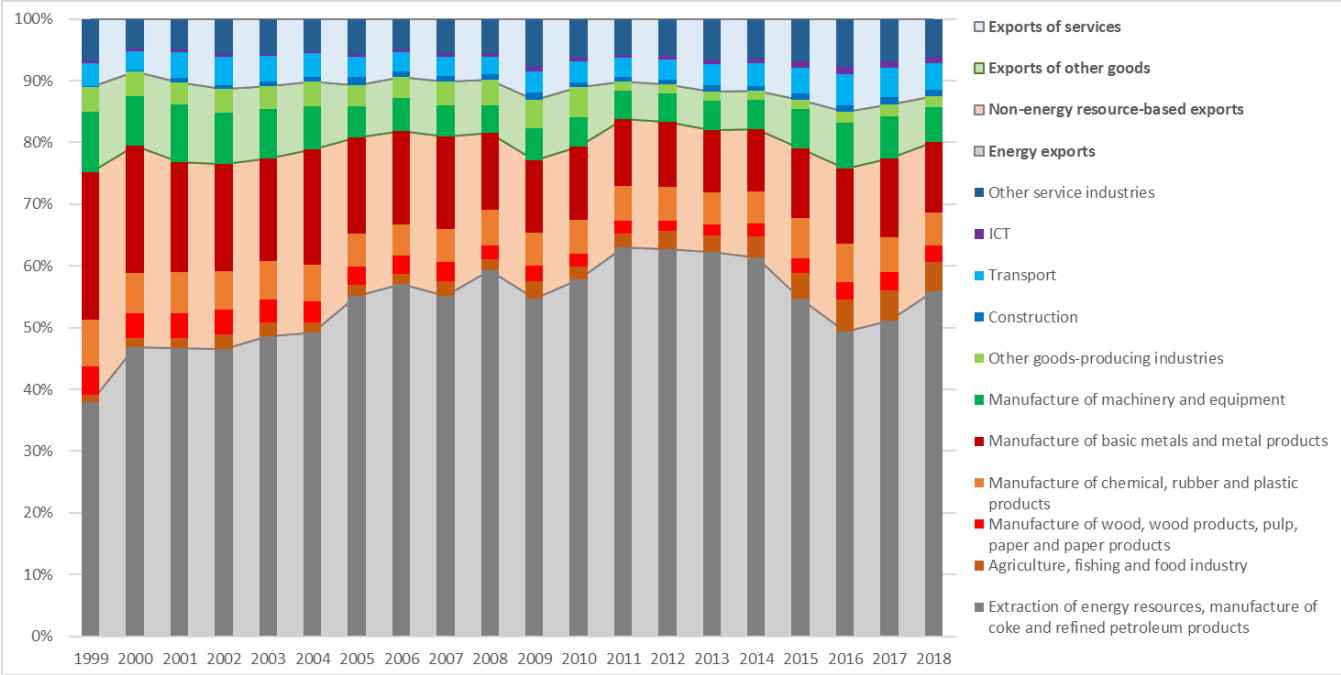


Figure 1. Sectoral structure of Russian exports of goods and services in 1999-2018

Source: The authors’ calculations based on data from the Federal State Statistics Service of the Russian Federation and the Federal Customs Service of the Russian Federation.

The energy sector, metallurgy, machine building, and chemical industry, as well as timber, woodworking, and pulp and paper industry, can be classified as export-oriented: the share of each of these sectors in total exports of goods and services noticeably exceeds its share in gross value added (Fig. 2). The opposite situation is observed primarily in construction, financial and insurance services, and the ICT sector, which, while having a significant share in the national economy, are characterised by relatively small export volumes. In general, commodity production is more export-oriented than services. The highest share of exports in output is observed in the industries engaged in the extraction and primary processing of natural resources.

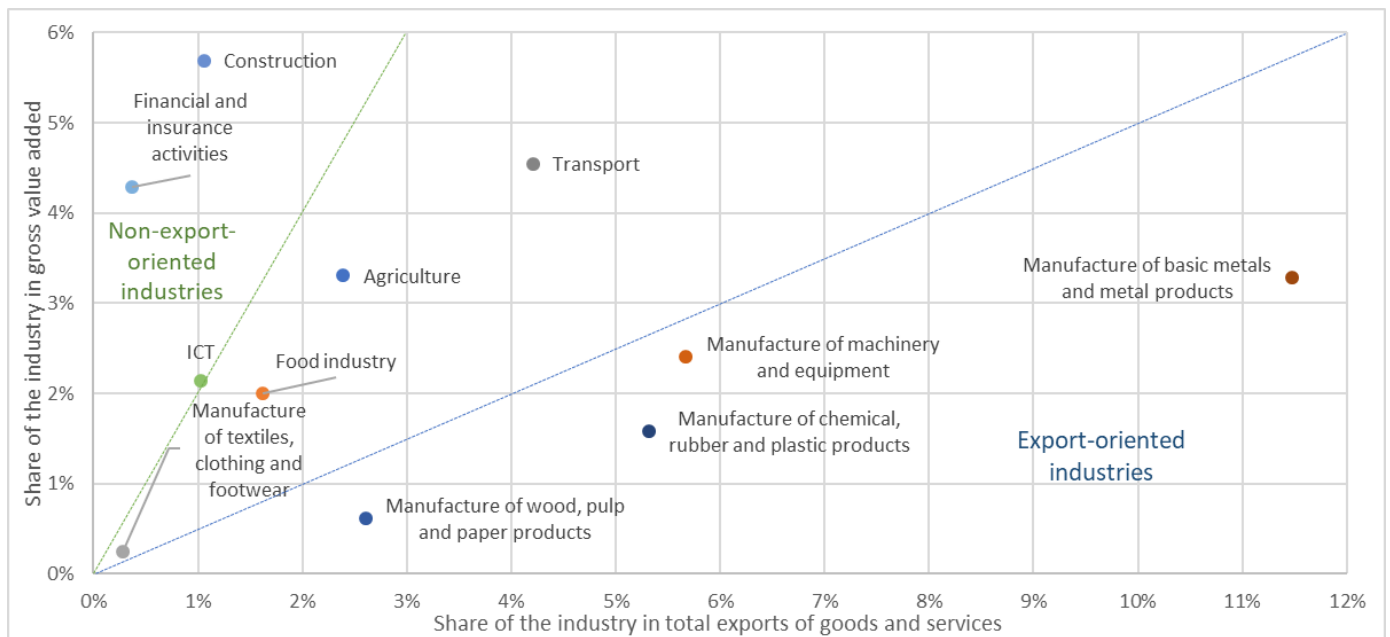


Figure 2. Export orientation of non-energy industries: shares in gross value added and total Russian exports of goods and services in 2018

Source: The authors' calculations based on data from the Federal State Statistics Service of the Russian Federation and the Federal Customs Service of the Russian Federation.

In general, while the Russian energy sector was keeping and increasing its export orientation during the twenty years under consideration, the non-energy sector showed some signs of convergence in the export activity of its industries: several traditionally export-oriented Russian industries (first of all, metallurgy and mechanical engineering) have significantly decreased their share in total exports, whereas the share of some industries that previously had a fairly weak export orientation (construction and ICT), on the contrary, has increased dramatically.

It is important to take into account that part of Russia's exports is a "quasi-export", as it is delivered to the EAEU⁴ countries that form a single customs territory with Russia. On the one hand, the share of goods supplied to EAEU countries in 2018 was relatively small - less than 9% in total merchandise exports and 13% in non-energy exports. On the other hand, some Russian industries are characterised by a significant share of exports to the EAEU countries: 45% of exports of machinery and equipment, 54% of exports of metal products, and 58% of exports of textiles, clothing and footwear.

One of the fundamental problems of the Russian economy throughout the post-Soviet period (as well as in the Soviet era) has been low labour productivity. Despite its fairly significant growth, the level of labour productivity in Russia is 2-3 times lower than in most industrialised countries such as the United States, Germany, France, or the UK. In addition, Russia lags far behind some post-communist countries, most notably Slovakia and Slovenia (Fig. 3). It is important to note that Russia's lag in labour productivity is minimally caused by the insufficient quality of human capital, while much more is due to the capital intensity (capital-labour ratio) gap and, especially, the lower level of total factor productivity (Yury V. Simachev, Anna A. Fedyunina, and Mikhail G. Kuzyk 2021). The latter is often interpreted as a contribution of technological progress to output growth (see, for example, Daron Acemoglu 2007)⁵.

⁴ In addition to Russia, the EAEU includes Armenia, Belarus, Kazakhstan and Kyrgyzstan.

⁵ However, strictly speaking, total factor productivity in addition to the level of technology reflects the influence of all other factors except physical and human capital, including an imperfect institutional environment (Vladimir A. Bessonov 2004; Daron Acemoglu and James A. Robinson 2012; Marcel P. Timmer and Ilya B. Voskoboinikov 2014).

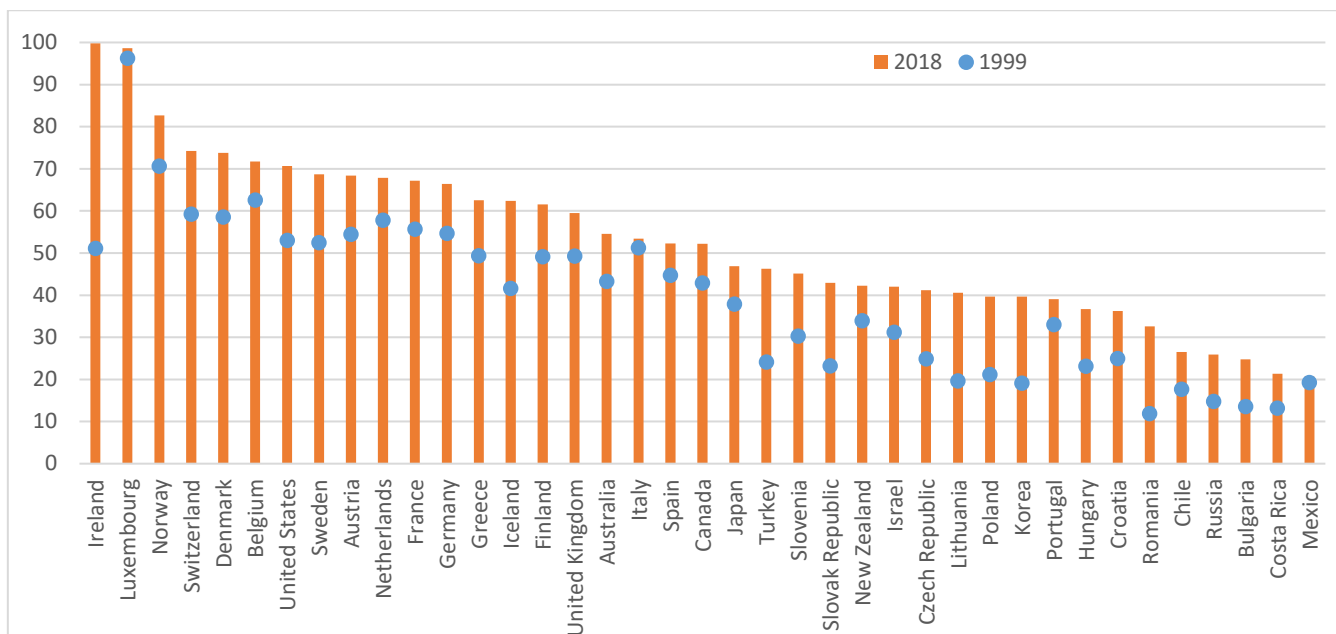


Figure 3. Labour productivity by country: GDP per hour worked, USD (constant prices 2010, PPP)

Source: Compiled by the authors based on OECD data.

In this context, the export activities of Russian firms are of particular importance. First, exporting firms demonstrate a higher level of innovation activity, often borrowing best practices and solutions from leaders in foreign markets and, thus, increasing their technological level (Golikova, Gonchar, and Kuznetsov 2012). Second, exporting firms outperform other firms in labour productivity, and the gap is much larger in Russia than in many other countries, particularly post-Communist countries. At the same time, several studies show that firms' exporting activities themselves can contribute to higher labour productivity due to the "learning-by-exporting" effect (Baldwin and Gu 2004; Blalock and Gertler 2004; Van Biesebroeck 2005; Love and Mansury 2009).

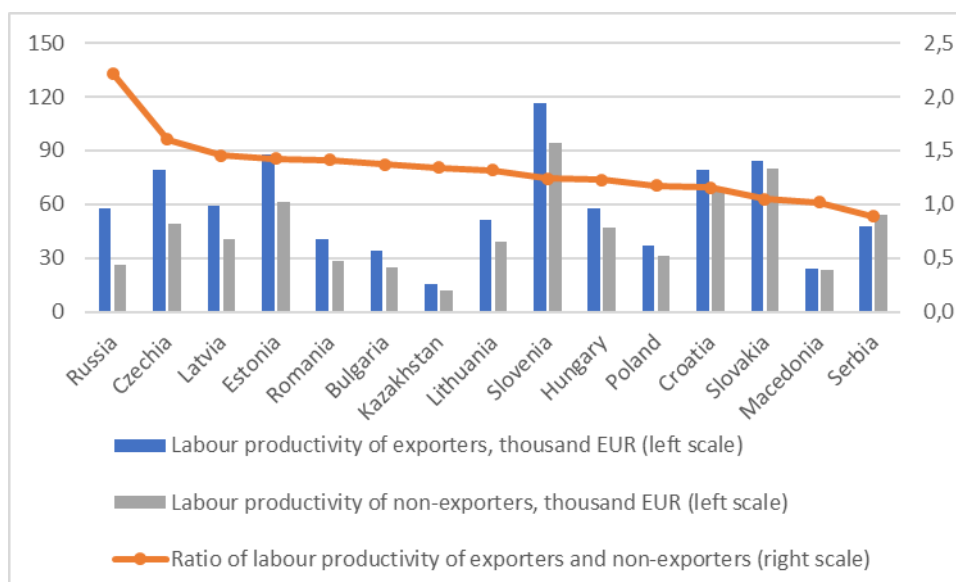


Figure 4. Labour productivity of exporting and non-exporting manufacturing firms in post-Communist countries in 2018: annual revenue per employee, median

Source: The authors' calculations based on data from the Business Environment and Enterprise Performance Survey (BEEPS), Eurostat, National Bank of the Republic of Kazakhstan.

3. Literature review and research propositions

Traditionally, *firms' size*, *ownership*, and *human capital quality* are considered as factors of firms' export activity (Table 1). In our study, we take these factors into account as basic control variables. In addition, empirical studies repeatedly reveal a positive relationship between exports and firms' *innovation activities*. Examples of relatively recent work of this kind, based on data from Russia and other transition economies, include studies by Gorodnichenko, Svejnar, and Terrell (2010) and Golikova, Gonchar, and Kuznetsov (2012). On the one hand, this is explained by the initially

higher level of innovation activity of exporting firms, which allows them to bring modern competitive products to foreign markets (Arkhipova and Aleksandrova 2014). On the other hand, exporting firms have the opportunity to adopt best practices from foreign partners and competitors. In turn, this leads to an increase in the innovation activity of firms, for which there is a lot of empirical evidence (see, for example, Gorodnichenko, Svejnar, and Terrell 2010; Golikova, Gonchar, and Kuznetsov 2012).

Firms' R&D activities and related expenditures are also often considered as a factor of export. The vast majority of relevant empirical studies find a positive relationship between R&D and firms' export activity (Ito and Pucik 1995; Sterlacchini 1999; Basile 2001; Lee and Habte-Giorgis 2004; Roper, Love, and Añon Higon 2006; Guner, Lee, and Lucius 2010; Ganotakis and Love 2012). Interestingly, in some cases, the contribution of research activities to exports is found only in certain industries. In India, for example, Kumar and Siddharthan (1994) found it only in low- and medium-tech industries and attributed this effect to a lack of domestic research capabilities for Indian firms to enter high-tech export markets. In general, the positive relationship between export activity and R&D investment is explained by the fact that the latter allows firms to master the production of globally competitive products, improve their operational efficiency, and reduce production costs (Guner, Lee, and Lucius 2010; Joana Reis and Rosa Forte 2016).

One of the key trends of the present time is *digitalisation*, which has an impact on various areas of firms' activity, including export. This manifests itself, not only in the extensive use of modern digital technologies, but also in the "end-to-end" digitalisation of companies' physical assets and integration into digital ecosystems with value chain partners (PwC 2016). The magnitude of the processes involved suggests the start of a digital revolution (UNCTAD 2019) and, if not the beginning, then at least the rapid approach of a new digital era (OECD 2019). Digital transformation directly affects international trade, which not only appears in the steady outstripping growth of exports of ICT and other digital services themselves (UNCTAD 2019), but also leads to a reduction in the transaction costs of foreign trade in traditional goods and services (Kuzyk, Simachev, and Fedyunina 2020). As a result, the use of digital technology is becoming a significant factor in export activities, especially for small and medium-sized companies (Noemi Sinkovics, Rudolf R. Sinkovics, and Ruey-Jer "Bryan" Jean 2013; Marco Pini, Ivano Dileo, and Ernesto Cassetta 2018; Dolores Añon Higón, and Daniel Bonvin 2024). However, as Tarutė and Gatautis (2014) point out, the digitalisation of firms achieves the best results only when the implementation of digital technology matches the internal capabilities of firms and is combined with organisational change. Cassetta, Meleo, and Pini (2016) show that digitalisation has a positive impact on firms' export activity when it is combined with process and organisational innovation and accompanied by investments in digital skills development.

The results of empirical studies on the factors of firms' export activity are briefly summarized in Table 1.

Table 1. Factors of firms' export activity - research summary

Factor	Evidence
Size	Positive relationship between the size of firms and their exports: Sylvie K. Chetty and Robert T. Hamilton (1993); Wagner (1995); Andrew B. Bernard and Wagner (1997); Ravindra H. Dholakia and Deepak Kapur (2004); Lee and Habte-Giorgis (2004); Marcel Fafchamps, Said El Hamine, and Albert Zeufack (2008); Dahai Fu, Yanrui Wu, and Yihong Tang (2010); Justina Tarvainyte (2014); Joana Reis and Rosa Forte (2016); Sevdie Alshiqi Bekteshi (2020) Non-monotonic relationship (n-shaped curve): Nagesh Kumar and N.S. Siddharthan (1994); Måns Söderbom (2001)
Ownership	Positive relationship between the export activity of firms and their foreign ownership: Larry Willmore (1992); Mona Haddad and Ann Harrison (1993); Nakos, Brouthers, and Brouthers (1998); Stephen Roper, James H. Love, and Dolores Añon Higon (2006); Fu, Wu, and Tang (2010)
Skilled personnel	Positive relationship of firms' exports with the availability and quality of labour: Wagner (1995); George E. Nakos, Keith D. Brouthers, and Lance Eliot Brouthers (1998); Katsikea and Skarmas (2003); Roper, Love, and Añon Higon (2006); Boughanmi et al. (2007) Positive relationship of firms' exports with employees' training: Pontus Braunerhjelm (1996); Farok J. Contractor and Susan M. Mudambi (2008); Gianmarco Ottaviano and Christian Volpe Martincus (2011); Wen Yue (2023)
Innovations	Positive relationship between exports and firms' innovation activities in post-communist countries: Gorodnichenko, Svejnar, and Terrell (2010); Golikova, Gonchar, and Kuznetsov (2012); Arkhipova and Aleksandrova (2014)
R&D activities	Positive relationship between R&D and firms' export activity: Ito and Pucik (1995); Sterlacchini (1999); Basile (2001); Lee and Habte-Giorgis (2004); Roper, Love, and Añon Higon (2006); Guner, Lee, and Lucius (2010); Ganotakis and Love (2012) Positive relationship only in certain industries: Kumar and Siddharthan (1994)

Digitalisation	Positive relationship between the export activity of firms and their digitalisation: Sinkovics, Sinkovics, and Jean (2013); Pini, Dileo, and Cassetta (2018); Añón Higón and Bonvin (2024) Positive role of firms' digitalisation when it is combined with organisational innovation: Tarutė and Gatautis (2014); Cassetta, Meleo, and Pini (2016)
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Source: Compiled by the authors.

Considered empirical evidence allows us to put forward the following proposition:

P1. Firms' export activity is positively related to innovation and R&D financing. The use of digital technologies is a significant export factor if combined with organisational innovation.

There is ample evidence, in the current literature, of *higher productivity* within exporting firms (including works based on Russian data: Wilhelmsson and Kozlov 2007; Kadochnikov and Fedyunina 2017). Empirical studies more often point to the "*self-selection*" of companies to export activities: the initially higher level of labour productivity of exporters (see, for example, reviews by Greenaway and Kneller (2005), Wagner (2005)). At the same time, several works have identified the "*learning-by-exporting*" effect: an increase in productivity during export activities (Baldwin and Gu 2004; Blalock and Gertler 2004; Van Biesebroeck 2005; Love and Mansury 2009; Ganotakis and Love 2012). Apart from the benefits of exposure to superior foreign knowledge and technology, exporting enables firms to acquire commercial information on foreign customers' preferences and methods through which operational efficiencies can be improved (Blalock and Gertler 2004; Ganotakis and Love 2012).

In addition, there is empirical evidence of the mutually reinforcing effect of firms' export and research activities on labour productivity: for example, Keiko Ito and Sebastien Lechevalier (2010), using data from a large sample of Japanese firms, found that firms that neither exported their products, nor funded R&D, had the lowest productivity, while the highest levels were found in firms that combined export and R&D activities.

On this basis, we suggest the following proposition:

P2. Exporting firms are characterised by higher labour productivity than other firms, especially when their export activities are combined with innovation and R&D funding. Export activity contributes to the growth of labour productivity.

4. Data and methodology

Since our study focuses on export activity in the non-energy sector, we use the results of a survey of firms' managers from four different non-energy industries of the Russian economy: agriculture, manufacturing (excluding fuel production), construction, and transport. The survey was conducted in July-September 2019 in 23 regions of the Russian Federation⁶. The survey was conducted using a formalised questionnaire under the condition of anonymity of respondents. Direct interaction with the respondents was carried out by regional representatives who had extensive experience in conducting surveys and stable relations with the heads of enterprises. This resulted in a very high response rate of over 90%. The final sample of the survey consists of 713 firms. The sample was not fully representative, but quotas were set for industries, activities within each industry, and firm size to approximate the structure of the general population.

A detailed description of the data in terms of the variables used is provided in Table 2.

⁶ The survey was organised by the National Research University Higher School of Economics as part of the research project "Analysis of factors and problems of increasing labour productivity at Russian enterprises, increasing the role of science and education in ensuring productivity growth". The fieldwork was conducted by the Information and Publishing Centre "Statistics of Russia".

Table 2. Description of variables and statistics

Variables	Description of variables	Min	Max	Number of observ.	Mean	Frequency	Standard deviation	
Dependent variables								
Export	The firm exported products (services) in 2018	0	1	713	0.30	30.2%	0.46	
Labour_productivity	The level of firms' labour productivity (value added per employee) within the industry in 2018: 3- high-performance (leading) firms - 20% of firms with the highest level of productivity within their industry in the sample; 1 - low-performance (lagging) firms - 40% of firms with the lowest level of productivity within their industry in the sample; 2 - middle-performance (middling) firms - all other firms in the sample	1	3	713	1.80	19.9% 40.4% 39.7%	0.75	
Labour productivity dynamics: Productivity_dyn	The change in labour productivity (value added per employee) in 2018 compared to 2013 (or the first full year of operation of the firm) in comparable prices in roubles: -2 - decrease of 20% or more; -1 - decrease of less than 20%; 0 - no significant change; 1 – growth of less than 20%; 2 – growth of 20% and more	-2	2	713	0.56	5.3% 7.2% 39.0% 23.6% 25.0%	1.10	
Independent variables								
Industry	non-energy raw materials	Incl. crop production, flour-and-cereals industry, chemical industry	0	1	713	0.17	17.0%	0.38
	others	Incl. dairy farming, dairy industry, meat farming, paper industry, publishing industry, pharmaceutical industry, building materials industry, machine tool industry, automotive industry, building and road construction, trucking, marine freight transport, air transport	0	1	713	0.83	83.0%	0.38
Ownership	public	The controlling owner of the firm is the government or a public sector company	0	1	713	0.09	9.3%	0.29
	foreign	The controlling owner of the firm is a foreign legal entity or individual	0	1	713	0.07	7.0%	0.26
Size	small	Number of the firm's employees in 2018 up to 100 people	0	1	713	0.31	31.3%	0.46
	medium	Number of the firm's employees in 2018 100-250 people	0	1	713	0.35	34.9%	0.48
	large	Number of the firm's employees in 2018 251-1000 people	0	1	713	0.26	26.4%	0.44
	largest	Number of the firm's employees in 2018 more than 1000 people	0	1	713	0.07	7.4%	0.26
Market leader	The firm is a monopolist or one of the largest players in the Russian market	0	1	713	0.18	17.8%	0.38	
R&D funding in 2018: RD_2018		The firm financed in-house or outsourced R&D in 2018	0	1	713	0.25	24.7%	0.43
R&D funding in 2013-2018: RD_2013_2018		The firm financed in-house or outsourced R&D at any time between 2013 and 2018	0	1	713	0.25	25.0%	0.43
Innovation	product	The firm had ever implemented new or improved products (services) in the 5 years prior to the survey	0	1	713	0.46	46.3%	0.50
	process	The firm had ever implemented new or improved technology in the 5 years prior to the survey	0	1	713	0.43	42.8%	0.50

Variables	Description of variables	Min	Max	Number of observ.	Mean	Frequency	Standard deviation
organisational	The firm had ever implemented organisational changes in production or management in the 5 years prior to the survey	0	1	713	0.21	21.3%	0.41
<i>Innovating</i>	The firm had ever implemented product, process, and/or organisational innovations in the 5 years prior to the survey	0	1	713	0.67	67.0%	0.47
Digitalised firms: <i>Digitalised</i>	The company uses any digital technology	0	1	713	0.49	49.2%	0.50
Share of highly up to 20%	Approximate share of firm's employees with completed higher or secondary education, working in their speciality area	0	1	713	0.26	26.2%	0.44
qualified employees: 20%-40%		0	1	713	0.30	30.4%	0.46
Qualified_pers 40-60%		0	1	713	0.22	21.9%	0.41
more than 60%		0	1	713	0.21	21.5%	0.41
<i>Digitalized * Product innovation</i>	The firm uses digital technology and has implemented product innovation in the 5 years prior to the survey	0	1	713	0.29	29.7%	0.46
<i>Digitalized * Process innovation</i>	The firm uses digital technology and has implemented process innovation in the 5 years prior to the survey	0	1	713	0.28	27.9%	0.45
<i>Digitalized * Organisational innovation</i>	The firm uses digital technology and has implemented organisational innovation in the 5 years prior to the survey	0	1	713	0.15	14.6%	0.35
<i>Export * RD 2013 2018</i>	The firm was an exporter in 2018 and financed R&D in 2013-2018	0	1	713	0.14	13.9%	0.35
<i>Export * Innovating</i>	The firm was an exporter in 2018 and had implemented any innovations in the 5 years prior to the survey	0	1	713	0.25	24.5%	0.43

Source: Compiled by the authors based on the survey data.

Analysis of the factors of firms' export activity is carried out by estimating the parameters of binary logistic (1) and probit (2) regression models:

$$P(x) = \frac{1}{1 + e^{-x}} \quad (1)$$

$$P(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}x^2} \quad (2)$$

where y is *Export*;
 x in the basic model is

$$x = \sum_i \beta_i \text{Size}_i + \beta^{mkt} \text{Market_leader} + \sum_j \beta_j \text{Ownership}_j + \sum_k \beta_k \text{Industry}_k + \sum_l \beta_l \text{Qualified_pers}_l + \beta^{RD} \text{RD_2018} + \beta^{inn} \text{Innovating} + \beta^{dig} \text{Digitalised} + \text{const} \quad (3)$$

x in the advanced model is

$$x = \sum_i \beta_i \text{Size}_i + \beta^{mkt} \text{Market_leader} + \sum_j \beta_j \text{Ownership}_j + \sum_k \beta_k \text{Industry}_k + \sum_l \beta_l \text{Qualified_pers}_l + \beta^{RD} \text{RD_2018} + \beta^{inn} \text{Innovating} + \beta^{dig} \text{Digitalised} + \sum_m \beta_m \text{Digitalised} * \text{Innovation}_m + \text{const} \quad (4)$$

To analyse the relationship of labour productivity with export and innovation activity, we also use logit (1) and probit (2) models, where: y is *Labour_productivity*;
 x in the basic model is

$$x = \sum_i \beta_i \text{Size}_i + \beta^{mkt} \text{Market_leader} + \sum_j \beta_j \text{Ownership}_j + \sum_k \beta_k \text{Industry}_k + \sum_l \beta_l \text{Qualified_pers}_l + \beta^{exp} \text{Export} + \beta^{RD} \text{RD_2018} + \beta^{inn} \text{Innovating} + \beta^{dig} \text{Digitalised} + \text{const} \quad (5)$$

x in the advanced model is

$$x = \sum_i \beta_i \text{Size}_i + \beta^{mkt} \text{Market_leader} + \sum_j \beta_j \text{Ownership}_j + \sum_k \beta_k \text{Industry}_k + \sum_l \beta_l \text{Qualified_pers}_l + \beta^{exp} \text{Export} + \beta^{RD} \text{RD_2018} + \beta^{inn} \text{Innovating} + \beta^{dig} \text{Digitalised} + \beta^{RD_exp} \text{RD_2018} * \text{Export} + \beta^{inn_exp} \text{Innovating} * \text{Export} + \text{const} \quad (6)$$

Finally, we use the propensity score matching (PSM) method to identify the impact of exports on productivity dynamics. The essence of this method is to identify, for each exporting firm, a non-exporting firm that is as close as possible to it in terms of the probability of exporting (propensity score). Then the effect of export on labour productivity is estimated as the difference between the dynamics of labour productivity in the target group (exporting firms) and the control group (non-exporting firms close to them)⁷.

The logistic regression model (1) is used to calculate the propensity score, where y is *Productivity_dyn*,

⁷ For more on this, see, for example, (Whitney K. Newey 2009; Simachev, Kuzyk, and Nikolay N. Zudin 2017).

$$x = \sum_i \beta_i \text{Size}_i + \sum_j \beta_j \text{Ownership}_j + \sum_k \beta_k \text{Industry}_k + \beta^{RD} \text{RD_2013_2018} + \beta^{dig} \text{Digitalised} + \text{const (7)}$$

Pairs of exporting and non-exporting firms were formed using the one nearest neighbour method (leave-one-out).

4. Empirical results

4.1. Factors of Russian firms' export activity

The results of regression modelling, based on the survey of Russian companies in non-energy sectors, indicate that one of the key factors of exports is the ownership of firms by foreign capital (Table 3). Generally speaking, this suggests that foreign investors who acquired or created production facilities in Russia often focused, not only on the domestic market, but also on the markets of neighbouring countries, considering their Russian assets as a kind of export platform. In addition, some MNC divisions in Russia initially focused on the Russian market, and subsequently strengthened their export activities, and expanded their sales geography due to the reduction in domestic solvent demand.

Table 3. Factors of export activity of Russian firms: regression model parameters

Independent variables		Dependent variable - Export			
		logit	probit	logit	probit
Size	small	base	base	base	base
	medium	0.510** (0.251)	0.289** (0.142)	0.461* (0.255)	0.265* (0.144)
	large	0.635** (0.266)	0.381** (0.153)	0.685** (0.272)	0.406*** (0.156)
	largest	0.681* (0.404)	0.387* (0.236)	0.559 (0.422)	0.327 (0.245)
Major player or monopolist in the Russian market		0.762*** (0.242)	0.446*** (0.144)	0.762*** (0.249)	0.449*** (0.148)
Industry	non-energy raw materials	0.247 (0.246)	0.130 (0.144)	0.214 (0.249)	0.101 (0.146)
	others	base	base	base	base
Ownership	state	-0.587 (0.371)	-0.373* (0.211)	-0.564 (0.377)	-0.371* (0.214)
	foreign	2.150*** (0.383)	1.226*** (0.219)	2.112*** (0.393)	1.202*** (0.224)
Share of highly qualified employees	up to 20%	base	base	base	base
	20%-40%	0.409 (0.273)	0.234 (0.154)	0.340 (0.278)	0.193 (0.156)
	40-60%	0.796*** (0.285)	0.449*** (0.163)	0.694** (0.291)	0.399** (0.166)
	more than 60%	0.901*** (0.287)	0.515*** (0.164)	0.832*** (0.293)	0.468*** (0.167)
R&D funding		1.179*** (0.214)	0.703*** (0.128)	1.088*** (0.224)	0.645*** (0.133)
Digitalised firm		0.213 (0.203)	0.128 (0.118)	0.004 (0.340)	-0.005 (0.190)
Innovations	any	0.403* (0.233)	0.238* (0.131)		
	product			0.642*** (0.302)	0.367*** (0.172)
	process			0.040 (0.321)	0.017 (0.182)
	organisational			0.251 (0.408)	0.145 (0.234)
Digitalised firm * Product innovation				0.450 (0.414)	0.275 (0.237)
Digitalised firm * Process innovation				0.063 (0.416)	0.058 (0.240)
Digitalised firm * Organisational innovation				-0.658	-0.387

				(0.498)	(0.288)
McFadden R ²		0.196	0.196	0.219	0.218
Hosmer-Lemeshow goodness-of-fit test	Chi-square	5.564	1.992	4.631	6.528
	P-value	0.696	0.981	0.796	0.588
N		713			

Notes:

Hereinafter the following designations are used:

* significant at 10% level;

** significant at 5% level;

*** significant at 1% level;

standard errors are given in parentheses;

cells corresponding to the variables that are not included in the specification are highlighted in grey.

Source: The authors' calculations based on the survey data.

Our results suggest that small Russian firms export their products and services less frequently than others, which is consistent with the numerous empirical findings mentioned above. In addition, Russian exporters are often major players or even monopolists in their domestic markets. Another “classical” export factor, the positive role of which was confirmed in our study, is the quality of human capital: export activity, other things being equal, is characteristic of firms with a significant share of qualified personnel. Thus, high-quality human capital contributes to the competitiveness of Russian firms in foreign markets.

As for our first proposition, it was only partially confirmed. R&D funding and the implementation of product innovations are positively related to firms' export activity. At the same time, exports have no significant relationship with either the digitalisation of companies or its combination with organisational innovation. This can be considered as new evidence of the repeatedly noted lack of digital maturity of many companies, which is typical, not only of Russia, but also of other countries, including developed ones (see, for example, the relevant review by Dmitry V. Kuzin (2019), as well as recent work by Lais S. da Costa, Igor P. Munhoz, Luciana Pereira and Alessandra C. S. Akkari (2022)). As a result, companies' use of digital technologies does not always lead to their digital transformation, which consists of making significant changes in their various activities, including exporting.

4.2. Export activity of Russian firms and labour productivity

Firms' export activity is positively related to the level of labour productivity: productivity leaders export about twice as often as laggards (Fig. 5). This seems quite logical: a high level of productivity contributes to the global competitiveness of firms and allows them to export their products or services. However, the lowest average share of export revenues in turnover is characteristic of middling firms - exporters, while it is comparable for the most productive companies and laggards. Thus, high-performing firms are more likely to operate in foreign markets, but there is little evidence to suggest that they rely more on exports than lagging firms.

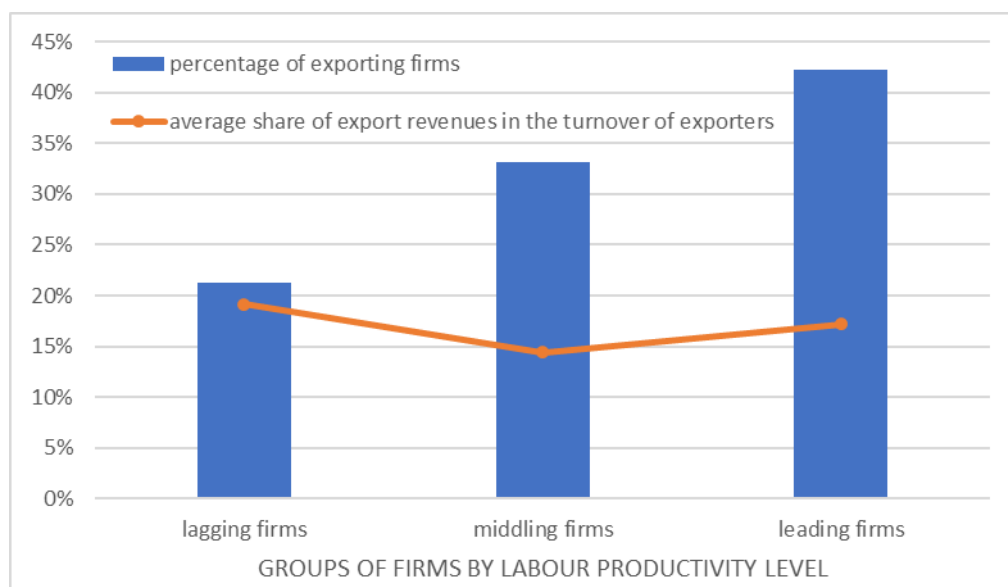


Figure 5. Firms' export activity in 2018 depending on the level of labour productivity

Source: The authors' calculations based on the survey data.

The results of the regression analysis indicate a positive connection of labour productivity with firm size, a significant share in the Russian market, and high quality of human capital, which seems quite logical (Table 4). In addition, unlike export activity, labour productivity is positively related to firms' digitalisation. As for our second

assumption, it was partially confirmed. As expected, we found a positive relationship between labour productivity and export activity of firms. At the same time, the combination of exports and R&D has no connection with labour productivity. A more surprising result is obtained for innovation activity, which, combined with exports, has a negative relationship with productivity. Generally speaking, this suggests two alternative models of how high-performing firms ensure their competitiveness, one related to export activity and the other to innovation.

Table 4. Relationship of firms' labour productivity to export activity, R&D, and innovation: regression models' parameters

Independent variables		Dependent variable - Labour productivity			
		logit	probit	logit	probit
Size	small	base	base	base	base
	medium	0.452** (0.183)	0.254** (0.109)	0.447** (0.183)	0.256** (0.109)
	large	0.910*** (0.203)	0.526*** (0.121)	0.939*** (0.204)	0.544*** (0.121)
	largest	1.038*** (0.318)	0.604*** (0.19)	1.091*** (0.32)	0.631*** (0.191)
Major player or monopolist in the Russian market		0.354* (0.204)	0.213* (0.122)	0.356* (0.204)	0.215* (0.122)
Industry	non-energy raw materials	-0.098 (0.125)	-0.061 (0.075)	-0.115 (0.126)	-0.071 (0.075)
	others	base	base	base	base
Ownership	state	-0.017 (0.257)	-0.003 (0.153)	-0.007 (0.258)	0.004 (0.154)
	foreign	-0.271 (0.297)	-0.141 (0.177)	-0.282 (0.298)	-0.152 (0.178)
Share of highly qualified employees	up to 20%	base	base	base	base
	20%-40%	0.294 (0.197)	0.155 (0.117)	0.295 (0.197)	0.159 (0.118)
	40-60%	0.415* (0.216)	0.222* (0.129)	0.430** (0.217)	0.236* (0.129)
	more than 60%	0.731*** (0.218)	0.401*** (0.130)	0.720*** (0.218)	0.400*** (0.130)
Export		0.361** (0.177)	0.217** (0.106)	0.919*** (0.340)	0.564*** (0.203)
R&D funding		-0.034 (0.184)	-0.030 (0.110)	0.065 (0.244)	0.028 (0.146)
Digitalised firm		0.301* (0.157)	0.189* (0.094)	0.306* (0.158)	0.193** (0.094)
Innovations		0.230 (0.168)	0.143 (0.100)	0.364* (0.190)	0.229** (0.113)
Export * R&D				-0.182 (0.366)	-0.100 (0.219)
Export * Innovations				-0.655* (0.396)	-0.415* (0.237)
McFadden R ²		0.060	0.058	0.062	0.061
Pearson goodness-of-fit test	Chi-square	843.609	844.891	833.303	834.243
	P	0.030	0.028	0.051	0.048
N		713			

Source: The authors' calculations based on the survey data.

Overall, between 2013-2018, Russian firms were generally characterised by labour productivity growth (in comparable prices). However, it is important to note that exporters were significantly more likely to increase their productivity than non-exporting firms (Fig. 6).

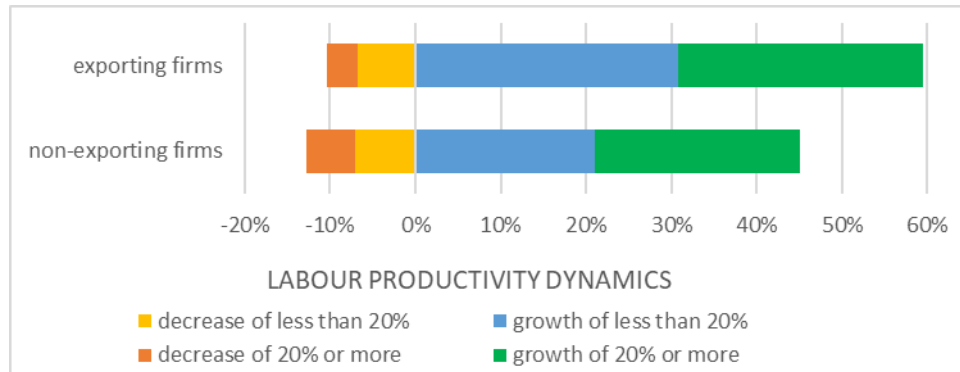


Figure 6. Labour productivity dynamics in 2013-2018 depending on firms' export activity

Source: The authors' calculations based on the survey data.

To test the proposition that firms' export activity positively affects labour productivity, we evaluated the corresponding treatment effect. The results (Table 6) show that exporting firms were significantly more likely to achieve productivity growth than their peers in the control group who did not export their products or services. This suggests a "learning-by-exporting" effect: competing in foreign markets with local and global leaders, exporting companies not only have the opportunity to borrow advanced technologies and practices, but are often forced to improve their efficiency to be competitive.

Table 6. Evaluation of the treatment effect of firms' export activities on labour productivity

Groups of firms	Labour productivity dynamics in 2013-2018 (percentage of firms in each group)					Number of observations	Significance of differences (Chi-square)
	decrease of 20% or more	decrease of less than 20%	no significant change	growth of less than 20%	growth of 20% or more		
Experimental group: firms that exported products or services in 2018 and the previous 5 years	3.6%	6.7%	30.3%	30.8%	28.7%	195	12.76**
Control group: companies that did not export products or services between 2013-2018	5.1%	6.2%	45.1%	18.5%	25.1%	195	

Note: The propensity score matching (PSM) procedure was used to select a control group of non-exporting firms (see, for example, Newey 2009). The following firm characteristics were used to calculate the propensity score: size, industry, ownership, R&D funding, and use of digital technologies.

Source: The authors' calculations based on the survey data.

5. Discussion and conclusion

It is often assumed that the factors and characteristics of exports have been studied in detail. However, analysis based on country-specific data sometimes yields surprising results.

1. Russia's total non-energy exports have tended to decline over the twenty years under consideration. However, there have been heterogeneous changes in different industries. Metallurgy traditionally plays the main role in Russian non-energy exports, but its share has more than halved. The contribution of other export-oriented industries (manufacture of machinery and equipment; wood, pulp and paper industry; manufacture of chemical, rubber and plastic products) to the total exports has also significantly decreased. On the contrary, the contribution of the agriculture and food processing industry, as well as the ICT and construction sectors, which previously had a weak export orientation, increased markedly. This suggests a certain convergence in the export activity of non-energy industries, which, however, was combined with a simplification of Russian exports and their shift towards low-value-added products.

2. The key factors of the export activity of Russian firms are their size, foreign ownership, quality human capital, and R&D financing. The fact that foreign investment is one of the most important factors of exports is not at all surprising

– foreign-owned companies tend to be more deeply integrated into global value chains. At the same time, it can be noted that such companies, as a rule, were created or acquired in Russia with a view to the domestic market. However, the limitations of domestic solvent demand in recent years are increasingly encouraging foreign investors to seek access to the global market for their firms in Russia.

3. As in other countries, in the Russian economy exporters outperform other firms in terms of labour productivity, but in Russia, the difference is particularly large. This is mainly due to the protection of Russian markets and the lack of domestic competition.

What motivates Russian companies to export when the domestic market is so strongly protected that it allows even low-performance firms to continue operations? In our opinion, there are several factors at play here.

The first is the tradition for many companies that dominate certain domestic markets and have "outgrown" them, to expand their sales by entering foreign markets. Here we should also note the limited scope of many Russian markets, primarily those related to advanced products and services. This motivates innovative companies to enter global markets.

The second factor, perhaps more specific, is the intention of major firms and monopolists to go beyond the restrictions on their activities in Russia, which are due to strict antitrust regulation, as well as informal obligations, and probable corruption. For these companies, the world market is an area of real commercial activity.

4. It is not surprising that the labour productivity of Russian firms is positively related to exports and innovation activity. At the same time, while in some other economies there is empirical evidence of mutually reinforcing effects of firms' export and research activities on labour productivity, in Russia, contrary to our assumption, we observe a "splitting" effect of higher productivity preconditions: either export-based or innovation-based. On the one hand, it is a consequence of the prevalence of low-end products and services in Russian exports, where the role of science-intensive innovations is limited. On the other hand, many Russian companies are characterised by a low intensity of innovations, mostly based on imitations. This provides a certain effect in the domestic "greenhouse" market but does not lead to significant positive results in the global market.

5. The significant learning-by-exporting effect on the growth of labour productivity of Russian firms is revealed. While competing in foreign markets with local and global leaders, Russian exporting firms can adopt their advanced technologies and management practices; in addition, exporters often need to improve operational efficiency to ensure their global competitiveness.

Our study contributes to the development of empirical knowledge about the structural features of Russian non-energy exports, their factors, and firm-level effects. Based on the results obtained, we can offer the following recommendations for government policy to stimulate non-resource exports in Russia and other resource rich countries. First, the service sector has a significant unrealised export potential. Its development often does not require a huge investment, but it needs qualified personnel, which Russia and some other post-communist countries are traditionally quite rich in. Second, the positive correlation of exports with R&D funding and product innovation indicates that a potentially highly effective form of export promotion is supporting projects that involve the development of new products and services aimed at foreign markets. Finally, the low level of digital maturity of many Russian companies, generally speaking, means that there is significant unrealised potential for export development through stimulating the digitalisation of firms.

In conclusion, it is important to draw attention to several limitations of our study. Firstly, the microdata we use does not allow us to distinguish between exports to the "near abroad" (EAEU) and "far abroad" countries. As already noted, the supply of products to the EAEU countries is a "quasi-export" due to both the common customs territory and historically close ties between companies in the post-Soviet space. However, another survey conducted in 2018⁸ shows that Russian companies most often combined exports to EAEU countries with exports to other countries.

Secondly, de jure foreign ownership of companies in Russia is not always the same in reality: foreign owners of Russian companies are quite often offshore firms, which in turn are controlled by Russian owners. However, even being "mixed" with offshore foreign ownership plays a significant role in the export activities of firms.

Third, the dynamics of labour productivity were estimated at comparable prices in national currency. However, the rouble underwent a significant devaluation in the period under review, which served as an incentive for exports and could noticeably affect the labour productivity of exporters expressed in roubles. Thus, the learning-by-exporting effect that we have identified requires additional confirmation in the period when the national currency exchange rate was more stable. This is one of the possible directions for the development of our work.

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⁸ HSE University. Project for Monitoring the Competitiveness of Russian Manufacturing. URL: <https://iims.hse.ru/en/rfge/>

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