Original Paper

The Impact of Exports on Economic Growth in Russia: Retrospective and Perspective

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Abstract. The most important roots of foreign income, government fiscal and monetary policies shape the general perception of competitiveness given that it is export that determines how a country can try for the level of economic growth. The aim of this study is to investigate the impact of exports on economic growth in Russia by analyzing the relationship between exports and economic growth in the period 2000–2022 and predicting the effects for the period 2023–2033. The unit root test, which is the Augmented Dickey-Fuller test (ADF), was used to determine stability in the data. The fully modified ordinary least squares method (FMOLS) was used to estimate the coefficient of variables, the Classification Prediction Model Based on LR was used, and artificial intelligence.The results showed that exports have a positive and significant impact on economic growth in Russia, and that there are positive developments at the level of economic growth, as well as at the level of the variables of exports and investment in the future, which confirms the impact of the hypothesis of exports on economic growth in Russiawhere it was found that there is a rise in the indicators of each of exports, investment, and economic growth from 2023 to 2032, according to the period adopted for the study. This proves the validity of the hypothesis, that there is a positive relationship between exports and the growth of the Russian economy during the next ten years after 2022.

Key words: aoreign trade; economic growth; Russia; gross domestic product; exports, investment; artificial intelligence.

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1. Introduction

Exports play an important role in the economic growth and progress of a country [1]. A country that has more exports has higher growth than a country that has fewer exports. Researchers have different views on the relationship between exports and economic growth [2]. Some argue that there is a positive relationship while others argue that there is a negative relationship between exports and economic development. Some argue that there is no direct relationship between export and economic growth. They argue that export activities generate the foreign exchange required for the import of capital goods. Increased imports of capital goods in turn stimulate the country's capacity to produce [3].

The developed and developing countries of the world alike are interested in establishing economic relations between them through foreign trade, considering the policy of economic liberalization, as these economic relations lead to the transfer of technology and knowledge between countries, and then affect the various aspects of economic development, and foreign trade contributes thanks to competition lowering the prices of goods and services.

As for export, which is the subject of our research because of its importance in terms of its ability to maintain or increase the national income of countries and achieve economic growth for them, it represents one of the explanatory variables in the growth function. For this reason, all countries seek to increase exports, open global markets, and face the increasing competition. Exports are considered one of the most important sources of foreign currency, which is reflected positively on improving purchasing power and pushing national production for improvement and diversification. Interest in expanding the volume of production, which contributes to increasing the growth of the domestic product, which means increasing economic growth, which was considered since ancient times a goal that most countries seek to achieve. Where the latter is considered among the indicators of the well-being and prosperity of society.

Looking at Russia as a country with a high share of the primary sector, it is the seventh largest economy in the world according to GDP, the sixth in terms of purchasing power, and the third in terms of the military budget, Russia's economy and budget are highly dependent on commodity prices in world markets. The share of the mining industry in the Russian economy in 2018 was 13 %. The share of natural resources and raw materials in 2018 amounted to more than 60 percent of Russia's total export earnings.

Great Russia is considered one of the countries that sought and seeks to diversify the economic base to accelerate economic growth rates, by adopting several schemes to diversify its exports from various economic sectors that have importance and effectiveness in increasing domestic income and thus raising and increasing the gross domestic product and raising the economic growth index.

Moreover, export is a major driver of economic growth as it also acts as an international marketing strategy to attract more foreign investors with different types of investment such as direct investment, joint ventures, and investment.

Statement of problem. Based on macroeconomics, the most important roots of foreign income, government fiscal and monetary policies shape the general perception of competitiveness given that it is export that determines how a country can try for the level of imports. Russia is currently a developed country, which is also considered a strong economy with a GDP growth rate of 4.7 percent in 2021.

The aim of this study is to analyze the effects of exports and foreign direct investment for both short- and long-term effects on economic growth in Russia. This paper mainly focuses on how exports and economic growth in Russia are related using annual data for the period 2000–2022, with potential implications for current export policies by the government.

This study aims to analyze the growth of Russia's economy based on exports, imports, and foreign direct investment. In particular, the research attempts to address the following *specific objectives*: (1) Examine the relationship between exports and economic growth; (2) Investment policies and strategies towards export growth; (3) Examining the structure and performance of Russia's exports.

Research question. This study will be reviewed using the following research question: How are exports and economic growth related in Russia?

Hypothesis: There is a positive relationship between exports and the growth of the Russian economy during the next ten years after 2022.

The paper consists of four sections: Introduction, theoretical framework and empirical evidence, methodological issues and data, empirical analysis, and conclusion.

2. Literature Review
2.1. Review of classical studies

Foreign Trade Theories. Foreign trade is the buying and selling of goods and services between countries [4]. Foreign trade enables countries to sell their domestically produced goods to other countries for economic gain. Therefore, trading with other countries or being part of any trade agreement has a positive impact on economic growth [5].

Recent theories support the theory of comparative advantage by identifying economies of scale as an important source of economic growth.

Absolute advantage Trade Theory. In his theory of absolute advantage, Adam Smith states that with free trade, countries can produce and export goods and services in which they could produce more efficiently than the other nations and import those commodities in which it could produce less efficiently, so that at the end that assistance bring the benefits to all countries [6].

Comparative advantage Trade Theory. In this theory, the factor of production is labour and production technology. In general, a country can still gain from international trade by investing all its resources into its most profitable productions though other countries have an absolute advantage in these goods [7].

Hecksher-Ohlin Trade Theory. Their theory is based on a country's production factors such as land, labour, and capital, which provide the funds for investment in plants and equipment. According to the H-O model, a country could export capital-intensive goods and import labour-intensive goods [8].

Economies of scale. This theory states that countries specialize in producing and exporting a restricted range [9] of goods taking advantage of economies of scale (reduction of average cost as a result of increasing the output).

Exports. Exports of goods and services represent one of the most important sources of foreign exchange income that relieve pressure on the balance of payments and create jobopportunities. The export led growth strategy aims to provide producers with incentives to export their goods through various economic and government policies. It also aims to increase the ability to produce competitive goods and services in the global market, to use advanced technology, and to provide the necessary foreign exchange for importing capital goods. Exports can increase trade within the industry, help the country integrate into the global economy and reduce the impact of external shocks on the domestic economy.

The experiences of the economies of Asia and Latin America provide good examples of the importance of the export sector for economic growth and development, which prompted economists to emphasize the vital role of exports as an engine of economic growth [10].

The argument regarding the role of exports as a major determinant of economic growth is not new. It goes back to the classical economic theories of A. Smith and D. Ricardo, who argued that international trade plays an important rolein economic growth, and that there are economic gains from specialization. It was also recognized that exports provide the economy with foreign exchange needed for imports that cannot be produced domestically [11].

Economic growth. Economic growth looks at the question of the driving forces that determine growthand economic development. The classical economists saw the determinants of economic growth in investments and the improvement of productive capacity [12].

Different interpretations of the "economic growth" concept provide both quantitative and qualitative. The qualitative aspect of economic growth is determined by living standards and quality of life indicatorsthe following elements that determine the economic growth [13]:

(1) accumulation of physical capital, human capital, and education; (2) diversity of institutions favorable to the economy; (3) free movement of capital, technology, ideas, foreign investment, and the free flow of information [14].

Theories of economic growth. The classical approach A characteristic feature of the classical approach is the view that production involves labour, produced means of production and natural resources. In contrast to some contributions to modern growth theory none of these factors – labour, capital, and land.

A. Smith viewed the growth process as strictly endogenous, placing special emphasis on the impact of capital accumulation onlabour productivity [15].

D. Ricardo set aside what may be called statically and dynamically increasing returns. The beneficial effects of capital accumulation on productivity mediated through the extension of the division of labour play hardly any role in his analysis. The resulting vision isreflected in what Ricardo called the 'natural course' of events [15].

R. Torrens made it clear that the physical schema of the production of commodities by means of commodities is not only important for the determination of the rate of profit and relative prices – it also provides the basis for assessing the growth potential of the economy. Growth in the Torrens model is linear and inward; It depends on the general rate of profit and the tendency to accumulate [16].

K. Marx stressed that the accumulation of capital is an essential component of the capitalist process of production, the objective and disguised motive of the capitalist is 'the extraction of surplus value and its capital, i. e. accumulation.

The neoclassical school of economic. The neoclassical school of economic thought seeks to explain the distribution of income in a symmetrical way through the relative scarcity of factors of production, labor, capital, and land. Interestingly, the idea of extrinsic growth not grasped by classical theory is the starting point for important early works in the marginal tradition [17].

K. Wicksell dealt with the problem of growth and income distribution by postulating that production takes place by means of labour, land and capital, i. e. the means of production produced, and that there is a possibility of substitution between these factors. He was very clear about the lack of the concept of capital in marginal productivity theory.

Where Gustav Cassel he assumed in his first model, that there are z (initial) factors of production. The quantities of these resources and therefore the quantities of services they provide are taken as a specific supply. The goods produced in the economy are pure consumer goods, i. e. there are no means of production or capital goods produced in the form: goods are produced exclusively by combining the services of the basic factor into fixed technical coefficients of production. Production processes for a single product where there are commodities to be produced, i. e. there is no choice of technology.

The 'New' Models of Endogenous Growth. The pioneers of this school emphasized the limitation of diminishing returns on capital. The first generation [18] of the school set the boundaries within which later contributions to developmental theories were carried out. The first category of models sets aside all non-accumulate factors of production such as labor and land and assumes that all production inputs are accumulative, i. e. "capital".

The second class of models preserved the duality of factors accumulating and not accumulating but constraining the effect of accumulating the first on their returns by adjusting the aggregate production function [19].

Finally, there is a large class of models that consider various factors to counter any decreasing trend of returns to capital [20].

2.2. Review of Empirical Studies

Initially, several authors estimated the impact of exports on economic growth by focusing on growth and innovation [21]. It is said here that capital goods help to realize new manufactured goods and influence the three major sectors of the economy, namely, agriculture, industry, and transportation. Importing machinery related to agriculture and industry increases the country's production as inputs to production.

According to Kaldor [22], because economic growth disrupts the terms of trade against a country, the country finds itself suffering a loss of economic wealth.

In the study of Champernowne [23], full employment conditions are valid in the model of two good factors, and when the supply of one of the factors of production increases, this leads to an increase in the production of goods that use this factor, while the production of goods that use other factors decreases. When there is an increase in the factor used only export commodities.

In the study of Awokuse [24], he addressed Russia's dependence on crude oil, the pressure of crude oil prices on economic growth, and the structure of the export basket for the period: 2000 (the first quarter) – 2014 (the fourth quarter). They concluded, however, that crude oil prices still affect the Russian economy, and this effect is stronger than the fiscal and monetary policies applied in Russia.

In the study of Salvadori [25], addressed the causal relationship between international trade and economic growth for the period 1997–2013. He found acceptance of the ELG hypothesis in Turkey, China, Russia, and Brazil.

Based on the review of the literature, it can be noted that the number of studies that investigate the causal and effect relationship between export and economic growth in one country, on the other hand, the number of studies that investigate the issue relied on the basis of the use of many modern technologies, and this topic is still opento study.

3. Research Procedure

3.1. Data & Methodology

This research used GDP data to express economic growth between the period 2000–2022 for analysis. In much of the current empirical research, abbreviated models that included the largest number of possible variables did not perform significantly better than abbreviated models containing significant variables chosen for regression analysis [26; 27].

In addition, the dynamic interaction between exports, investment and other relevant variables is generally considered as the basis for the computational modeling of economic growth as such, in this research, considering the frequency of use of different explanatory variables used in the current literature, *GDP* as a dependent variable and exports (*export*) and investment (*inv*) as independent variables that were used for prediction.

As a result of the implemented taxation reforms in the oil and gas sectors, oil and gas revenues were raised to the budget 40 times from 2000 to 2019, or eight times in real terms. This helped the government to significantly reduce taxes on the non-primary materials-sector without hurting the federal budget. Russia's total revenue for all investments almost doubled in real terms over the period. All kinds of government spending also grew, and so, by 2008 to 2019, public investment had nearly tripled in real terms [28]. Increased expenditures and wages in the public sector created additional consumer demand, while increased volume of government purchases boosted demand for industrial products.

3.2. Model

To find out the effect of exports on the rate of economic growth and to predict it in the long run, the following models are used:

Classification Prediction Model Based on LR. The pre- diction function has the characteristics of high speed, simplicity, and strong generalization ability for new data. It is a linear binary classification model that maps the results of the linear function to the s-type function (sigmoid function). The prediction function of the algorithm is shown:

$$h_\theta = \frac{1}{1+e^{\theta T}}. \qquad (1)$$

In the formula (1), the value range of $h\theta X$ is between 1 and 1, indicating the probability that the result value is 1. We apply this generalized data model.

Basic model:

$$y_{it} = \alpha_i + \beta x_{it} + \mu_{it}. \qquad (2)$$

A substitute for regression methods can be achieved by a statistical technique named regression tree [29]. In the regression tree technique, the entire dataset is split into two or more uniform sets to build a model. Upon the termination of the splitting process, a node is named a terminal node. A single value is termed a decision node upon which each node is split into sub-nodes. The recurring binary splitting is used to build a regression tree model with input considerations and a response parameter:

$$R_1(j, s) = and \ R_2(j, s) = \frac{X}{Xj} > s, \qquad (3)$$

where s and j are the splitting point and variables, respectively. Further, s and j are used for achieving the most uniform splitting group.

The embedding formulation in [30] suggests that, once a historical record S is available, the problem of one-step forecasting can be tackled as a problem of supervised learning. Supervised learning consists in modeling, on the basis of a finite set of observations, the relation between a set of *input* variables and one or more *output* variables, which are considered

somewhat dependent on the inputs. Once a model of the mapping is available, it can be used for one-step forecasting. In one-step forecasting, the *n* previous values of the series are available and the forecasting problem can be cast in the form of a generic regression problem.

A multi-step time series forecasting task consists of predicting the next H values $[y_{N+1},…, y_{N+H}]$ of a historical time series $[y_1,…, y_N]$ composed of N observations, where $H > 1$ denotes the forecasting horizon [31].

The *Recursive* strategy [23] trains first a one-step model f:

$$y_{t+1} = f(y_t, …, y_{t-n+1}) + w_{t+1}, \qquad (4)$$

with $t \in (n, …, N − H)$ and $h \in (1, …, H)$ and returns a multi-step forecast by concatenating the H predictions. Since the Direct strategy does not use any approximated values to compute the forecasts. First, since the H models are learned inde-pendently no statistical dependencies between the predictions is considered. Second direct methods often require higher functional complexity [32] than iterated ones in order to model the stochastic dependency between two series values at two distant instants [33]. Last but not least, this strategy demands a large computational time since the number of models to learn is equal to the size of the horizon.

4. Results

As was with the RF model and the XGBoost model, the ANN model LSTM utilized the same data. In the case of artificial neural networks, the approach use stacked hidden layers, and depending on the Epoch, the data results may vary. In order to analyze the earlier data, the LSTM model used the Keras deep learning library from the Python language. Furthermore, the LSTM uses the Keras deep learning library with a default activation function

that outputs a value between 1 and 1 via the hyperbolic tangent function.

As such, by using the min max scaler, the input values are similarly changed to a measure between 1 and 1. The behavior of the LSTM model can change depending on the optimizer and activation function used. As such, since tuning the parameters affects the resulting value, suitable values for the parameters were obtained through a grid search approach within a set boundary while the overall structure remained fixed.

In this research, the ReLU activation was used as it was, proven to be the most effective. Furthermore, in order to reduce overfitting and improve the performance of the model, the dropout and recurrent dropout settings were each set to 0.1.

The epochs were set to 100, with an early stopping function with a patience setting of 10 put in place in order to make sure the loss function output did not increase during the training. Next, setting the number of units as 8, 16, 32, the learning rate as 0.01, 0.05, 0.1.The table 1 shows the results of the algorithms.

For knn was MSE45621.71 and RMSE was 213.59, R2 was 0.88 in logarithmRabdom was MSE42660.84 and RMSE was 206.54, R2 was 0.89 in logarithmAdaBoost was MSE38744.70 and RMSE was 196.83, R2 was 0.90.

As for the results of forecasting according to time series, the results are in the figures below, where it was found that there is a rise in the indicators of each of exports, investment, and economic growth from 2023 to 2032, according to the period adopted for the study.This proves the validity of the hypothesis, that there is a positive relationship between exports and the growth of the Russian economy during the next ten years after 2022.

Change figures differed in the indicators of each of exports, investment and economic growth. It is noticeable that in the year 2000 exports were estimated at 114.43 billion dollars [34], while investment was 2068 billion dollars, and economic growth was estimated at 259.71 billion dollars. The indicators of the variables under study fluctuated between.

The periods of the study, between decline and rise, but what we noticed is that in 2008 the indicators of the variables under study increased despite the economic crisis that affected all countries of the world [35], as exports were estimated at 520.00 billion dollars, investment at 74.78, and economic growth at 1660.85 billion dollars.

5. Conclusion

The result predicted that exports and foreign direct investment will positively affect the growth of the Russian economy. As a result of our study, the hypothesis is confirmed that there is a positive relationship between exports and the growth
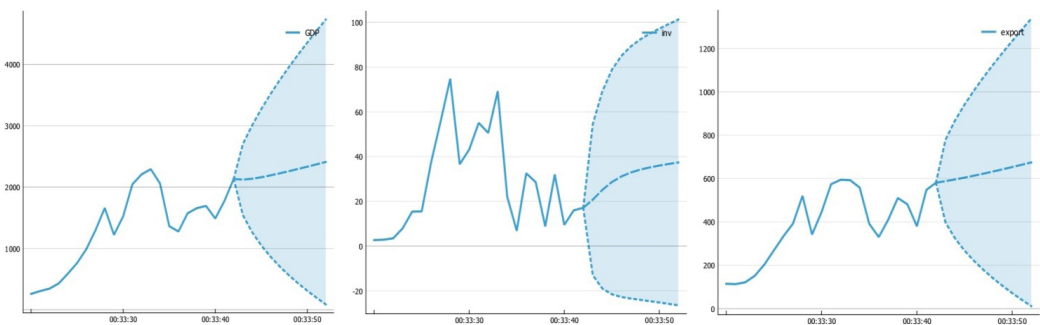

Figure 1. Expectations of economic growth rates, investment, exports for the period 2022–2032 in Russia

Source: Calculation byauthor

Table 1. **Results of the algorithms used**

Test and Score   Sat Dec 24 22, 12:33:19

Settings

Sampling type: Stratified 5-fold Cross validation

Scores

Model	MSE	RMSE	MAE	R2
kNN	45621.71671443479	213.5924079044824	178.97826086956525	0.8836814028682998
SVM	415739.5948474997	644.778717737721	524.2847171700253	-0.0599830503410661
Neural Network	2175697.605860071	1475.0246119506178	1337.2470235255469	-4.547228634129175
AdaBoost	38744.70426086956	196.83674519984717	162.9713043478261	0.9012152551356969

Test and Score   Sat Dec 24 22, 12:35:51

Settings

Sampling type: Stratified 5-fold Cross validation

Scores

Model	MSE	RMSE	MAE	R2
kNN	45621.71671443479	213.5924079044824	178.97826086956525	0.8836814028682998
SVM	415739.5948474997	644.778717737721	524.2847171700253	-0.0599830503410661
Random Forest	42660.84530479425	206.54502004355916	183.0534353002071	0.891230535900985
Neural Network	2175697.605860071	1475.0246119506178	1337.2470235255469	-4.547228634129175
AdaBoost	38744.70426086956	196.83674519984717	162.9713043478261	0.9012152551356969

Test and Score   Sat Dec 24 22, 12:40:58

Settings

Sampling type: Stratified 5-fold Cross validation

Scores

Model	MSE	RMSE	MAE	R2
kNN	45621.71671443479	213.5924079044824	178.97826086956525	0.8836814028682998
SVM	415739.5948474997	644.778717737721	524.2847171700253	-0.0599830503410661
Random Forest	42660.84530479425	206.54502004355916	183.0534353002071	0.891230535900985
Neural Network	2175697.605860071	1475.0246119506178	1337.2470235255469	-4.547228634129175
AdaBoost	38744.70426086956	196.83674519984717	162.9713043478261	0.9012152551356969

Source: Calculation byauthor

of the Russian economy over the next ten years after 2022.

This proves that Russia It was pursuing different policies from different countries of the world, which made it not affected by the economic crisis of 2008as it was noted that during the spread of the Covid 2019 crisis, Russia was not affected by its indicators related to the variables of our study, as the investment index rose to 31.97 billion dollars. Compared to 2018, when it was estimated at 8.78 billion dollars, and economic growth rose to 1693.11 compared to 2018, which was 1657.33.

There are increases by 1.31 percent, while investment there were increases by

20.96 percent, which affected the economic growth index positively with an increase estimated at 0.64 percent, and it shows us the confirmation of the relationship between exports and economic growth, the higher the export rates, the higher the growth rates. Russia's economy, and this indicates that Russia relies on strategic policies with regard to exports and the investment variable, and its interest in developing and making these two variables more effective, more flexible and diversified, which reflects positively on the economic growth of Russia, which in turn is reflected positively on the progress and prosperity of Russia, which confirms on the great power of Russia.

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Влияние экспорта на экономический рост в России: ретроспектива и перспектива

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Аннотация. Наиболее важные аспекты экспортных доходов, государственной фискальной и денежно-кредитной политик формируют общее восприятие конкурентоспособности государства, учитывая, что именно экспорт определяет, как страна может попытаться достичь экономического роста. Целью данной работы является исследование влияния экспорта на экономический рост в России путем анализа взаимосвязи между экспортом и экономическим ростом в период 2000–2022 гг. и прогнозирования последствий такого влияния на период 2023–2033 гг. Модульный корневой тест, который является расширенным тестом Дики – Фуллера (ADF), использовался нами для определения стабильности данных. Для оценки коэффициента переменных нами использовался полностью модифицированный метод обыкновенных наименьших квадратов (FMOLS), а также использовалась классификационная модель прогнозирования на основе LR и искусственного интеллекта. Результаты показали, что экспорт оказывает положительное и существенное влияние на экономический рост в России, а также на уровне экономического роста, на уровне переменных экспорта и инвестиций в будущем. Результаты исследования подтверждают нашу гипотезу о влиянии экспорта на экономический рост в России. Было установлено, что наблюдается рост показателей каждой группы экспортных товаров, а также инвестиций и экономического роста с 2023 по 2032 г. Это доказывает обоснованность гипотезы о том, что существует положительная связь между экспортом и ростом российской экономики в течение ближайших десяти лет после 2022 г.

Ключевые слова: внешняя торговля; экономический рост; Россия; валовой внутренний продукт; экспорт, инвестиции; искусственный интеллект.

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