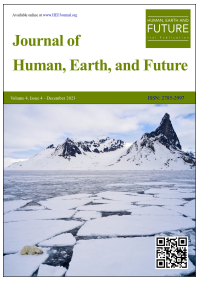
HUMAN, EARTH AND FUTURE
Ital Publication
ISSN: 2785-2997

Available online at www.HEFJournal.org

Journal of
Human, Earth, and Future

Vol. 4, No. 4, December, 2023



The Influence of Macroeconomic Factors on the Export of Cereal Crops in Foreign Trade Activities Individual Countries

S. M. Khairova [1, 2], V. V. Perskaya [3], B. G. Khairov [2], E. S. Galaktionova [4*], D. B. Gazizova [2], N. R. Karymov [1]

[1] *Department of Economics, Logistics and Quality Management, Federal State Budgetary Educational Institution of Higher Education "Siberian State Automobile and Highway University (SibADI)", Omsk, Russian Federation.*

[2] *Department of Economics and Transport Management, Omsk Institute of Water Transport - branch of the Federal State Budgetary Educational Institution of Higher Education "Siberian State University of Water Transport", Omsk, Russian Federation.*

[3] *Federal State Educational Budgetary Institution of Higher Education "Financial University under the Government of the Russian Federation", Moscow, Russian Federation.*

[4] *Department of Transportation and Traffic Safety, Federal State Budgetary Educational Institution of Higher Education "Siberian State Automobile and Highway University (SibADI)", Omsk, Russian Federation.*

Received 04 July 2023; Revised 01 November 2023; Accepted 08 November 2023; Published 01 December 2023

Abstract

Aims: The aim is to analyze the impact of macroeconomic factors on the dynamics of realizing the foreign trade potential of companies based on vector autoregression and the formation of strategic priorities for the companies' economic activities. *Methods*: The research methodology is based on the application of methods of time series analysis and impulse response functions. The Granger causality test was used for the linear causal relationship between the analyzed indicators. The study used statistical data for the period 2001–2020 in the annual section of the World Bank Trade Map portal. *Results*: It is shown that the innovative development of the country contributes to an increase in non-raw material trade with countries geographically close to its borders. It was revealed that the level of agricultural development of the importing country influences the import of cereals with a lag effect of 3–4 years. Justified: The intensification of export-import operations contributes to the development of the production potential of countries as a whole, creating great potential for enhancing the economic activity of agricultural companies and creating incentives for the development of the economies of the country's regions. It has been determined that the foreign trade system is an equilibrium system that returns to a stable state 2-3 years after the shock impact of exogenous and endogenous factors. *Novelty*: The novelty of the study lies in the assessment of the dynamic impact of the shock impact of exogenous and endogenous factors on macroeconomic indicators, taking into account the specifics of the foreign trade turnover of countries. *Conclusion*: The results of the study can be used to develop a strategy for the development of foreign trade activities, including grain crops for both countries, to realize more reliable forecasting of foreign economic transactions with a lag of 3-5 years.

Keywords: Macroeconomic Factors; Multimodal Transportation; Foreign Trade Relations; Non-Resource Exports; Sanctions Pressure.

1. Introduction

At present, food security issues are becoming urgent, representing an important component of national economic policy for all countries in the world community. This is facilitated by extensive urbanization, changes in land use

* Corresponding author: es_galaktionova@inbox.ru

http://dx.doi.org/10. 28991/HEF-2023-04-04-08

mechanisms, and the transformation of agricultural technologies. Abu Hatab et al. (2019) [1] concluded that there is insufficient development of inclusive urban-rural linkages to shape food systems and agricultural value chains and to achieve more sustainable food systems and more sustainable urbanization in different countries.

There has been an increase in foreign trade food prices, primarily for cereals. As of July 15, 2022, the Agricultural Price Index was up 19% from January 2021. Corn and wheat prices were up 15% and 24%, respectively, from January 2021.* Thompson et al. (2019) [2]; Kruseman et al. (2020) [3]; Shokoohi & Saghaian, (2022) [4] concluded that this is primarily due to climate change, rising energy prices, the formation of new agri-food conglomerations, and fluctuations in food markets.

Over the past 10 years, Russia has taken a leading position among countries exporting cereal crops, despite the tough competition in the food services market. The export of grains for the economy of the Russian Federation is an important component in terms of diversifying export potential and gradually moving away from the dominance of energy raw materials in export supplies. This will contribute to the intensification of investment activity as part of the development of domestic infrastructure, energy, and transport. In 2020, Russia exported more than 17 million tons of grain to the world market, which exceeded the indicated figure in 2019 by 8%. In the structure of exports of cereal crops from the country, the main place is occupied by wheat, about fourteen million tons, the share of which is almost eighty-three percent; 2.5 million tons, or 14.2%, is occupied by barley; and 0.51 million tons, or 2.9%, is exported corn. Sheikhova & Orlova (2021) [5] found that the majority of grain exports from Russia are made up of two main regions: North Africa and the Middle East, which account for about 60–70% of the total volume. The main consumers of Russian cereals in the Middle East are Turkey, Saudi Arabia, and Iran.

Despite the complications of the geopolitical situation around Russia, one of the strategic goals in our country is to increase the volume of exports of cereal crops. As part of solving this problem, it is planned to implement a flexible approach to the selection of importing countries to expand trade turnover, including taking into account factors such as a friendly attitude towards Russia as well as the actual macroeconomic indicators of importing countries. The development of non-resource exports is an indicator of the diversification of the national economy and its competitiveness in world markets. Considering the territorial proximity of the Iranian Islamic Republic and the Russian Federation, the development of grain exports from Russia to Iran is a major task of mutual interest for partners since it covers Iran's needs for grain crops, and for Russia, it contributes to an increase in labor productivity and expansion of export potential. Shapovalova & Salnikov (2019) [6] put forward the hypothesis that the increase in consumption of food products in Iran contributes to the growth of export volumes, including those from Russia, while at the same time stipulating the acceleration of the resolution of a number of issues that currently do not contribute to the growth of the potential of bilateral cooperation.

In order to realize Russia's export potential in terms of the supply of grain crops, it is planned to intensify investment activities in the development of export infrastructure, including the implementation of energy, transport, information, and communication technology projects. Macroeconomic factors reflect regional and national aspects of the lives of societies; therefore, they are key indicators of the economic efficiency of economic activity and are carefully monitored at all levels of management. The purpose of the study is to analyze the impact of macroeconomic factors on the dynamics of the implementation of foreign trade potential by companies based on vector autoregression and the formation of strategic priorities for their economic activities. The novelty of the study lies in a number of provisions:

Despite the large number of scientific works devoted to assessing the influence of macroeconomic factors on the export of goods, the authors proposed the following provisions that determine novelty:

- To make a forecast assessment of the export of cereal crops in the context of the influence of macroeconomic factors, the authors developed the provisions of the theory of competitive advantages, including the dependence of export volumes on the real economic conditions of exporting and importing countries;
- To assess the influence of regional macroeconomic factors on the export of cereals from Russia to Iran, the authors built mathematical models for each of these countries, taking into account their regional and sectoral specifics, which makes it possible to more reliably predict the foreign trade turnover of each country;
- To reliably forecast foreign trade turnover, the tools of the Granger causality test and the VAR model were used, which allow us to assess the actual elasticity of foreign trade activities in the analyzed countries while at the same time allowing us to identify the effects and formulate patterns of influence of macroeconomic factors on the export of cereals from Russia to Iran.

The previously published articles have analyzed the impact of macroeconomic indicators on exports of manufactured goods, assessed the relationship between trade openness and goods exports, and examined the impact of innovation on export complexity. It becomes relevant to assess the patterns and current trends of the international grain trade market. The study proposes a new approach to analyzing the influence of macroeconomic factors using the Granger causality

* Food Security Update: https://www.worldbank.org/en/topic/agriculture/brief/food-security-update#

test and the VAR model, as well as constructing impulse response functions, which made it possible to evaluate the foreign trade systems of exporting and importing countries from the standpoint of a systems approach and risk management theory and determine their level equilibrium within the framework of the shock impact of exogenous and endogenous factors, the development of innovative technologies, and transport corridors, which will solve the problem of optimizing the management of foreign trade activities of the participating countries.

2. Literature Review and Hypothesis of the Study

Issues of the influence of macroeconomic factors on trade turnover between countries are analyzed in a number of publications by domestic and foreign scientists. Yang & Mallick (2014) [7] analyzed aspects of the influence of country differences at the macroeconomic level on the export of goods. It is revealed that in countries with higher external demand (measured by distance-weighted global GDP for each country), there is a higher level of impact of exports on labor productivity in different areas of economic activity. The growth of a country's international competitiveness correlates with an increase in export volumes. Todshki & Ranjbaraki (2016) [8] assessed the impact of macroeconomic indicators on the export of manufactured goods. The results show a statistically positive and significant relationship between steel exports and gross national product, world oil prices, population, and domestic steel production.

Kacou et al. (2022) [9] established the relationship between trade openness and goods exports. A change in this indicator contributes to a change in the structure of goods exported. In countries with a higher level of openness, changes in the structure of exports change the level of productivity in manufacturing. Trade openness and macroeconomic volatility increase the sustainability of export policy in economically developed countries, for example, according to Chakrabarti (2018) [10], EU countries. The innovative development of countries changes the structure of exports and the volume of trade turnover between countries. Bierut & Dybka (2021) [11] and Song et al. (2022) [12] concluded that innovation has a direct stimulating effect on export complexity. This is especially true for emerging economies. Corporate technological innovation in central and eastern China has a significant impact on commodity exports, mainly through the realization of economies of scale and increased risk in business activities. Zhou et al. (2021) [13] came to the conclusion that exports simultaneously, using the example of the PRC, initiate the registration of patents for inventions and utility models with high technological content. Sener & Delican (2019) [14], based on the results of a panel causality analysis (Dumitrescu & Hurlin panel causality analysis), identified a relationship between exports and innovation, information, and communication technologies, which subsequently determine the growth of international competitiveness in both developed and developing countries.

Bottega & Romero (2021) [15] found that technological competitiveness primarily affects high-tech exports rather than low-tech exports. This statement in relation to the PRC, state-owned enterprises show inertia in the development of new directions, including in relation to export supplies.

Forming Russia’s non-resource export potential and solving the problems of import substitution in modern conditions seems to be a highly urgent task. Yang et al. (2021) [16] are of the view that Russia has a high level of dependence on the export of raw materials and fluctuations in world prices, creating problems of its macroeconomic instability in modern conditions; in fact, this dependence takes place in the consumer sector and is due to limited the possibilities of domestic production, the characteristics of consumer preferences of Russians, experts from the Higher School of Economics believe*. An indirect consequence is that changes in the conditions for importing goods (customs duty rates, duty-free import limits, etc.) have a strong impact on final prices and can become an important factor in inflationary pressure. At the same time, in the context of climate change and growing problems in the field of food supply in the world community, the creation of export potential in Russia, and primarily grain, appears to be one of the priority tasks for the development of both the Russian national economy and for the development of the global food market. In the food market, one of the leading places in the structure of exports and imports in Russia is occupied by cereal crops; sustainable exports of wheat alone vary between 17-20% according to USDA data in total exports. Considering the importance of Russia’s non-resource supplies abroad, it should be noted that in order to ensure the sustainability of the national economy, it is necessary to forecast and assess the prospects for real export opportunities, for which the accuracy of taking into account all influencing factors and, in particular, macroeconomic factors. Černý et al. (2021) [17] argue that the export and import of goods seems to be the most important component of the planning and indicative activities of both exporters and importers.

The trade turnover of cereal crops between countries is at the same time subject to the laws and current trends of the international trade market for grain crops. Volanti et al. (2021) [18] concluded that the import of goods into the country is influenced by socio-economic, innovation, and production factors, including land use issues, as key factors in shaping the life cycle of cereal crops and their turnover. Chouchane et al. (2018) [19] calculated forecast estimates of imports of food products, including cereals, by 1.4–1.8 times by 2050 due to population growth and shortages of water resources. The trend of rising energy prices is also taken into account, causing a reduction in production volumes and, consequently, exports of cereal crops. Shannak (2022) [20] determined that in countries with hot climates. Pinsard et al. (2021) [21]

* Russians' dependence on imports exceeded 75%. https://www.finanz.ru/novosti/aktsii/zavisimost-rossiyan-ot-importa-prevysila-75percent-1030979635

came to the conclusion that for European countries, the factors that reduce the volume of purchases of fossil fuels, feed, and synthetic fertilizers, primarily from Russia, are of decisive importance, and Belarus, as they believe.

Based on the above, the first hypothesis of the study is as follows.

- *Foreign trade turnover of food between Russia and Iran is related to the level of socio-economic and innovative development, agricultural production capacity of each country.*

The structure and functioning of the global transport system* is one of the defining elements of organizing trade turnover between countries. Park (2020) [22] determined that a country's ability to create an efficient logistics and transport infrastructure determines its export potential, competitive advantages in the global economy and contributes to the creation of additional domestic added value in exports. Töngür et al. (2020) [23] and Tang & Abosedra (2019) [24] hypothesized that logistics infrastructure has a positive effect on the value and volume of exports of various goods.

del Rosal & Moura (2022) [25]; Cordón-Lagares & García-Ordaz (2020) [26] concluded that the higher the transport connectivity and synergy of cargo transportation, the higher the volume of goods exported between countries. The importance of maritime transport in the transportation of exported goods has been observed. Wiederer & Straube (2019) [27] found that companies involved in the transportation of liquid cargo and containers have the best chance of survival. The dependence of the production and export of fruits and vegetables in Spain on road transport is noted. Pérez-Mesa et al. (2019) [28] concluded that increasing transport costs, environmental taxes, and land transit restrictions force exporters to look for alternatives to road transport, such as sea transport, within the framework of intermodal transportation. Railroad transport, similar to maritime transport, forms the structure of goods exports and their volumes. Yuan et al. (2022) [29] on the example of China assessed the effectiveness of affiliated railway infrastructure enterprises, increased the desire of manufacturers to transport goods by this type of transport with a higher cost, and became an instrument for transforming the structure of exports and imports of goods.

Papoušková (2021) [30], and Feng et al. (2022) [31] analyzed the need for uniformity in the development of different modes of transport. Wei et al. (2019) [32] proved the creation of conditions and determined the need for the development of multimodal transportation through the application of methods for organizational optimization of domestic import and export of goods in various network scenarios through the use of a bi-objective mixed integer programming model using a genetic algorithm with adaptive weight (awGA) as a solution method proposed by Saeed et al. (2022) [33]. The development of this type of cargo transportation helps to reduce the cost of trade between countries and improve the quality of delivered perishable products. Veselova (2019) [34] states that a sufficient level of development of intermodal freight transportation allowed the United States to adapt to new conditions during the COVID-19 pandemic, which allowed manufacturers and carriers to maintain their income and ensure their development.

The following hypothesis is that the export of cereals from Russia to Iran is one of the factors in the development of multimodal transportation of these countries.

The sphere of global trade turnover, as numerous studies show, is an open nonequilibrium system, depending on many different factors and business cycles that synchronize its development and the activities of organizations operating in this area. Schofer et al. (2022) [35], Azcona (2022) [36] found that intensive trade turnover between countries becomes one of the causes of economic shocks †in regional systems and bifurcation effects in them. Also Yildirim & Arifli (2021) [37] assessed the occurrence of shocks in exporting countries that contribute to changes in prices for resources, including oil. Liu et al. (2021) [38] found that for global trade, an increase in oil prices has a significantly greater impact than a decrease in oil prices in the long term, as discussed in Togonidze & Kočenda (2022) [39]. Souza & McKibbin (2021) [40] found that the most susceptible to shocks are the spheres of foreign trade built on the export of primary goods, according to the opinion. Boateng et al. (2022) [41] hypothesized that this effect is strongest in emerging economies.

E Aragie et al. (2023) [42] concluded that the potential benefits of export promotion policies need to be evaluated against the monetary and non-monetary costs they represent. The production and turnover of cereal crops are influenced by sharp fluctuations in macroeconomic factors. Wang and McPhail (2014) [43] analyzed the economic shock associated with energy prices negatively affects US agriculture, creating 10% volatility in agricultural commodity prices. Udmale et al. (2020) [44] found that the impact of energy prices outweighs the contribution of agricultural productivity in the medium term (3 years) Chenet al. (2018) [45] determined that the use of structural vector autoregression (SVAR) and linear non-Gaussian acyclic model (LiNGAM) concluded that wheat price fluctuations are the main cause of conflict events in Sudan according to researchers

Doojav et al. (2023) [46] hypothesized that commodity demand shocks have a more persistent and stronger impact on internal cycles than commodity supply shocks. Trade and financial (resource export earnings, lending, and exchange rate) channels play an important role in the transmission of shocks. The occurrence of events leading to shocks in one

* See, for example, the website: https://www.pravda.ru/world/1727060-summit_iran/. Al-Mashareq and AFP. Increasingly isolated, Iran and Russia promote the North-South Transport Corridor. https://almashareq.com/en_GB/articles/cnmi_am/features/2022/07/12/feature-02 Access date: 07/30/2022.

†An economic shock is an event that occurs external to the economy itself, which leads to positive or negative changes in it. Further in the text we will use the term shock.

country often triggers the spread of shocks in other countries associated with them, including through trade links. Faryna and Simola (2021) [47] and Berger et al. (2021) [48] believe that, for example, indirect trade and financial linkages play an important role in the spread of shocks to the CIS countries. Swamy (2020) [49] concluded that idiosyncratic shocks in the eurozone, on average, had a large impact on economic activity in India. The variation explained by innovation based on the BVAR model is observed in the range of 1.8 to 3.6% over a horizon of 1 to 12 quarters. The main results are confirmed by empirical estimates from wavelet analysis. Berger et al. (2021) [48] found that output elasticity estimates suggest that the Eurozone recession had a significant negative impact on India. Sohag et al. (2023) [50] considered sharp fluctuations in the economic and political atmosphere to pose a serious threat to world governments in terms of balancing macroeconomic indicators and implementing effective national economic development policies.

Based on the above, the third hypothesis of the study. The point is that the spheres of foreign trade in Russia and Iran are interacting nonequilibrium systems that significantly depend on bifurcation changes determined by the influence of mainly macroeconomic factors.

3. Research methodology

The research methodology (Figure 1) includes the following stages: 1) formulation of research hypotheses; 2) formation of the data set; 3) application of the Granger causality test; 4) calculation of VAR models for each of the countries under study; 4) constructing an impulse response function for variables affecting the export of cereal crops for the specified countries; 5) analysis of the results.

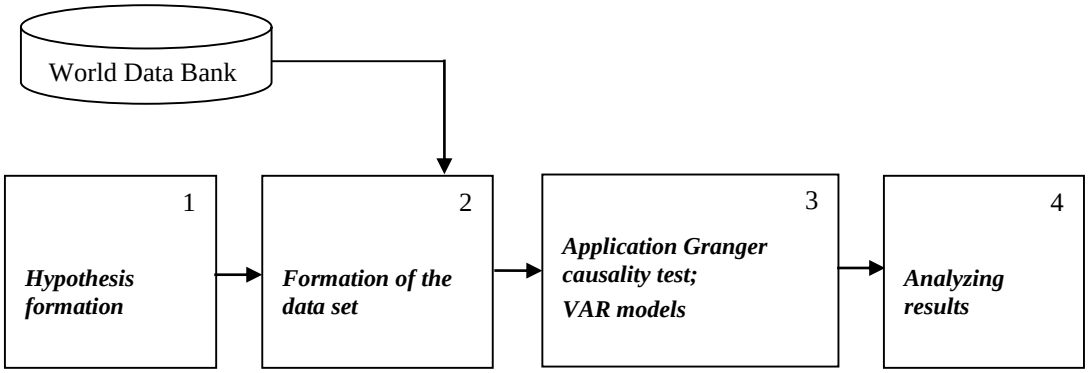


Figure 1. Research scheme

The study utilized statistical data for the period 2001–2020 in an annual breakdown available in open sources.

Bilateral trade between Russia and Iran, the Islamic Republic, product cluster: 10 "Cereals" (export value per year, US dollars") "Bilateral trade between Russians" was used as an indicator determining the export of cereals from Russia to Iran. Federation and Iran, Islamic Republic of Product: 10 "Cereals" (value in year, US Dollar) (Exp). Data were taken from the trade statistics portal for international business development, "*Trade Map*" (www.trademap.org). Product cluster 10 “Cereals” includes: rice, grain sorghum, oats, corn, wheat, and meslin; barley; rye; buckwheat; millet; canary seed; and other cereals. The calculations used the total export value of the specified cereal crops for the year in US dollars.

For Russia, the impact on the export of cereal crops was assessed by the following macroeconomic factors specified by the indicators:

- Agriculture, forestry, and fishing, value added (current US$) – (Aff_r);
- Cereal production, Russia, tons (Cerp_r)
- transported by rail, million t-km (Railways, goods transported (million ton - km) – (Rgt _ r);
- Container transport in ports, 20-foot equivalent units (Container port traffic (TEU: 20 feet equivalent units) – (Cpt _ r);
- Earth under production cereals, ha (Land under cereal production (hectares) – (Lucp_r);
- Productivity grain, kg / ha (Cereal yield (kg per hectare) – (Cyield_r);
- Research and development expenditure (% of GDP) – (Inn_r);

All the above indicators are taken from the World Bank Open Data database (*https://data.worldbank.org/indicator*).

For Iran, the influence of the following macroeconomic factors specified by the indicators was assessed:

- % annualized (Inflation, consumer prices (annual%) – (Inf_ir);
- consumer price index (in 2010 the value of the indicator was 100%), (Consumer price index (2010 = 100) – (Cpi_ir);
- gross domestic savings (in current US dollars), US dollars (Gross domestic savings (current US$) – (Gds_ir);
- GDP (current US dollars), US dollars (GDP (current US$) – (Gpd_ir);
- total population of Iran, no. people (Population, total) – (Popul _ ir);
- cereal production, metric tons (Cereal production (metric tons) – (Gpr_ir);
- railways, goods transported, million t-km (Railways, goods transported (million ton - km) – (Rgt _ ir);
- container shipping in ports, 20-foot equivalent units (Container port traffic (TEU: 20 feet equivalent units) – (Cpt _ ir);
- Research and development expenditure (% of GDP) – (Inn_ir).

All data for Iran are taken from the World Bank Open Data database.

3.1. Unit Test (Unit Root Test)

Before performing the Granger causality test, we checked the stationarity of the time series given by the trade turnover between the countries under study and the macroeconomic indicators used in the study. The statistical procedure for testing for unit roots, discussed in the works of Arvanitis (2017) [51]; Skrobotov (2020) [52]. Standard unit root testing is done using the Augmented Dickey-Fuller (ADF) test, which is based on the t-statistic to test the null hypothesis that $\alpha = 0$in the regression.

$$\Delta y_t = \mu + \beta t + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-1} + e_t \quad (1)$$

where the trend can be excluded from the model.

For a linear causal relationship between the indicators analyzed in the study, we use Granger's test of casualness, which was developed in the works of Granger (1969) [53]; Granger (1980) [54]; Granger (1988) [55]. The essence of the Granger test is as follows: the variable $x$is causal to the variable y. Therefore, two conditions must be met simultaneously: 1) the variable $x$must make a significant contribution to the prediction of the variable's values y; 2) the variable $y$should not make a significant contribution to the forecast x. If each of the above variables makes a significant contribution to the prediction of the other, then most likely there is a third variable $q$that influences both variables. The null hypothesis "x does not affect y" specifies that all coefficients are equal to zero at the same time β. To test the specified hypothesis, the F -test is used. The alternative hypothesis tested "y does not affect x" is tested similarly. The Granger test for causality is very sensitive to the number of lags m in the regression equation; therefore, it is necessary to carry out the specified test for various values of m, established in the work of Fedorova & Izotova (2014) [56].

3.2. VAR Model

To solve the problem of studying the spheres of trade turnover in Russia and Iran, a vector autoregression model (VAR model) was used, which makes it possible to generalize autoregression models (AR models) to multivariate time series.

The basic VAR model that we use to analyze the consequences of economic shocks for trade in Russia and Iran is as follows:

$$Y_t = A(L)Y_{t-1} + B(L)X_t + \varepsilon_t \quad (2)$$

where Y_t is the vector of endogenous variables; X_t is vector of exogenous variables; ε_t is vector of errors under normal distribution.

The vector of endogenous variables Y_t is given by the values of the turnover of cereal crops (exports, imports) between Russia and Iran:

$$Y_t = [Exp_t], \quad (3)$$

where Exp_t is the volume of exports (imports) of cereal crops within the framework of trade turnover between the countries under study in year t, in US dollars.

The vector of exogenous variables X_t contains the values of macroeconomic indicators that have a significant impact on the trade turnover of cereal crops between the countries under study and the constant:

$$X_t = [x_{1t}, x_{2t,\dots,}x_{kt,}c], \quad (4)$$

where x_{it} is a macroeconomic indicator that has a significant impact on trade turnover between the countries under study; k is the number of significant indicators that have a significant impact on trade turnover between the countries under study; c is constant.

The selection of significant exogenous macroeconomic variables was carried out using the Granger Test for causality. The study interval was selected based on the criteria of Akaike and Schwartz [57].

4. Results

In order to bring to stationarity, all-time series under study were prologarith-mizedand the first difference was taken. The calculation results are summarized in Table 1.

Table 1. Extended Dickey-Fuller Test Results for Measures Used in the Study

Designation	ADF Statistics	p-level	The series is stationary
$\Delta lnExp$	-5.291	0.000	Yes
	Russia		
ΔlnAff_r	-2.756	0.010	Yes
$\Delta lnCerp\_r$	-6.930	0.001	Yes
$\Delta lnRgt\_r$	-3.40 7	0.011	Yes
$\Delta lnCpt\_r$	-2.84 5	0.008	Yes
$\Delta lnLucp\_r$	-6.5 90	0.000	Yes
$\Delta lnCyield\_r$	-6.49 1	0.001	Yes
$\Delta lnInn\_r$	-3.89 7	0.002	Yes
	Iran		
$\Delta lnInf\_ir$	-3.859	0.002	Yes
$\Delta lnCpi\_ir$	-3.35 6	0.012	Yes
$\Delta lnGds\_ir$	-2.57 1	0.0 3 9	Yes
$\Delta lnGpd\_ir$	-2.954	0.039	Yes
$\Delta lnPopul\_ir$	-11.152	0.000	Yes
$\Delta lnGpr\_ir$	-4.858	0.000	Yes
$\Delta lnRgt\_ir$	-4.557	0.000	Yes
$\Delta lnCpt\_ir$	-3.3 7 6	0.011	Yes
$\Delta lnInn\_ir$	-5.236	0.000	Yes

The analysis of the Table 1 allowed us to conclude that the time series under study are stationary.

The results of calculating the Granger causality test are given in Table. 2. Calculations were carried out for lags m = 1, 2, 3, 4, 5.

Table 2. Calculation results of the Granger causality test

Null hypothesis	m= 1		m= 2		m= 3		m= 4		m= 5	
	F- statistic	P- value	F- statistic	P- value	F- statistic	P- value	F- statistic	P- value	F- statistic	P- value
					Russia					
ΔlnAff_r → $\Delta lnExp$	0.30 0	0.59 0	0.53 0	0.600	0.81 0	0.5 20	1.960	0.220	1.67 0	0.360
$\Delta lnExp$ → ΔlnAff_r	4.240	0.049**	2.500	0.12 0	0.8 40	0.510	0.55 0	0.7 10	4.02 0	0.140
$\Delta lnCerp\_r$ → $\Delta lnExp$	0.586	0.456	0.234	0.795	0.861	0.496	0.8 70	0.53 3	2.418	0.249
$\Delta lnExp$ → $\Delta lnCerp\_r$	0.055	0.818	1.646	0.233	0.65 2	0.602	0.439	0.77 8	1.72 4	0.347
$\Delta lnRgt\_r$ → $\Delta lnExp$	10.08	0.006 ***	3.958	0.04 8**	2.108	0.169	1.674	0.27 3	1.22 7	0.46 2
$\Delta lnExp$ → $\Delta lnRgt\_r$	2.841	0.113	1.335	0.300	0.804	0.522	0.556	0.70 6	0.502	0.766
$\Delta lnCpt\_r$ → $\Delta lnExp$	0.134	0.7 20	0.264	0.772	0.394	0.760	1.052	0.454	0.73 5	0.64 5
$\Delta lnExp$ → $\Delta lnCpt\_r$	1.542	0.233	0.652	0.539	0.264	0.850	0.158	0.952	1.960	0.308
$\Delta lnLucp\_r$ → $\Delta lnExp$	0.835	0.375	0.344	0.71 6	1.073	0.408	1.867	0.235	3.200	0.145
$\Delta lnExp$ → $\Delta lnLucp\_r$	0.006	0.9400	2.113	0.163	0.862	0.495	0.609	0.671	2.266	0.266
$\Delta lnCyield\_r$ → $\Delta lnExp$	0.294	0.595	0.120	0.888	0.477	0.706	0.386	0.81 2	1.258	0.453
$\Delta lnExp$ → $\Delta lnCyield\_r$	0.128	0.726	1.192	0.337	0.484	0.702	0.315	0.859	1.005	0.533
$\Delta lnInn\_r$ → $\Delta lnExp$	0.076	p=0.786	2.51 9	0.122	1.821	0.21 4	3.948	0.066	50.322	0.004 ***
$\Delta lnExp$ → $\Delta lnInn\_r$	0.545	0.47 2	0.50 4	0.61 7	0.10 1	0.95 8	0.2 70	0.887	0.6 20	0.70 2

					Iran					
$\Delta lnInf\_ir \rightarrow \Delta lnExp$	0.109	0.74 6	1.507	0.26 1	0.731	0.559	2.80 7	0.125	1.7 30	0.34 6
$\Delta lnExp \rightarrow \Delta lnInf\_ir$	2.959	0.106	2.587	0.116	1.094	0.400	0.825	0.554	3.176	0.185
$\Delta lnCpi\_ir \rightarrow \Delta lnExp$	2.274	0.152	0.843	0.454	0.500	0.692	1.130	0.42 5	0.671	0.676
$\Delta lnExp \rightarrow \Delta lnCpi\_ir$	0.004	0.951	2.232	0.150	1.221	0.357	0.844	0.545	1.211	0.466
$\Delta lnGds\_ir \rightarrow \Delta lnExp$	1.316	0.269	0.509	0.614	1.162	0.377	0.702	0.618	0.892	0.576
$\Delta lnExp \rightarrow \Delta lnGds\_ir$	1.194	0.292	0.361	0.704	0.250	0.860	0.641	0.65 3	3.566	0.162
$\Delta lnGpd\_ir \rightarrow \Delta lnExp$	0.316	0.583	0.156	0.857	0.310	0.818	0.581	0.688	0.919	0.566
$\Delta lnExp \rightarrow \Delta lnGpd\_ir$	0.714	0.411	0.215	0.810	0.641	0.608	1.749	0.257	7.321	0.06
$\Delta lnPopul\_ir \rightarrow \Delta lnExp$	0.004	0.950	0.731	0.502	0.466	0.713	0.324	0.85 3	0.844	0.596
$\Delta lnExp \rightarrow \Delta lnPopul\_ir$	0.194	0.666	0.330	0.726	1.063	0.412	0.714	0.612	4.797	0.114
$\Delta lnGpr\_ir \rightarrow \Delta lnExp$	3.136	0.097	3.907	0.049	4.233	0.040**	6.397	0.023 **	2.990	0.198
$\Delta lnExp \rightarrow \Delta lnGpr\_ir$	0.699	0.416	2.180	0.156	0.875	0.489	1.657	0.276	0.374	0.84 2
$\Delta lnRgt\_ir \rightarrow \Delta lnExp$	1.887	0.190	2.365	0.136	1.232	0.354	1.588	0.291	93.700	0.001 ***
$\Delta lnExp \rightarrow \Delta lnRgt\_ir$	0.452	0.512	0.254	0.780	1.707	0.235	0.852	0.541	13.114	0.0 30**
$\Delta lnCpt\_ir \rightarrow \Delta lnExp$	0.357	0.559	0.351	0.711	0.109	0.953	0.182	0.940	0.331	0.86 8
$\Delta lnExp \rightarrow \Delta lnCpt\_ir$	0.667	0.427	0.160	0.854	0.050	0.984	5.514	0.033**	9.174	0.04 9**
$\Delta lnInn\_ir \rightarrow \Delta lnExp$	0.269	0.612	1.669	0.229	1.093	0.401	0.871	0.533	6.971	0.070
$\Delta lnExp \rightarrow \Delta lnInn\_ir$	0.028	0.868	0.009	0.99 1	1.95 0	0.192	0.97 6	0.485	4.049	0.140

Note. * - significance at the 10% level, ** - significance at the 5% level, *** - significance at the 1% level

The following conclusions can be drawn on the basis of the calculations conducted (Table 2).

1. The dynamics of exports of cereal crops from Russia to Iran are directly related to changes in the amount of added value produced in agriculture, forestry, and fishing in the current year without the lag effect of Russia.
2. Changes in the volumes of cargo transported by rail in Russia play a role in forecasting the export of cereals from Russia to Iran only during the first two years.
3. The dynamics of research and development expenditures in Russia affect the export of cereals to Iran with a lag of five years.
4. Cereal production in Iran affects the volume of cereal imports from Russia with a lag in the third and fourth years.
5. Changes in the dynamics of the volume of cargo transported by rail in Iran affect the volume of imports of cereal crops from Russia only in the fifth year.
6. The dynamics of the volume of imports of cereal crops from Russia to Iran contribute to the growth of freight turnover by rail in Iran only in the fifth year.
7. The dynamics of the volumes of imports of cereal crops from Russia to Iran affect the volumes of cargo transported by sea in Iran in the fourth and fifth years.

The vector autoregression model for Russia includes the following indicators as exogenous variables affecting the export of cereal crops: 1) Railways, transported cargo, million tons ·km; 2) Research and development expenses (% of GDP).

Figure 2 shows the impulse response functions of the above macroeconomic indicators and the indicator that determines the export of cereal crops for Russia, included in the VAR model, the shock of which determines a change in the indicator by one standard deviation. The dotted lines represent the 95% confidence interval. Impulsive responses are given over a 10-year period.

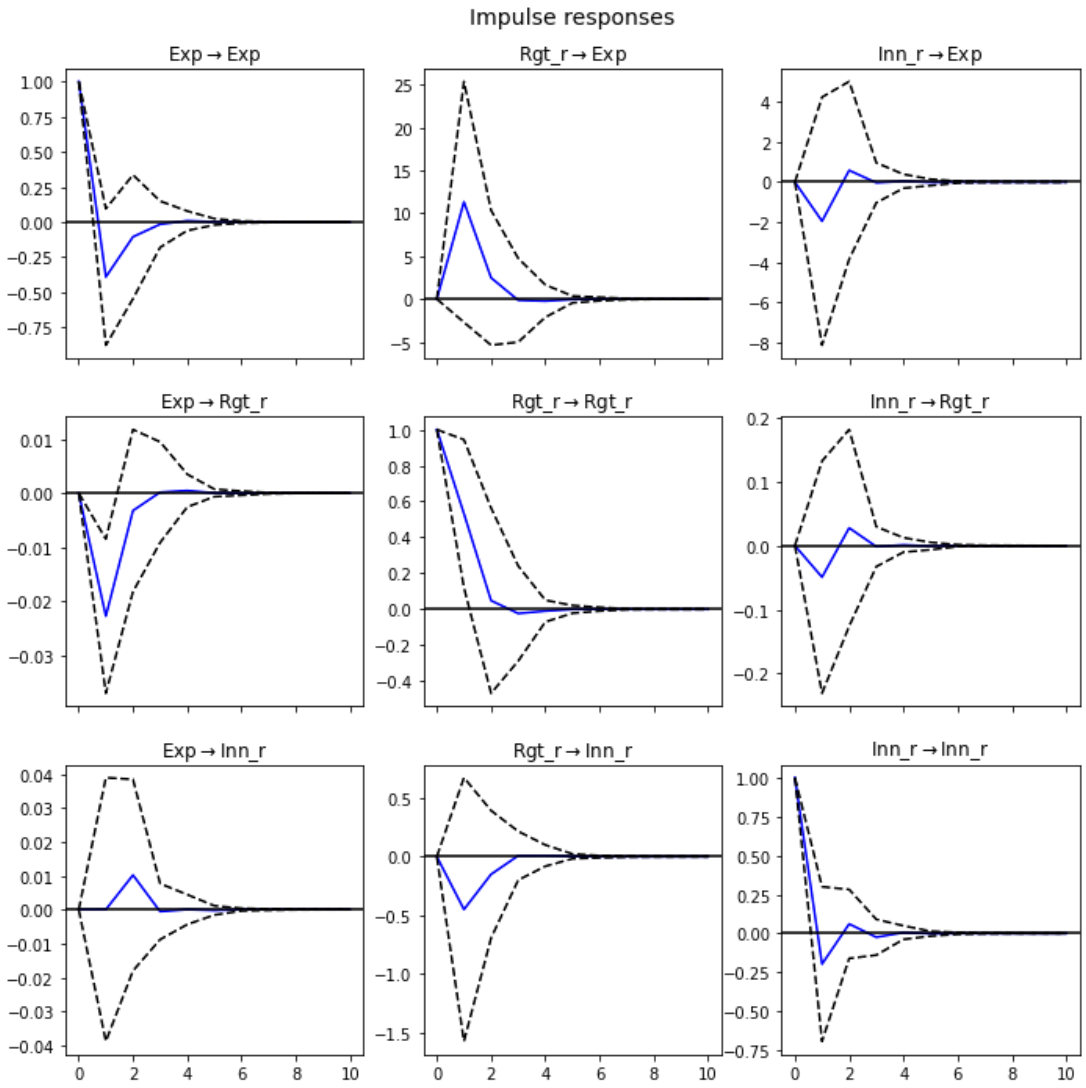


Figure 2. Impulse response function for variables affecting the export of cereals from Russia to Iran

Let us characterize the results obtained (Figure. 2).

1.1. The impact on railway capacity of the export of cereals from Russia to Iran.

After sharp fluctuations in the capacity of Russian railways (which is associated with an increase in the volume of cargo transportation on this type of transport, changes in the railway infrastructure, and financing), a sharp increase in the volume of grain exports from Russia to Iran is expected in a year, but in the future there will be a return to the original values. We believe this is due to the peculiarities of investing in Russia's transport infrastructure and limited innovation in the management process.

1.2. The impact of innovation on the export of cereal crops from Russia to Iran.

The export of cereal crops is associated with a change in the financing of innovation, which affects mainly the first year, reducing volumes. As a rule, this is due to a change in the organization of exports—the emergence of new partnerships in order to obtain a synergistic effect from participation in export operations by both parties. Sometimes there is a process of resistance to change on the part of the collective of manufacturing companies in the exporting country to innovations. By the end of the second year in agriculture, innovations have acquired the status of introduced and existing technologies, and exports return to their previous levels. Some growth in export volumes is possible. Technological innovations, which entail organizational changes in the actual process of product delivery, in the introduction of new concepts and management technologies, after the completion of the 3-year confidence interval, no longer have a change in the dynamics and volume of supplies. This pattern occurs when exporting agricultural products with adjustments for the specific life cycle and climatic conditions, as well as the level of yield.

1.3. The impact of the export of cereals from Russia to Iran on the capacity of domestic railways.

The shock change in the export of cereals in the structure of trade turnover between Russia and Iran leads to a sharp decrease in the capacity of railways in the first year with an increase in the volume of exports of cereals; by the end of the second year, the situation is restored to its original state. This pattern is explained by the insufficient development of both the infrastructure of the transport system and the lack of developed digital solutions for organizing multimodal transportation.

1.4. The impact of domestic innovations on the capacity of railway transportation in the framework of solving the problems of trade turnover between the countries under study.

A shock change in the financing of innovation contributes to a slight decrease in the capacity of railway transport during the first year and a slight increase in this indicator in the second year. This is explained by the fact that the intensification of innovative development, including in the economy, is accompanied by a necessary period of adaptation of the transport infrastructure to changes, as well as transformation, which includes logistics processes and management.

1.5. The impact of grain exports from Russia to Iran on the financing of innovation in the domestic economy.

The shock caused by the sharp change in the volume of cereal exports is accompanied by a slight increase in innovation funding in Russia in the second year following the sharp fluctuation in the country's foreign trade, with the situation stabilizing by the third year. The short-term nature of this effect may be due to the insufficient level of development of the systems underlying the organization of interaction between Russia and other countries in the framework of resolving issues of trade in food products.

1.6. The impact of the capacity of domestic railways on the financing of innovation in Russia.

The shock change in the capacity of domestic railways is accompanied by some fluctuation in the indicator characterizing the financing of innovation in Russia during the first two years, which is associated with the diversion of resources to solve emerging problems. The situation will stabilize in the third year, and activities aimed at both technological and organizational innovations are not excluded.

The vector autoregression model for Iran includes the following indicators as exogenous variables that affect the import of cereals from Russia into the country: 1) cereal production, metric tons; 2) railways, freight transported, million tons.km. Figure 3 shows the impulse response functions of the above macroeconomic indicators and the indicator that determines the import of cereal crops to Iran, included in the VAR model. Impulsive responses are given over a 10-year period.

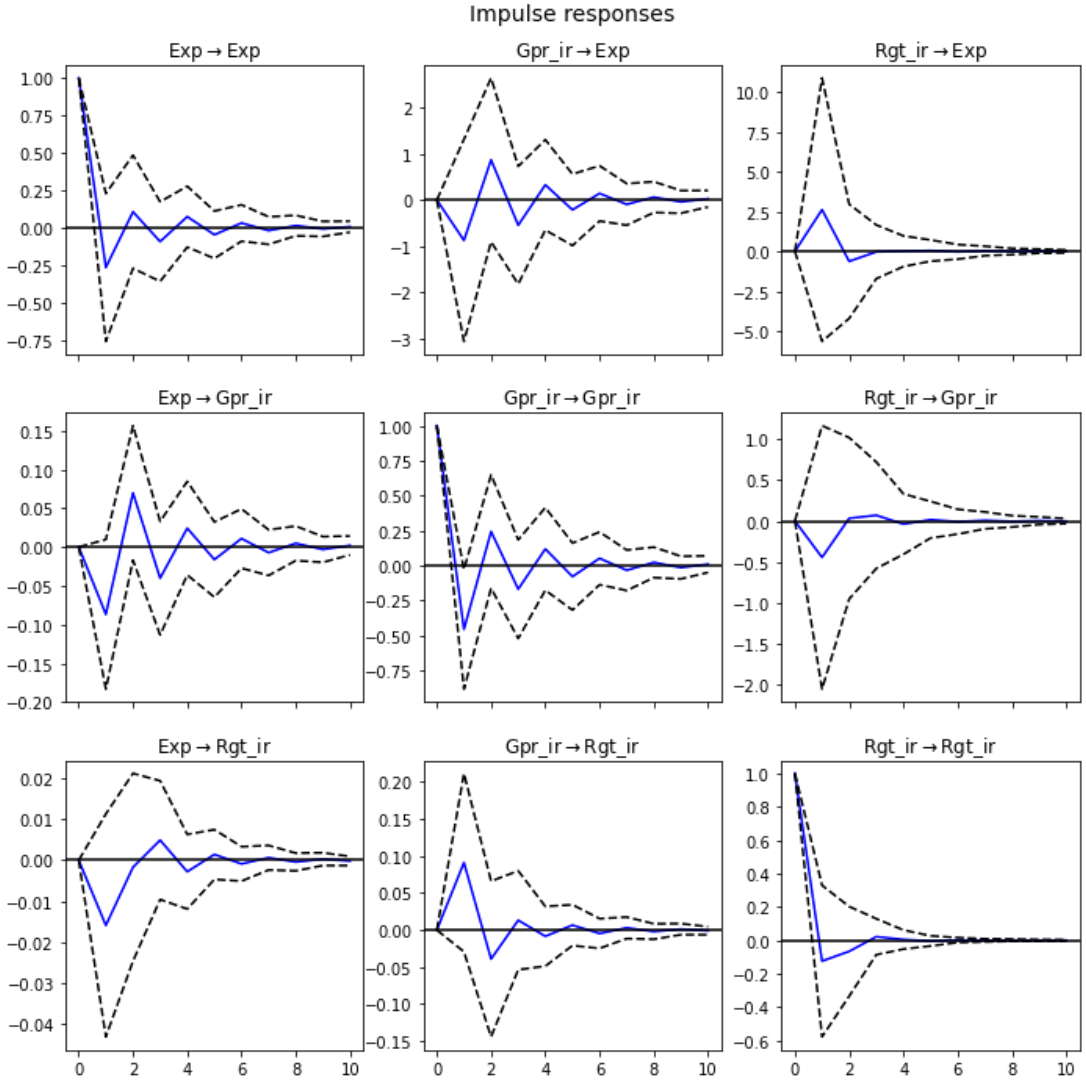


Figure 3. Impulse response function for variables affecting the import of cereals from Russia to Iran

2.1. The impact of cereal production in Iran on grain exports from Russia to the country.

The shock accompanying a sharp change in the volume of cereal cultivation in Iran contributes to an increase in the variability of the values of the indicator characterizing the export of cereal crops from Russia to this country. Periodic fluctuations in the turnover of cereal crops between the analyzed countries subside only in the eighth year. Also, one of the reasons for such a long response to this shock is the dependence of the agricultural industry on natural and climatic conditions and the short life cycle of the products under study.

2.2. The impact of Iranian railway capacity on the export of grain crops from Russia.

Shock changes in railway capacity in Iran contribute to a slight increase in the consumption of Russian cereal crops during the first year, while the situation is restored to the initial values of indicators in the second year, which indicates a short-term effect of the influence of railways on the trade turnover of cereal crops between the countries under study and possible alternative delivery of food products to the final consumer in Iran from Russia.

2.3. The impact of exports of cereals from Russia on their production in Iran.

Changes in the trade turnover of cereal crops between countries have the nature of a so-called “long-term response” that characterizes the functioning of agriculture in Iran. The production volumes of cereal crops in Iran periodically decrease and increase; stabilization occurs over a long period of time, in the 8th–9th year, so it is this period that should be included in the basic forecast estimates of the trade turnover of grain crops between countries.

2.4. The impact of Iranian railway capacity on cereal production in the country.

A sharp change in the capacity of Iran's railways will cause a slight decrease in the production of cereals, during the second year the situation will stabilize and in the future there will be no impact of the capacity of Iran's railways on the production of cereals in Iran. This may be due to the reorientation of Iranian railways to deliver imported food to the country.

2.5. The impact of exports of cereals from Russia on the capacity of Iranian railways.

The shock change in the volume of cereal exports from Russia to Iran reduces the capacity of railways in the Islamic republic, as they need to adapt to changing conditions. This period, as shown by the corresponding impulse response function, is 4-5 years, after which the situation returns to the original values of the railway performance indicator in Iran.

2.6. The impact of cereal production in Iran on the capacity of Iran's railways.

The shock change in cereal production in Iran is one of the points of development for railways in the country. The development of Iran's transport infrastructure makes it possible to increase the capacity of Iran's railways while increasing cereal production in the first year. At the end of the second year, there is a slight decrease in throughput, which is associated with an increase in production. The situation evens out only in the fourth year.

5. Discussion

The export of cereal crops in Russia is one of the key aspects of the development of the domestic economy. The study revealed that fundamental changes in the economic model of the Russian grain market, associated with its reorientation from an import to an export model, revealed a discrepancy between the infrastructure created by the grain market and transport logistics to meet the growing needs of Russian export growth. The Islamic Republic of Iran is one of the key consumers of domestic food products, including grain crops. Russian wheat is in demand on the Iranian market in terms of price-quality ratio. The increase in exports of grain and its processed products to Iran is based on increasing international competitiveness, including by reducing costs and improving quality and safety while complying with phytosanitary standards.

As a result of the study, a significant influence of macroeconomic factors on trade turnover between these countries was revealed. The key element influencing the export of cereals from Russia to Iran is agriculture. If in Russia the grain market stimulates the development of domestic agriculture without a lag effect, then in Iran the development of its own agriculture affects changes in the consumption of imported cereal crops only after three to four years. A distinctive feature of the international cereal market in Russia from Iran is its dependence on innovation, which manifests itself after five years. This is due, on the one hand, to the fact that exporters are prone to innovation; on the other hand, the innovativeness of firms stimulates their entry into foreign markets [59]. The innovation process involves the introduction of management innovations, for example, benchmarking and outsourcing of management functions, the introduction of information technology, obtaining ISO certificates, etc. [60].

As the study showed, the international market for cereal crops significantly depends on the level of development of the transport systems of countries, both exporters and importers. In Russia and Iran, the railway has a special influence on export-import operations. In Iran, the import of cereals from Russia contributes to the development of maritime

transport. To ensure the dynamic development of the grain complex, it is necessary to connect existing and under-construction terminals to the public railway infrastructure, taking into account the capacity of roads adjacent to port and land railway terminals. Reducing infrastructure and logistics costs within the vertical supply chain is possible by developing capacities that provide storage and transshipment of grain and reducing the total costs of its shipment, transshipment, and transportation by road, rail, and water transport.

Infrastructural difficulties in the transport sector limit the development of the country's resource potential, which influences the increase in export volumes. There is a need for correspondence between the shipping capabilities of the importing country's maritime transport and railway approaches to seaports and border crossings, increasing the processing capabilities of stations and transshipment complexes in the exporting country for the development of transport corridors. The railroad between the coasts of the Caspian Sea and the Gulf of Oman will make it possible to organize the transit of goods from India through Iran to Russia. The Kazakhstan-Turkmenistan-Iran railroad of the North-South international transport corridor will create additional routes connecting Kazakhstan and the Central regions of Russia with Turkmenistan, Iran, the countries of the Persian Gulf, and South and Southeast Asia.

The need to combine maritime and railway modes of transport when solving the problems of transporting cereals from Russia to Iran is the basis for the development of multimodal transport between countries. The potential of railways to absorb emerging trade flows and contribute to regional economic development through improved rail and multimodal infrastructure, improved bulk terminals, and logistics terminals increasingly represents important investments to better serve specialized markets for the transport of agricultural goods. Multimodal transportation will speed up the process of forming sustainable supply chains for the implementation of export-import operations in cross-country cooperation between Russia and Iran.

The Russian foreign trade system is more resistant to external factors; shock changes in macroeconomic indicators will destabilize it for 2-3 years. At the same time, imports into Iran under the same conditions return to a stable state only after 5-8 years.

6. Conclusions

Based on the calculations performed, the following conclusions can be drawn:

Foreign trade in cereals is an important strategic element for the development of the Russian economy, since the intensification of export-import transactions with Iran contributes to the development of production potential in the country. It is necessary to note the significant impact of innovation on the structure of exports between the countries under study. The innovative development of Russia contributes to an increase in non-resource trade with other countries.

The level of agricultural development of the importing country influences the import of cereals from other countries, with a lag effect of 3–4 years. Based on the above, it can be argued that the first hypothesis was partially confirmed: the export of cereal crops is influenced by the level of agricultural development and innovation. The volume of cereal exports depends on the state of transport infrastructure. In Russia, this is railway transport; in Iran, railway and sea modes of transport create the basis for multimodal transport. Consequently, the second hypothesis was fully confirmed.

The foreign trade system in Russia is an equilibrium system that returns to a stable state after 2–3 years. The foreign trade system in Iran is quite unstable, since after shock changes in macroeconomic indicators, it returns to its original state after 5-8 years. The third hypothesis was partially confirmed. The results of this study can be useful for developing a strategy for the development of foreign trade activities, including grain crops for both countries, for more reliable forecasting of Russia's foreign economic transactions with a lag of 3-5 years. As part of further areas of research, it is planned to solve the problem of constructing a set of simulation models for managing export-import operations within the framework of intercountry interaction between Russia and Iran.

7. Declarations

7.1. Author Contributions

Conceptualization, S.M.K.; methodology, S.M.K., V.V.P. and E.S.G.; software, N.R.K.; validation, B.G.K.; formal analysis, V.V.P.; investigation, B.G.K.; writing—original draft preparation, V.V.P., B.G.K., E.S.G., and D.B.G.; writing—review and editing, E.S.G., D.B.G., and N.R.K.; visualization, S.M.K., V.V.P., B.G.K., and E.S.G.; project administration, S.M.K. All authors have read and agreed to the published version of the manuscript.

7.2. Data Availability Statement

The data presented in this study are available in the article.

7.3. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

7.4. Institutional Review Board Statement

Not applicable.

7.5. Informed Consent Statement

Not applicable.

7.6. Declaration of Competing Interest

The authors declare that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

8. References

[1] Abu Hatab, A., Cavinato, M. E. R., Lindemer, A., & Lagerkvist, C. J. (2019). Urban sprawl, food security and agricultural systems in developing countries: A systematic review of the literature. Cities, 94, 129–142. doi:10.1016/j.cities.2019.06.001.

[2] Thompson, W., Dewbre, J., Pieralli, S., Schroeder, K., Pérez Domínguez, I., & Westhoff, P. (2019). Long-term crop productivity response and its interaction with cereal markets and energy prices. Food Policy, 84, 1–9. doi:10.1016/j.foodpol.2018.12.001.

[3] Kruseman, G., Mottaleb, K. A., Tesfaye, K., Bairagi, S., Robertson, R., Mandiaye, D., Frija, A., Gbegbelegbe, S., Alene, A., & Prager, S. (2020). Rural transformation and the future of cereal-based agri-food systems. Global Food Security, 26. doi:10.1016/j.gfs.2020.100441.

[4] Shokoohi, Z., & Saghaian, S. (2022). Nexus of energy and food nutrition prices in oil importing and exporting countries: A panel VAR model. Energy, 255. doi:10.1016/j.energy.2022.124416.

[5] Sheikhova, M. S., & Orlova, E. P. (2021). Grain market in Russia: analysis and development prospects. Bulletin of the Don State Agrarian University, 3, 137-144.

[6] Шаповалова, А. М., & Сальников, А. В. (2019). Russia's policy towards Iran: challenges and risks, scenario for the development of relations. Caucasian Science Bridge, 2(2 (4)), 45-51. (In Russian).

[7] Yang, Y., & Mallick, S. (2014). Explaining cross-country differences in exporting performance: The role of country-level macroeconomic environment. International Business Review, 23(1), 246–259. doi:10.1016/j.ibusrev.2013.04.004.

[8] Todshki, N. E., & Ranjbaraki, A. (2016). The Impact of Major Macroeconomic Variables on Iran's Steel Import and Export. Procedia Economics and Finance, 36, 390–398. doi:10.1016/s2212-5671(16)30051-x.

[9] Kacou, K. Y. T., Kassouri, Y., Evrard, T. H., & Altuntaş, M. (2022). Trade openness, export structure, and labor productivity in developing countries: Evidence from panel VAR approach. Structural Change and Economic Dynamics, 60, 194–205. doi:10.1016/j.strueco.2021.11.015.

[10] Chakrabarti, A. S. (2018). Dispersion in macroeconomic volatility between the core and periphery of the international trade network. Journal of Economic Dynamics and Control, 88, 31–50. doi:10.1016/j.jedc.2018.01.019

[11] Bierut, B. K., & Dybka, P. (2021). Increase versus transformation of exports through technological and institutional innovation: Evidence from Bayesian model averaging. Economic Modelling, 99. doi:10.1016/j.econmod.2021.105501.

[12] Song, Y., Hao, X., & Zheng, L. (2022). Intermediate import, independent innovation and export sophistication of Chinese manufacturing enterprises. Structural Change and Economic Dynamics, 60, 126–140. doi:10.1016/j.strueco.2021.11.012.

[13] Zhou, D., Peng, J., & Gao, X. (2021). Examining export trade and corporate innovation: A multiphase difference-in-differences method. China Journal of Accounting Research, 14(2), 207–230. doi:10.1016/j.cjar.2021.01.002.

[14] Sener, S., & Delican, D. (2019). The causal relationship between innovation, competitiveness and foreign trade in developed and developing countries. Procedia Computer Science, 158, 533–540. doi:10.1016/j.procs.2019.09.085.

[15] Bottega, A., & Romero, J. P. (2021). Innovation, export performance and trade elasticities across different sectors. Structural Change and Economic Dynamics, 58, 174–184. doi:10.1016/j.strueco.2021.05.008.

[16] Yang, J., Rizvi, S. K. A., Tan, Z., Umar, M., & Koondhar, M. A. (2021). The competing role of natural gas and oil as fossil fuel and the non-linear dynamics of resource curse in Russia. Resources Policy, 72. doi:10.1016/j.resourpol.2021.102100.

[17] Černý, I., Vaněk, M., Maruszewska, E. W., & Beneš, F. (2021). How economic indicators impact the EU internal demand for critical raw materials. Resources Policy, 74. doi:10.1016/j.resourpol.2021.102417.

[18] Volanti, M., Savarino, F. O., Passarini, F., Vassura, I., & Grosso, S. A. (2021). Environmental analysis of crop rotations through the application of the Cereal Unit approach. Ecological Indicators, 121. doi:10.1016/j.ecolind.2020.107199.

[19] Chouchane, H., Krol, M. S., & Hoekstra, A. Y. (2018). Expected increase in staple crop imports in water-scarce countries in 2050. Water Research X, 1, 100001. doi:10.1016/j.wroa.2018.09.001.

[20] Shannak, S. (2022). Optimizing dynamics of water-energy-food nexus in a desert climate. Energy Policy, 164. doi:10.1016/j.enpol.2022.112884.

[21] Pinsard, C., Martin, S., Léger, F., & Accatino, F. (2021). Robustness to import declines of three types of European farming systems assessed with a dynamic nitrogen flow model. Agricultural Systems, 193. doi:10.1016/j.agsy.2021.103215.

[22] Park, S. (2020). Quality of transport infrastructure and logistics as source of comparative advantage. Transport Policy, 99, 54–62. doi:10.1016/j.tranpol.2020.07.016.

[23] Töngür, Ü., Türkcan, K., & Ekmen-Özçelik, S. (2020). Logistics performance and export variety: Evidence from Turkey. Central Bank Review, 20(3), 143–154. doi:10.1016/j.cbrev.2020.04.002.

[24] Tang, C. F., & Abosedra, S. (2019). Logistics performance, exports, and growth: Evidence from Asian economies. Research in Transportation Economics, 78. doi:10.1016/j.retrec.2019.100743.

[25] del Rosal, I., & Moura, T. G. Z. (2022). The effect of shipping connectivity on seaborne containerized export flows. In Transport Policy (Vol. 118, pp. 143–151). doi:10.1016/j.tranpol.2022.01.020.

[26] Cordón-Lagares, E., & García-Ordaz, F. (2020). Factors affecting the survival of maritime goods transport firms in Spain. Research in Transportation Business and Management, 37. doi:10.1016/j.rtbm.2020.100520.

[27] Wiederer, C., & Straube, F. (2019). A decision tool for policymakers to foster higher-value perishable agricultural exports. Transportation Research Interdisciplinary Perspectives, 2. doi:10.1016/j.trip.2019.100035.

[28] Pérez-Mesa, J. C., García-Barranco, M. C., Piedra-Muñoz, L., & Galdeano-Gómez, E. (2019). Transport as a limiting factor for the growth of Spanish agri-food exports. Research in Transportation Economics, 78. doi:10.1016/j.retrec.2019.100756.

[29] Yuan, H., Wang, K., & Yang, H. (2022). Rail's efficiency gain by separating affiliated businesses and its impact on product mix of export by rail. Transport Policy, 115, 126–140. doi:10.1016/j.tranpol.2021.11.004.

[30] Papoušková, K. (2021). The concept of railway transport in the Czech Republic. Transportation Research Procedia, 53, 154–158. doi:10.1016/j.trpro.2021.02.020.

[31] Feng, X., Wang, Y., & Zhao, L. (2022). Export capacity constraints and distortions. Journal of Development Economics, 157. doi:10.1016/j.jdeveco.2022.102889.

[32] Wei, H., & Dong, M. (2019). Import-export freight organization and optimization in the dry-port-based cross-border logistics network under the Belt and Road Initiative. Computers & Industrial Engineering, 130, 472–484. doi:10.1016/j.cie.2019.03.007.

[33] Saeed, N., Hoff, A., & Larsen, O. I. (2022). Analysis of hinterland transport strategies when exporting perishable products. Research in Transportation Business and Management, 43. doi:10.1016/j.rtbm.2021.100766.

[34] Veselova, N. A. (2019). Features of foreign trade activities in Russia. Young Scientist, 51, 377-379.

[35] Schofer, J. L., Mahmassani, H. S., & Ng, M. T. M. (2022). Resilience of U.S. Rail Intermodal Freight during the Covid-19 Pandemic. Research in Transportation Business and Management, 43. doi:10.1016/j.rtbm.2022.100791.

[36] Azcona, N. (2022). Trade and business cycle synchronization: The role of common trade partners. International Economics, 170, 190–201. doi:10.1016/j.inteco.2022.04.006.

[37] Yildirim, Z., & Arifli, A. (2021). Oil price shocks, exchange rate and macroeconomic fluctuations in a small oil-exporting economy. Energy, 219, 119527. doi:10.1016/j.energy.2020.119527.

[38] Liu, D., Meng, L., & Wang, Y. (2021). The asymmetric effects of oil price changes on China's exports: New evidence from a nonlinear autoregressive distributed lag model. Journal of Asian Economics, 77. doi:10.1016/j.asieco.2021.101398.

[39] Togonidze, S., & Kočenda, E. (2022). Macroeconomic responses of emerging market economies to oil price shocks: An analysis by region and resource profile. Economic Systems, 100988. doi:10.1016/j.ecosys.2022.100988.

[40] Souza, R. da S., & Fry-McKibbin, R. (2021). Global liquidity and commodity market interactions: Macroeconomic effects on a commodity exporting emerging market. International Review of Economics & Finance, 76, 781–800. doi:10.1016/j.iref.2021.07.008.

[41] Boateng, E., Asafo-Adjei, E., Addison, A., Quaicoe, S., Yusuf, M. A., Abeka, M. J., & Adam, A. M. (2022). Interconnectedness among commodities, the real sector of Ghana and external shocks. Resources Policy, 75. doi:10.1016/j.resourpol.2021.102511.

[42] Aragie, E., Balié, J., Morales, C., & Pauw, K. (2023). Synergies and trade-offs between agricultural export promotion and food security: Evidence from African economies. World Development, 172. doi:10.1016/j.worlddev.2023.106368.

[43] Wang, S. L., & McPhail, L. (2014). Impacts of energy shocks on US agricultural productivity growth and commodity prices—A structural VAR analysis. Energy Economics, 46, 435–444. doi:10.1016/j.eneco.2014.05.006.

[44] Udmale, P., Pal, I., Szabo, S., Pramanik, M., & Large, A. (2020). Global food security in the context of COVID-19: A scenario-based exploratory analysis. Progress in Disaster Science, 7. doi:10.1016/j.pdisas.2020.100120.

[45] Chen, J., Kibriya, S., Bessler, D., & Price, E. (2018). The relationship between conflict events and commodity prices in Sudan. Journal of Policy Modeling, 40(4), 663–684. doi:10.1016/j.jpolmod.2018.01.014.

[46] Doojav, G. O., Luvsannyam, D., & Enkh-Amgalan, E. (2023). Effects of global liquidity and commodity market shocks in a commodity-exporting developing economy. Journal of Commodity Markets, 30. doi:10.1016/j.jcomm.2023.100332.

[47] Faryna, O., & Simola, H. (2021). The transmission of international shocks to CIS economies: A global VAR approach. Economic Systems, 45(2). doi:10.1016/j.ecosys.2020.100769.

[48] Berger, J., Dalheimer, B., & Brümmer, B. (2021). Effects of variable EU import levies on corn price volatility. Food Policy, 102, 102063. doi:10.1016/j.foodpol.2021.102063.

[49] Swamy, V. (2020). Macroeconomic transmission of Eurozone shocks to India - A mean-adjusted Bayesian VAR approach. Economic Analysis and Policy, 68, 126–150. doi:10.1016/j.eap.2020.09.008.

[50] Sohag, K., Hassan, M. K., Kalina, I., & Mariev, O. (2023). The relative response of Russian National Wealth Fund to oil demand, supply and risk shocks. Energy Economics, 123. doi:10.1016/j.eneco.2023.106724.

[51] Arvanitis, S. (2017). A note on the limit theory of a Dickey–Fuller unit root test with heavy tailed innovations. Statistics & Probability Letters, 126, 198–204. doi:10.1016/j.spl.2017.02.032.

[52] Skrobotov, A. (2020). Structural Breaks and Unit Root Testing. SSRN Electronic Journal, 1-48. doi:10.2139/ssrn.3594366.

[53] Granger, C. W. J. (1969). Investigating Causal Relations by Econometric Models and Cross-spectral Methods. Econometrica, 37(3), 424. doi:10.2307/1912791.

[54] Granger, C. W. J. (1980). Testing for causality. Journal of Economic Dynamics and Control, 2, 329–352. doi:10.1016/0165-1889(80)90069-x.

[55] Granger, C. W. J. (1988). Some recent development in a concept of causality. Journal of Econometrics, 39(1–2), 199–211. doi:10.1016/0304-4076(88)90045-0.

[56] Fedorova, E. A., Izotova, E. I. (2014). The influence of macroeconomic factors on the market for mergers and ac-quisitions in the energy industry in Russia based on the application of the Granger test for causality. Finance and Credit, 46 (622), 2-10.

[57] Christiano, L. J. (2012). Christopher A. Sims and Vector Autoregressions. The Scandinavian Journal of Economics, 114(4), 1082–1104. Portico. doi:10.1111/j.1467-9442.2012.01737.x.

[58] Greenaway, D., & Kneller, R. (2007). Firm Heterogeneity, Exporting and Foreign Direct Investment. Economic Journal, 117, 134–161. doi:10.1111/j.1468-0297.2007.02018.x.

[59] Golikova, V. V., Gonchar, K. R., & Kuznetzov, B. V. (2012). Influence of export activity on technological and managerial innovations of Russian firms. Russian Management Journal, 10(1), 3-28.