Article

Evaluating the Socio-Economic Factors Impacting Foreign Trade Development in Port Areas

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Abstract: Seaports are an important component of the Russian transport infrastructure. They play a major role in the sustainable development of adjacent territories and the country. Investments in port infrastructure facilitate the introduction of new technologies that accelerate cargo handling, contribute to the efficient use of resources and foreign trade increase. Ports have a major impact on the dynamics of economic indicators in the coastal region, its socio-economic development and environmental condition. In turn, the optimal development of the port infrastructure depends not only on the volume of investments made but also on other socio-economic indicators of the region. This paper analyzes the impact of socio-economic factors on export and import indicators in port areas. Based on a sample of five Russian ports and ten regions, and data observed in the period from 2010 to 2019, dependency patterns were identified for the regions of the Arctic, Baltic, Far Eastern, Azov-Black Sea and Caspian basins. The methods of correlation and regression analysis, panel data analysis (fixed-effect models) and nonlinear models, are used for the analysis. The study’s findings show that investments in the development of seaports stimulate foreign trade growth in port areas and neighboring regions, which, in turn, shows the level of a region’s integration into the global economic cooperation system. The results of the original research can be used to develop programs to support the foreign economic activity of certain regions. Conclusions are also made about the existence of inverse dependence of the volume of exports and imports on the level of costs for environmental protection. The results may have scientific significance for subsequent deeper research of the problem, as well as practical value for the development of regional development strategies within the framework of a single nationwide sustainability politics.

Keywords: seaport; infrastructure; integration; regional development; foreign trade; sustainability

1. Introduction

The problems of assessing the transport and logistics infrastructure impact on regional development have been considered in the scientific literature for more than a decade. Fujita, Krugman and Venables [1], examining spatial economics, explained the spatial consequences of reduced transport costs. Notteboom and Winkelmans considered seaports not as separate processing points for cargo and ships but as key nodes in global supply chains [2]. Cohen and Monaco [3] found that increasing the infrastructure of ports and highways decreased manufacturing costs at the state-level.

An important area of research has focused on finding the relationship between port infrastructure and the adjacent territory development. Gripaios and Gripaios investigated the existing and potential role of ports in the process of regional development [4]. Park
and Seo [5] assessed the impact of cargo port capacity and investment on regional economic growth. The work of Crescenzi and Rodríguez-Pose [6] analyzed infrastructure in relation to other factors such as innovation, migration and social filters. Shan, Yu and Lee [7] investigated the impact of the seaport on a host city’s economic development.

A number of researchers have questioned the theses of the positive impact of ports on the region’s economy [6,8]. Thus, it is assumed that transport infrastructure development leads to the opening of markets and increases local producers’ exposure to competition [9]. Stronger competition may encourage local producers to innovate and/or reduce costs in order to maintain or improve their competitiveness, which positively impacts the regional economic growth and, possibly, employment. In addition, the reduction in transport costs associated with the new transport infrastructure should allow local producers to buy cheaper resources, specialize in industries where the regional economy has a comparative advantage or find new markets for their products.

A study of South Korean practices has shown that cargo ports without sufficient capacity hinder regional economic growth, and they contribute to regional economic growth if they have sufficient capacity [5]. A container port’s operations have a positive impact on the regional economic growth, and port investments indirectly lead to economic growth. The findings from China support the impact of port capacity on the host city’s economic growth [7]. In addition, competing ports in the neighborhood have an even greater positive connection to the local port city.

According to the estimates of Song and van Geenhuizen [10], the degree of influence of port investment on the growth of the regional economy through various multiplier effects is not known, and there is no assessment of regional differences in these effects.

Bottasso et al. [11] estimated the impact on GDP in port and non-port European regions. Analyzing the spillover effects of ports to the regions, the researchers found a correlation between port throughput and a region’s GDP. Empirical findings indicate that increasing port throughput by every 10% could lead to an increase in the economy by between 6% and 20% and influence the neighboring regions in the range of between 5% and 18%.

Mudronja, Jugovic and Škalamera-Alilović [9] proved that seaports have an impact on the economic growth of a region, and that they build a trend towards an increase in GDP per capita in the region where they are located. Seaports that invest in new technologies and sophisticated data processing systems have greater preconditions to be successful in their business.

Crescenzi and Rodríguez-Pose [6] studied the impact of transport infrastructure on the economic development of EU regions from 1990 to 2004. Their research shows the weak impact of investment in infrastructure on the economic growth of the region. Several factors have an influence in a complex manner including investment in R&D, a favorable social climate and the attraction of an external labor force. Crescenzi [12] developed a model for the relationship between innovation and growth in the EU regions. The study proved the existence of a relationship between innovation and regional growth, but the change in innovation activity did not provide a certain effect in a specific region. An important result of the study was the determination of the importance of investment in human capital in peripheral areas.

Han et al. [13] found that ports play an irreplaceable role in the economic development of the Beijing–Tianjin–Hebei regions in China. The direct effect and the spillover effects of ports have stronger power in influencing the regional economy than other indicators. At the same time, the role of the port is also stronger in every single sub-region, which means that coordination of the sub-regional development also continues to be required.

According to Robinson, ports provide added value for shippers and third-party service providers [14].

At the same time, the study of Efimova and Gapochka [8], conducted in the Baltic Basin, did not support the hypothesis of a port’s ultimate role in the region’s development.
The authors concluded that ports in Russia and Europe vary in their impact on regional socio-economic development. Partly, this points to the particular relevance of assessing the marine infrastructure project’s impact on the development of Russian regions. Another Russian researcher, Zaostrovskikh [15], suggested that there is no correlation between the GRP growth rate and the growth rate of cargo transshipment in Far Eastern seaports. This is because of the shipment of most of the cargo from other regions of the Russian Federation.

As reported by certain studies, one ton of cargo in the port brings USD 100 of added value, and an increase of one million tons of cargo in the port generates 300 additional jobs [16]. However, the findings of a group of European scientists [17] showed that certain categories of cargo (liquid cargo) and passengers did not exert a considerable impact on the employment in the port region.

Thus, the research carried out contributes to the understanding of the factors that influence the development of the region. However, they do not reflect a systematic approach to assessing these dependencies in the framework of sustainable development. For seaports, these issues are especially relevant, because: (1) if there is an economic effect, there may be a negative environmental impact; (2) the state of the economy determines the resources for the development of the social sphere and environmental support.

The main purpose of our study is to assess the impact of investments in the development of ports and several other socio-economic factors on the volume of foreign trade in coastal and neighboring regions. The key hypothesis of the study refers to the assumption that there is a direct relationship between the level of investments in port infrastructure and the volume of exports and imports.

2. Materials and Methods

2.1. Assessment Methods for the Impact of Infrastructure Projects on Regional Development

The efficiency assessment, according to the documents on the strategic development of Russian ports, is performed integrally on the basis of an individual measures efficiency assessment, taking into account the multiplicative synergistic effects. Groups of social (socio-economic) and commercial performance indicators are used. The project’s commercial performance indicators consider the financial consequences of its implementation for the participant implementing the project, given that all the necessary spending for the project’s implementation is made and all its results are used. The calculation principle is based on the assessment of the return on investment and, for this purpose, methods of investment analysis are used. Public performance indicators accommodate the socio-economic consequences of the project implementation for the society as a whole, including the direct outcomes and costs of the project, as well as ‘external’ costs and outcomes in allied sectors of the economy, and environmental, social and other non-economic effects.

The methodological approaches used in the scientific literature are presented in Table 1.

Zaostrovskikh [15] suggests a combination of two approaches. The first approach is based on the transport operating costs estimation and considers transportation services through the prism of added value. The basis for the second approach is the external costs evaluation for the society of the transport system operation since, depending on the region accessibility, the transportation benefits and costs affect the well-being of people.

Efimova and Gapochka [8] used statistical methods to assess the impact of infrastructure development on the gross regional product, the level of employment and the generation of new jobs.

Mudronja, Jugovic and Škalamera-Altolić [9] used a model for estimating the dependence of GDP per capita on the cargo turnover volume, the amount of investment and labor capital. The model is limited to the assessment of economic factors only. From the point of view of sustainable development, the region’s economic condition is influenced by social and environmental factors. Therefore, we suggest a method for assessing the
impact of infrastructure projects based on three groups of indicators—economic, social and environmental.

Park and Seo [5] applied econometric analysis using an augmented Solow model based on panel data to assess the economic growth of a region.

Gürol and Acar [18] estimated port throughput capacity based on regression analysis.

Botasso, Ferrari et al. [11,17] analyzed the impact of port activities on local development for a sample of regions located in European countries and estimated both the direct and indirect effects associated with port activities.

Crescenzi [12] investigated the relationship between innovation and regional growth in EU regions. The author calculated his own innovation index, which was used in regression analysis.

Han et al. [13] revealed the spillover effects of ports and the contribution of logistics development to the growth of regional economics based on the partial least squares (PLS) and ordinary least squares (OLS) methods.

Table 1. Methods for analyzing the infrastructure projects impact, used in scientific research.

| Authors | Methods | Dependent Indicators |
|---------|---------|----------------------|
| Zaostrovskikh [15] | Estimation of transport operating costs and external expenses of the society for the transport system operations | Welfare |
| Efimova, Gapochka [8] | Statistical methods | Gross regional product, level of employment and job creation |
| Mudronja, Jugovic, Škalamera-Alilović [9] | Dynamic panel data analysis, using the two-step GMM | GDP per capita expressed in purchasing power standards (PPS) |
| Gürol, Acar [18] | Combining SWOT with AHP technique, statistical model developed by using stepwise regression analysis | Port Throughput |
| Park, Seo [5] | Econometrics analysis employing an augmented Solow model based on the panel data | Regional economic growth |
| Ferrari et al. [17] | GMM System estimator | Employment levels |
| Bottasso et al. [11] | Spatial panel econometric framework | GDP in port and non-port regions |
| Crescenzi [12] | Regression analysis | Regional growth |
| Han et al. [13] | Cobb-Douglas production function | Per capita GDP |

2.2. Port Infrastructure Development in Russia

Over the past 15 years, the capacity of Russian ports has increased almost 2.5 times (from 452 million tons in 2004 to 1130 million tons in 2019). The commissioning of facilities in the port of Vostochny (increased by 16.5 million tons), the construction of port terminal No. 38 in the port of Novorossiysk (increased by 3.5 million tons), reconstruction and entry into operation facilities in the ports of the Arctic (increased by 2 million tons) and Baltic basins (increased by 3.5 million tons) provided the port capacity increase of approximately 26 million tons in 2019. However, according to the Accounts Chamber of the Russian Federation [19], the actual level of cargo turnover in seaports is lower than their design capacity. At the end of 2019, cargo turnover amounted to 840.3 million tons, or 76% of the design capacity.
Russia’s Seaport Infrastructure Development Strategy to 2030 [20] states that the
development of seaports in Russia has a boosting effect on the economic growth of territorial
entities, entrepreneurial activity and competition in the market, the influx of investment
and qualified personnel, and the development of innovative technologies. In many cases,
seaports are monotonous enterprises that have social implications on the region. Sea
transport provides for about 60% of Russia’s foreign trade and economic relations, plays
a major role in the fulfillment of Russia’s transit potential and provision of transport ser-
vices in hard-to-reach areas and delivery of goods to the Far North. However, the findings
of assessing a port’s impact on regional development have not obtained a wide circulation
and are the subject of unconnected studies.

The analysis of port development strategic documentation at the regional level shows
that the issues of an individual port’s development and the forecasts of their operations
are addressed in almost every region of the Russian Federation bordering the sea. The
specifics of infrastructure projects implemented in Russian ports between 2019 and 2024
and the objectives to be accomplished are provided in Table 2. The largest number of pro-
jects are accounted for by the Azov-Black Sea and Far Eastern basins, while the maximum
increase in capacity (37% of the total increase through all basins) should be provided for
in the Baltic Basin.

Table 2. Regional development objectives achieved through infrastructure projects.

| Basin             | Number of Projects | Design Capacity, M. of tons | Objectives                                                                 |
|-------------------|--------------------|-----------------------------|---------------------------------------------------------------------------|
| Arctic Basin      | 6                  | 32.03                       | Provision of prospecting and production of hydrocarbons in the Arctic shelf area, development of the Northern Sea Route, organization of Northern Supply Haul to hard-to-reach regions, etc. |
| Baltic Basin      | 10                 | 145.9                       | Development of terminals system that facilitates the transfer of the maximum possible volume of cargo operations outside the port |
| Azov-Black Sea Basin | 20               | 86.9                        | Development of the region’s transport potential through the integrated development of regional transport hubs |
| Caspian Basin     | 1                  | 1.5                         | The increase of throughput capacity and the creation of a logistics corridor with the countries of the Caspian region |
| Far Eastern Basin | 18                 | 126.8                       | Diversified development of ports, based on the import-export and transit potential fulfillment and on the solution of regional social problems (development of coastal transport, organization of wholesale fish exchanges in ports) |

1 Authors.

2.3. Ports and Regions Selection

For the study, 5 seaports were selected, located in five basins: Great Port of Saint
Petersburg, Murmansk, Olya, Novorossiysk, Vostochny. Each of the selected ports is the
largest in the basin. The characteristics of the selected ports in terms of throughput, types
of cargo handled and annual cargo turnover are shown in Table 3. Ports differ in terms of
throughput and types of cargo handled, these differences are due to the peculiarities of
the location regions and traffic flows.
Table 3. Characteristics of the studied seaports.

|                         | St. Petersburg | Olya | Murmansk | Novorossiysk | Vostochny |
|-------------------------|---------------|------|----------|--------------|-----------|
| **Cargo Terminal Capacity** |               |      |          |              |           |
| Total, million tons per year | 118,201       | 1,580| 26,611 * | 213,375      | 81,738    |
| Liquid cargo, million tons | 19,030        | -    | 2,810    | 159,788      | 34,288    |
| Dry, million tons        | 32,634        | 1,580| 19,110   | 40,219       | 39,248    |
| Rolling, million tons    | 2,405         | -    | -        | -            | -         |
| Containers, thousand units in twenty-foot equivalent | 5348,1 | - | 390,9 | 1114 | 683,5 |
| Freight turnover in 2020, million tons | 59,9 | 0,6 | 56,1 | 141,8 | 77,4 |
| Growth rate of freight turnover relative to 2019, % | 100,1 | 113,2 | 90,7 | 90,4 | 105,2 |

1 Authors. * The port is undergoing reconstruction, the capacity is in the process of change.

The geography of the ports and surrounding areas covered by the analysis is shown in Figure 1:

The territory of the port of Murmansk, including the Murmansk Region (1) and the Republic of Karelia (2);

The territory of the Great Port of St. Petersburg, including the city of St. Petersburg, Leningrad (3) and Vologda (4) regions;

The territory of the port of Novorossiysk, including the Krasnodar (5) and Stavropol (6) territories;

The territory of the port of Olya, including the Astrakhan (7) and Volgograd (8) regions;

The territory of the port of Vostochny, including the Primorsky (9) and Khabarovsk (10) Territories.

![Figure 1. Location of the studied ports and regions.](image)

2.4. Analysis Methods

Table 4 summarizes information from the dataset, which was obtained from the Federal State Statistical Service [21], data from the Federal Agency for Maritime and River Transport of the Russian Federation [22] for 10 regions of the Russian Federation.
The dataset contains 14 variables. The data is annual and with 10 years of data for 11 regions, the panel has 110 observations in total. Indicators such as export and import of the port region of the Russian Federation were assumed to be effective indicators. The relative values of these factors prevail over the periods under review. The productive and factorial signs are shown in Table 5.

The statistical information was analyzed and processed with the help of Gretl application software packages. Observation frequency was annual.

This is based on the construction of models for the analysis of panel data. To improve the quality of the initial data and the constructed models, the variables Ln_Export, Ln_IMPORT were introduced, for which the models were evaluated.

The work used the approach of constructing panel data models with fixed effects (cross-section FE-cross-section fixed effects), which is a general means of studying regional samples. We hypothesized that the target indicators under consideration have a pronounced regional specificity, therefore, a model with fixed effects is best suited for describing such data. Conducted research confirmed the correctness of this assumption.

Table 4. Basic information from the dataset.

| Variables       | Mean   | Standard Deviation | Median  | Minimum | Maximum |
|-----------------|--------|--------------------|---------|---------|---------|
| Export          | 2,2333 | 0,1798             | 1,6728  | 0,2817  | 9,2117  |
| Import          | 1,3201 | 0,1533             | 0,5712  | 0,1297  | 7,2508  |
| Investment      | 3,6528 | 0,3232             | 2,3846  | 0,0000  | 13,3670 |
| Living wage     | 11319,7121 | 276,2181 | 10925,0000 | 7207,0000 | 17482,0000 |
| Labor force ratio | 53,1362 | 0,3045 | 52,6132 | 48,2029 | 61,0441 |
| Employment rate | 94,0173 | 19,0734 | 91,4192 | 30,0023 | 281,8170 |
| Capital investment | 99,0494 | 0,2865 | 90,5000 | 5,6482 |
| Railroad density | 407,5814 | 26247,0063 | 2,3846 | 0,0000  | 3204,0000 |
| Environmental protection | 29,0717 | 19,0734 | 4,2554 | 0,0000  | 2100,8783 |
| Cash            | 28748,8700 | 1761,3450 | 26247,0063 | 3876,0000 | 118656,0000 |
| Population      | 2333 | 0,1512             | 1,7697  | 0,6181  | 5,6482  |
| Below living wage | 260,2571 | 17,6746 | 179,7000 | 74,7000 | 639,7000 |
| Share           | 12,5781 | 0,2865 | 12,9539 | 6,5492 | 16,7017 |
| Road            | 8,8638 | 0,5508             | 7,3956  | 0,0000  | 24,6437 |

Table 5. Description of socio-economic indicators.

| Variables                                           | Name of Variable | Measure Units                           |
|-----------------------------------------------------|------------------|-----------------------------------------|
| Investments in port infrastructure                  | Investment       | RUB billion                              |
| Export                                              | Export           | USD million per thousand people          |
| Import                                              | Import           | USD million per thousand people          |
| The value of the subsistence minimum per capita of the working-age population | Living wage | RUB/month |
| Labor force ratio                                   | Labor force      | %                                       |
| Employment rate                                     | Employment       | %                                       |
| Fixed capital investments                           | Capital investment | RUB million per thousand people        |
| Density of public railways (at the end of the year) | Railroad density | kilometers of tracks per 10,000 square kilometers of territory |
| Current (operating) costs of environmental protection, including payment for environmental services | Environmental protection | RUB thousand |
| Average per capita monetary income of the population | Cash             | RUB / month                             |
| Population size                                     | Population       | billion people                           |
For all models, the hypothesis of the presence of fixed effects was tested (joint test on named regressors and the difference in constants in groups according to the Welch criterion, robust test for differing group intercepts). Panel diagnostics were performed resulting in a weak null hypothesis about the adequacy of the pooled panel data model, favoring the fixed effects model. A weak null hypothesis was also obtained about the adequacy of the random effects model, favoring the fixed effects model. Thus, the hypotheses about the presence of fixed effects in the models were accepted.

3. Results

3.1. Factors for Export

As a result of data analysis, various models of the heteroscedasticity and autocorrelation consistent (HAC) regressions for Ln_Export were built, from which the best were selected. Table 6 shows the models:

- With a statistical significance of no more than 10% for estimates of regression coefficients for variables;
- With the explanatory power above 40%;
- With robust to heteroscedasticity standard errors (HAC);
- Without explicit multicollinearity;
- With the fulfillment of the normality condition for the model residuals.

Table 6. Results of the heteroscedasticity and autocorrelation consistent (HAC) regressions for Ln_Export.

| Variables                  | Model 1                  | Model 2                  | Model 3                  | Model 4                  |
|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Constant                   | -5.73199***              | -7.0752***               | 1.0706*                  | -0.8947***               |
| Investment                 |                          |                          |                          |                          |
| Living wage                | 7.86929*10^-5**          |                          |                          |                          |
| Labor force ratio          | 0.134454***              | 0.1619***                |                          |                          |
| Capital investment         | 0.00242123**             | 0.002421*                | 0.005395**               | 0.009054***              |
| Environmental protection   | -0.000318797***          | -0.0002590***            | -0.0002823***            |                          |
| Population                 |                          |                          |                          | 0.1929***                |
| Share below living wage    | -0.207083***             | -0.1641***               | -0.1481***               |                          |
| Road                       | 0.0851288***             | 0.08465***               | 0.04234***               | 0.01369**                |

1 Authors. Results from the generated HAC models (*** represents significant at 1% level, ** represents significant at 5% level, * represents means significant at 10% level).

Hypothesis 1 claims that investments in port infrastructure have a positive relationship with export potential. The estimation does not reject the hypothesis. As investments in the port increase by RUB 1 billion, the exports of the port region increase by an average of USD 1.101761 million per thousand of the population.

Investments in the development of port infrastructure are an integral part of a more general indicator—investments in fixed capital. The analysis shows that investments in fixed capital and export volumes have a positive relationship. An increase in investments in fixed capital by RUB 1 million per thousand population leads to an increase in the export of the port region by an average of USD 1.009095 million per thousand population. It
is noticeable that investments directly in the port infrastructure give a more noticeable economic effect than investments in the fixed capital of the region.

In this study, the authors wanted to check whether the socio-economic indicators of a region's development have a significant impact on its export potential. Calculations show that an increase in the population by 1 billion people leads to an increase of the port region’s export by an average of USD 1.212762 million per thousand population.

It was a question to investigate if potential exports depends on regional road infrastructure. The estimation shows that when the length of public roads increases by 1 km, the exports of the port region increases by an average of USD 1.013784 million per thousand population. However, the hypothesis of a direct relationship between export volumes and the level of development of the railway network has not been confirmed.

Table 7 illustrates the hypotheses of export dependence and actual results with the best models selected. The models with low significance are not mentioned in the table.

Table 7. Hypotheses of export dependence and actual results (all the results are significant at the 1% level).

| Variables       | Hypothesis | Result |
|-----------------|------------|--------|
| Investment      | +          | +      |
| Living wage     | ?          | -      |
| Labor force ratio | +       | +      |
| Employment rate | +          | +      |
| Capital investment | +      | +      |
| Railroad density | +          | -      |
| Environmental protection | -     | +      |
| Cash            | ?          | -      |
| Population      | ?          | +      |
| Share           | +          | +      |
| Road            | +          | +      |

Port infrastructure modernization and an increase in the foreign trade flow of goods lead to an increase in harmful emissions and environmental pollution. This fact is well known and described in many modern studies. At the same time, the authors found an inverse relationship, which was not so obvious at the beginning of the research. Modeling showed that an increase in current (operating) costs for environmental protection, including payment for environmental services, by RUB 1 thousand per thousand people leads to a decrease in the exports of the port region by an average of about USD 1 million per thousand population.

3.2. Factors for Import

As a result of data analysis, various models of the heteroscedasticity and autocorrelation consistent (HAC) regressions for Ln_Import were built, from which the best were selected. Table 8 shows the models:

With a statistical significance of no more than 10% for estimates of regression coefficients for variables;
With explanatory power above 40%;
With robust to heteroscedasticity standard errors (HAC);
Without explicit multicollinearity;
With the fulfillment of the normality condition for the model residuals.
Table 8. Results of the heteroscedasticity and autocorrelation consistent (HAC) regressions for Ln_Import.

| Variables                  | Model 5          | Model 6          | Model 7          | Model 8          |
|----------------------------|------------------|------------------|------------------|------------------|
| Constant                   | −14,9660 ***     | −17,8073 ***     | −2,0118 ***      | −8,2672 ***      |
| Investment                 | 0,06979 *        |                  |                  |                  |
| Labor force ratio          | 0,2308 ***       | 0,2837 ***       |                  | 0,1403 ***       |
| Capital investment         | 0,005647 ***     | 0,005278 ***     | 0,005130 **      | 0,005595 **      |
| Railroad density           |                  |                  | 0,0003884 ***    |                  |
| Environmental protection   | −0,0003867 ***   | −0,0005231 ***   |                  |                  |
| Cash                       |                  |                  | 8,6986*10⁻⁶ *    |                  |
| Below living wage          | 0,004232 ***     | 0,004857 ***     | 0,001215 **      |                  |
| Road                       | 0,04888 **       | 0,07125 ***      |                  |                  |

1 Authors. Results from the generated HAC models (** represents significant at 1% level, * represents significant at 5% level, * represents means significant at 10% level).

Hypothesis 2 claims that investments in port infrastructure have a positive relationship with import potential as well as to export potential. Our estimation does not reject the hypothesis. When investments in port infrastructure increase by RUB 1 billion, import in coastal region increases by USD 1,1106 million per thousand population.

It was a question to investigate if import trade flow depends on dynamics of regional socio-economic indicators. The estimation shows the presence of a significant statistical relationship between the volume of imports and indicators such as the population size and the value of the subsistence minimum per capita of the working-age population. However, the hypothesis of a correlation between employment and imports has not been confirmed.

Table 9 illustrates the hypotheses of import dependence and actual results.

Table 9. Hypotheses of import dependence and actual results (all the results are significant at the 1% level).

| Variables                  | Hypothesis Result | Actual Result |
|----------------------------|-------------------|---------------|
| Investment                 | +                 | +             |
| Living wage                | ?                 | +             |
| Labor force ratio          | +                 | +             |
| Employment rate            | +                 | -             |
| Capital investment         | +                 | +             |
| Railroad density           | +                 | +             |
| Environmental protection   | -                 | -             |
| Cash                       | ?                 | -             |
| Population                 | ?                 | +             |
| Below living wage          | +                 | +             |
| Share                      | +                 | -             |
| Road                       | +                 | +             |

In contrast to the models calculated for exports, in this case it was possible to confirm the existence of a relationship between imports and the length of the railway networks. With an increase in the density of public railways by 1 km of tracks per 10,000 square km of territory, imports of the port region will increase by an average of USD 1,000388 million per thousand population.
Hypothesis 3 claims that environmental protection does not influence import potential. However, the estimation shows that an increase in current (operating) costs for environmental protection, including payment for environmental services, by RUB 1 thousand per thousand people leads to a decrease in imports of the port region by USD 1,000387 million per thousand population.

4. Discussion

Generally speaking, the issues of port infrastructure development are usually related to the evaluation of the investment performance and the economic development of a region. However, sustainable development includes numerous indicators that are interrelated and mutually dependent. This study evaluates the investment impact on certain economic and social factors of regional development.

The seaport influences the economic development of the hinterland that it serves. At the same time, the success of the seaport will be of interest not only to investors but also to the authorities since external effects extend to the economy of the hinterland [23]. In this regard, it is necessary to understand how investments in port infrastructure can be balanced within the framework of federal and local government policies. Improving the efficiency of ports is more important than expanding infrastructure, which means the need to increase the utilization of port capacity, improve internal transport links and accelerate the integration of ports with supply chains. Song and Geenhuizen point out that for port regions, intermodality between different modes of transport should be considered to improve the connectivity of the transport network [10]. These aspects are relevant for any port embedded in regional or global supply chains. Another issue of particular importance is the assessment of the optimal level of investment, above which additional investment in the port does not ensure further economic growth.

The importance of the relationship between the development of port infrastructure and foreign trade is recognized at the federal level. The new transport strategy of the Russian Federation will define a unified infrastructure backbone for sea and water transport. The backbone network of seaports will include ports that provide the export–import potential of Russia, and ports with socially significant functions in territories where there is no road and rail infrastructure and where northern delivery is carried out.

The issues of neutralizing the negative impact of ports on the environment deserve special attention in further studies. In relation to the Sustainable Development Goals, these factors are strategically important along with social and economic ones [24,25]. Environmental problems include emissions into the atmosphere and soil, consumption of resources and disturbance of biodiversity [26], local water pollution [27], waste discharges and oil spills [27,28] and noise pollution [29]. Some studies have been devoted to issues that are a consequence of environmental problems of urban development and infrastructure [30].

The environmental aspect is of particular importance on a global scale since it is not just related to the port territories. The port facilities should be commissioned while preserving ecosystems and maintaining the appropriate quality of the environment.

In the future, the growth of the port industry is expected, which will increase the negative environmental impact on marine ecosystems and coastal communities [27,28]. Therefore, environmental management is of great importance [24]. The issues of reducing air pollution by emissions from ships and port infrastructure facilities, ports’ compliance with the ‘green standards’, which are aimed at rational water use, pollution prevention, energy preservation and efficiency, the use of environmentally friendly materials and the application of the ‘zero waste’ principle, are becoming more and more urgent.

A systematic study of various components of sustainable development can be based on the use of new models, in particular:

1. The concept of low-carbon development with low energy consumption, low pollution and high energy efficiency, which must be implemented in all aspects of regional
construction. This allows the transition to sustainable development in combination with economic growth, social progress and environmental safety [31];

(2) A cost-effective green policy combined with stakeholder involvement, sustainable operation and port development is the basis of the concept proposed by Lam and Van De Voorde [32]. For example, the results of the Hossain study [24] showed that most ports place particular emphasis on identifying and neutralizing environmental impacts, as well as improving energy management and stakeholder engagement. However, many ports are still lagging in the implementation of initiatives related to energy management, certification, reporting in the field of sustainable development and adaptation to climate change.

5. Conclusions

The study shows that investments in fixed assets and export volumes have a positive relationship. At the same time, investments in the development of the port infrastructure give a more tangible economic effect than investments in the fixed capital of the region.

A practically significant result of the study is the identification of a significant statistical relationship between the volume of imports and such indicators as the size of the population and the value of the subsistence minimum per capita of the working-age population.

An important result of the study is the discovery of the inverse dependence of the volume of exports and imports on the level of costs for environmental protection, including payment for environmental services. At the same time, the need to ensure the development of the region does not allow for the consideration that the goals of protecting the environment and enhancing foreign economic activity contradict each other. Sustainable development requires local government to both ensure the financial stability of regional companies and introduce elements of a green economy aimed at protecting the environment.

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