Article

Development of a Methodology for Econometric Modeling of The Effective use of Export Potential

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Abstract: Effective utilization of export potential is critical for sustaining economic growth, regional competitiveness, and foreign economic stability. In Uzbekistan's Khorezm region, structural imbalances and a lack of systematic export-import policy hinder optimal use of export potential, necessitating robust assessment frameworks. Despite global efforts in econometric evaluation of foreign economic activity, methodological tools for analyzing export potential at the regional level—particularly for small open economies—remain underdeveloped. This study aims to develop a methodology for econometric modeling of the effective use of export potential, focusing on calculating efficiency indicators, evaluating spatial economic security, and proposing predictive tools for export policy optimization. Using statistical data from 2020–2024, the research applied correlation-regression analysis and spatial modeling techniques, revealing that declining export volumes and policy inefficiencies are limiting Khorezm's growth. A new model was formulated using weighted Euclidean distance and a "Potential Field" framework to comprehensively assess regional export capacities. The study advances the field by integrating quantitative econometric tools and spatial analysis to assess export efficiency, offering a replicable model for regional analysis. The proposed methodology provides policymakers with actionable insights for enhancing regional export performance and aligning foreign economic strategies with national priorities. It also contributes to establishing critical thresholds for trade security and sustainability, thus offering a scientifically grounded basis for informed decision-making in regional economic planning.

Keywords: Export Potential, Econometric Modeling, Economic Indicators, Assessment, Forecast Indicators, Foreign Economic Activity, Khorezm Region

1. Introduction

The effectiveness of managing foreign economic activity is generally determined by key factors that reflect the efficiency of an economic system's resource production, consumption, and logistics potential. All else being equal, efficient management of a region's foreign economic activity helps create favorable living conditions, supports sustainable economic growth, and strengthens resilience to internal and external challenges. Timely development and implementation of strategies to enhance and effectively utilize a state's foreign economic potential–particularly its export potential–are essential for gaining competitive advantages, ensuring economic security, and systematically improving the balance of payments. In this context, diversification plays a crucial role in economic development at both the enterprise and national levels. It involves exploring new business expansion strategies, increasing the variety or volume of exported

goods, and entering new markets. In the modern economy, export diversification involves expanding and renewing the product assortment [1].

Literature Review

At the same time, small enterprises can integrate into the value chains of larger corporations, facilitating diversification. Export refers to the movement of domestically produced goods across international borders, encompassing the sale of goods and services from one country to another. Enhancing export potential requires strategies that improve the competitiveness of enterprises and industries while promoting import–substituting production [2].

Identifying and developing a region's competitive advantages helps determine key economic activities, pinpoint investment opportunities for expansion, and establish core groups of goods and services–essential factors in shaping and effectively utilizing export potential. This, in turn, fosters a favorable investment climate, strengthens social security, and serves as a prerequisite for sustainable development at both the state and regional levels. Given the urgency of developing scientific and methodological tools to assess and analyze the efficiency of foreign economic potential–particularly export potential–this research examines models of foreign trade policy formation and the factors influencing the export orientation of national economies. By analyzing economic openness and export product structures, this study explores key trends in trade liberalization.The study highlights structural imbalances in the export and import activities of the Khorezm region, revealing the lack of a balanced, targeted, and effective export–import policy at both national and regional levels. These shortcomings undermine foreign economic security and hinder the development of export potential [3].

This research focuses on developing a conceptual model for optimizing regulatory processes in state–managed foreign economic activities. It explores practical applications of optimization models and methods in foreign economic management, presenting a framework for calculating foreign economic efficiency indicators. Additionally, the study demonstrates the successful use of correlation–regression analysis to identify and forecast key factors influencing enterprise exports. We believe that insights from other small open economies facing similar challenges can contribute to developing effective methods for assessing the efficiency of export potential utilization in Uzbekistan and its regions. As a practical contribution, this study applies econometric tools to evaluate and model foreign economic activity indicators in the Khorezm region [4].

Our findings suggest that slow growth in production exports is a critical factor limiting the region's overall economic performance. In response, we propose a structured approach for evaluating, analyzing, and forecasting foreign economic indicators at national and regional levels using economic and mathematical tools. Furthermore, we highlight additional benefits of this methodology, considering its potential to enhance export activities. The effectiveness of managing and regulating foreign economic processes at both national and regional levels is shaped by a complex interplay of internal and external factors. Among the internal factors influencing the efficient utilization of foreign economic potential–both regionally and nationally–the effectiveness of socio–economic policies plays a crucial role. This can be evaluated by analyzing the level of foreign economic security in the Khorezm region, along with its key territorial value indicators [5].

2. Materials and Methods

Methodology for Assessing Export Potential Utilization Efficiency

Studying the regional dimensions and specific factors influencing the formation and utilization of a region's export potential is essential for identifying key determinants of an effective national foreign economic policy. Notably, a regional strategy for developing foreign economic complexes should not rely solely on export orientation as the primary

driver of economic growth. At the same time, evaluating, analyzing, and forecasting the efficiency of a region's export potential remains a key priority for applied research [6].

Accordingly, we argue that defining priority directions for a region's foreign economic activity should involve identifying region–specific forms, methods, and approaches. These must consider the existing institutional and geopolitical context, the region's socio–economic and environmental development level, and opportunities to optimize territorial systems and growth processes [7].

Furthermore, we propose that the ultimate objectives of managing a region's foreign economic activity should be to:

a. Integrate the region and its territorial systems into a sustainable development trajectory;
b. Gradually reduce social tensions;
c. Maximize the use of regional competitive advantages and resource potential,
d. Foster self–regulation in foreign economic activity, and maintain balance in foreign economic development processes [8].

Addressing these challenges requires a comprehensive analysis of export indicators and their efficiencyn [9].

Methodological Framework

To analyze dynamic patterns, a system of indicators is typically used to describe the direction and intensity of changes over time. These include absolute growth, average annual absolute growth, growth coefficients, growth rates, and average growth rates, calculated using both basic and chain methods [10].

3. Results and Discussion

Our analysis indicates a positive trend in absolute export growth across nearly all districts of Khorezm during the study period (Section 3.2). For assessing export efficiency at the regional level, we adapted our methodology based on available statistical data. Export efficiency is determined by comparing export revenues and expenditures related to foreign economic activity. Using statistical data from the Khorezm region, we calculate the regional export efficiency indicator (ESi) as follows:

$$ES_i = \frac{\left(\frac{Ex_i}{As_i}\right)*\left(\frac{Ex_i}{YIM}\right)*10}{\left(\frac{Ex}{As}\right)*\left(\frac{Ex_i}{YHM}\right)} \qquad (1)$$

where EExi is the export efficiency of the i–region;

$\frac{Ex_i}{As_i}$ – i–region exports per capita;

$\frac{Ex_i}{YIM}$ –share of region's exports in national GDP;

$\frac{Ex}{As}$ –national export per capita;

$\frac{Ex_i}{YHM}$ – The share of i–region exports in GRP.

The dynamics of export indicators and their efficiency, along with the critical role of quantitative evaluation in shaping socio–economic development and economic security programs, underscore the need for robust quantitative methods. This indicator represents the relative income per capita per percentage of GDP exported, benchmarked against an average value of 100%. The coefficient of participation in the international division of labor is calculated as follows:

$$K_i XMT = \frac{Ex_i/Ex_c}{YaIM_i/YaIM_c}$$

Where: Ex_i – i–country export;
Ex_c – world exports;
$YaIM_i$ – i–country's gross domestic product;
$YaIM_c$ –world GDP.

We adapt this coefficient to measure a country's participation in global production and export of specific goods/services. For Khorezm region, the proposed coefficient is:

$$K_i XAI = \frac{Ex_{ij}/Ex_{cj}}{YIch_{ij}/YIch_{cj}}$$

Where:

$K_i XAI$ = Coefficient of participation in global exports of goods/services;

Ex_{ij} = Export of product (j) by country (i);

Ex_{cj} = Global exports of product (j);

$YIch_{ij}$ = Production volume of product (j) in country (i);

$YIch_{cj}$ = Global production of product (j).

Quantitative Assessment and Spatial Analysis

The existing literature lacks a universally accepted methodology for quantifying export potential. However, methods for assessing economic potential–of which export potential is a key component–can be applied to regional planning. The proposed approach for evaluating regional economic security levels through Euclidean distance analysis, while incorporating consumer market potential, involves the following key methodological components:

a. Measuring actual values of the region's foreign economic activity indicators. This includes both comprehensive regional assessments of export/import efficiency and specific performance metrics for key commodity groups in foreign trade.

Second, this approach involves quantitatively assessing regional foreign economic potential by systematically clustering territories based on their capacity utilization efficiency. It separately evaluates the export–import potential for different product and service categories and conducts comparative analyses of individual regions' trade performance.

This methodology applies spatial analysis techniques to establish objective benchmarks for assessing economic security. It places particular emphasis on export–import balance dynamics within specific commodity markets. By combining macro–level regional evaluations with micro–level sectoral analyses, it provides comprehensive insights into trade efficiency [11].

To formalize this problem, we introduce the following notation:

Let there be m regions examined through a system of indicators $x_1, x_2,...,x_n$ forming set J. Then the indicators of the i–th region can be represented as objects $P_i(x_{i1}, x_{i2},...,x_{in})$, j=(1,m). To evaluate the development level of the i–th region, we assess the degree of proximity between objects:

1. $P_i(x_{i1}, x_{i2}, ..., x_{in})$ and $P_{0i}(x_{01}, x_{02}, ..., x_{0n})$, $j = \overline{1,m}$ – an ideal object in multidimensional space whose coordinates can be found as:

$- x_{0j}^* = \max_i x_{ij}^*$ agar j if j is an indicator stimulating foreign economic activity (separately for export and import), j=(1,m);

$- x_{0j}^* = \min_i x_{ij}^*$ if j is an indicator hindering regional development (separately for export and import), j=(1,m);

2. $P_i(x_{i1}, x_{i2}, ..., x_{in})$ and $P_{ci}(x_{c1}, x_{c2}, ..., x_{cn})$, an object in multidimensional space whose coordinates correspond to national–level indicator values;

3. $P_i(x_{i1}, x_{i2}, ..., x_{in})$ and $P_{ui}(x_{u1}, x_{u2}, ..., x_{un})$, – an object in multidimensional space whose coordinates correspond to international or regional–level indicator values (depending on specific research objectives).

The study thoroughly examines the application possibilities of Euclidean distance in determining foreign economic activity potential. When assessing the level of a region's foreign economic activity using weighted Euclidean distance, we propose introducing a multiplier to account for possible linear dependence between factor variables:

$$\prod_{j'''=1}^{j-1}(1 - r_{j''' j}), \tag{2}$$

where $r_{j''' j}$ is the Pearson correlation coefficient between normalized indicators $x_{j''' j}^*$ va x_j^*. Considering this, the formula can be written as:

$$d_{ij} = \sqrt{\sum_{k=1}^n (x_{ik}^* - x_{jk}^*)^2 \prod_{k''=1}^{k-1}(1 - r_{k'' k})} \tag{3}$$

Without assigning decisive importance to any single factor affecting the region's foreign economic activity level, we assume all weight coefficients equal to one. Accounting for the limitations of additional convolution, the integral assessment of distance between objects in Euclidean space is determined using multiplicative convolution:

$$D_{ij} = \sqrt[p]{\prod_{s=1}^{p} d_{sij}} \quad (4)$$

Based on these considerations, the formulas for determining proximity measures between $P_i(x_{i1}, x_{i2}, \ldots, x_{in})$ and $P_{0i}(x_{01}, x_{02}, \ldots, x_{0n})$ take the following form:

– For partial assessment:

$$d_{si0} = \sqrt{\sum_{k=1}^{n}(x_{sik}^* - x_{sok}^*)^2 \prod_{k'=1}^{k-1}(1 - r_{k''k})} \quad (5)$$

– For integral assessment:

$$D_{i0} = \sqrt[p]{\prod_{s=1}^{p} d_{si0}} \quad (6)$$

Where:

x_{sik}^* – standardized value of the k–index of the s–subsystem of object i;

x_{sok}^* – standardized value of the k–index of the s–subsystem of the ideal object;

ns – –number of indicators in the s–subsystem;

$r_{k''k}$– x_{sik}^* and x_{sok}^* – Pearson correlation coefficient between x_{sik}^* and x_{sok}^** indicators;

p– number of subsystems;

d_{si0}– assessment of distance between the s–subsystem indicators of object i and the ideal object;

D_{i0} – integral assessment of distance between objects Pi and P0

Similarly, we write formulas to determine the degree of proximity between:

$P_i(x_{i1}, x_{i2}, \ldots, x_{in})$ va $P_{ci}(x_{c1}, x_{c2}, \ldots, x_{cn})$,

$$d_{sik} = \sqrt{\sum_{k=1}^{n}(x_{sik}^* - x_{sck}^*)^2 \prod_{k'=1}^{k-1}(1 - r_{k''k})} \quad (7)$$

$$D_{ic} = \sqrt[p]{\prod_{s=1}^{p} d_{sic}}$$

$P_i(x_{i1}, x_{i2}, \ldots, x_{in})$ va $P_{ui}(x_{u1}, x_{u2}, \ldots, x_{un})$,

$$d_{siu} = \sqrt{\sum_{k=1}^{n}(x_{siu}^* - x_{suk}^*)^2 \prod_{k'=1}^{k-1}(1 - r_{k''k})} \quad (8)$$

$$D_{iu} = \sqrt[p]{\prod_{s=1}^{p} d_{siu}}$$

We calculated the participation coefficients of Khorezm region in the export of goods, jobs and services to world markets over five years, see Table 1.

Table 1. Participation Level of Khorezm region in export of goods, jobs and services to world markets (2020–2024).

Indicators	Years				
	2019/2020	2020/2021	2021/2022	2022/2023	2023/2024
Ex_{ij}/Ex_{cj}	0,323	0,333	0,161	0,102	0,160
B_{ij}/BBx_{cj}	0,08	0,078	0,069	0,068	0,052
$K_i M$B	4,0	4,27	2,33	1,5	3,08

The Khorezm region has shown particularly strong participation in global barley production and exports, as reflected in calculated coefficients consistently exceeding 1.0 across all analyzed years. The highest coefficient was recorded in the 2019/2020 period when Khorezm region held a strong position among exporting nations for goods, jobs, and services in global markets.

However, our analysis indicates a significant decline in this indicator starting in 2021, driven by reduced export volumes of manufactured goods, jobs, and services from the region. As a result, Khorezm region's relative importance among other exporting territories weakened substantially.

A notable participation level of 3.08 was observed in 2024/2023, highlighting Khorezm region's significant share in the Republic's total exports. However, it is important to note that this coefficient primarily reflects realized export capacity rather than accounting for potential export opportunities.

To accurately assess a country's export potential, a comprehensive evaluation of all export dimensions is necessary. In this context, we emphasize the importance of the graph–analytical method called "Potential Field", which is used to diagnose enterprise capabilities [12].

This method is based on the analysis of four key components of export potential:

a. Production, distribution, and sales
b. Organizational structure and management
c. Marketing
d. Financial indicators

A key advantage of this method is its comprehensive coverage of various indicators within each of these categories. Using the proposed formula (3.3.9) below, four general evaluation indicators are determined. These indicators are then transformed into vector lengths, which collectively form the square of enterprise potential.

$$Bk = 100 - (Pj-n) \times (100 / n(m-1)) \qquad (9)$$

Where:

Pj = sum of ranking positions obtained during the evaluation process;

n = sum of coefficients by groups (sections);

m = number of analyzed enterprises.

The potential type of the studied enterprises is determined by the shape of the resulting square or the length of the obtained vectors. We believe this method can be effectively adapted to assess enterprises' export potential using the indicators proposed above [13].

Our proposed indicators for grouping provide a comprehensive assessment of enterprises' existing production capacity and export opportunities. They also enable the consideration of production, logistics, and export capacity ratios. The weight or sensitivity coefficient of indicators across the four groups was determined by analyzing the impact of specific factors on enterprises' production and export activities [14].

In evaluating export–oriented enterprises in the Khorezm region, we considered export potential indicators within each component of the potential square:

the "production, distribution, and sales" group includes factors such as agricultural land area and assessments of production and marketing logistics;

the "organizational structure and management" group focuses on the share of export contracts held by enterprises;

the "marketing" group considers the domestic barley market share and national export share [15].

Under these conditions, the following statements are correct:

a. The smaller the value of D_{i0}, the higher the effectiveness of foreign economic activity and its efficiency in the i–th region, and vice versa;
b. The smaller the values of D_{ic} and D_{iu}, the closer the i–region is to national and global levels in terms of foreign economic activity effectiveness, and vice versa;

c. In the case where $D_{iu} > D_{ic}$ – the i–th region lags behind the country's average level in terms of efficiency in utilizing foreign economic potential;

d. In cases where $D_{i0} > D_{iu}$, $D_{i0} > D_{ic}$– during the period under study, the region experienced a decline in foreign economic activity potential relative to national and global trends.

4. Conclusion

This study analyzed global and domestic practices in defining, assessing, and forecasting foreign economic activity indicators. Some of these findings are reflected in this article. Forecast indicators for exports in the Khorezm region were calculated, along with their effectiveness. Additionally, a possible approach to evaluating regional export potential, foreign economic activity development, and promising growth areas was proposed. The scientific novelty of this study lies in the enhancement and development of existing methods for assessing and analyzing the region's foreign economic activity. Specifically, the research introduces and implements a new approach to assessing export effectiveness, leveraging the existing statistical base.

Furthermore, it proposes a method for evaluating the region's foreign economic potential using the weighted Euclidean distance. Further development of this research direction, using appropriate economic and mathematical tools, will enable a qualitatively new approach to enhancing the efficiency of managing the region's foreign economic activity. Practical research, including interdisciplinary studies, aims to develop scientific and methodological approaches for quantitatively assessing the export and import potential of regions and their territorial systems.This assessment considers key factors such as resource availability, production capacity, consumer demand, and infrastructure potential for specific product groups and types. Additionally, the study seeks to establish critical threshold values for export and import indicators of individual commodity groups–particularly those essential for ensuring economic, social, and environmental security–while systematically improving these indicators under stable conditions..

REFERENCES

[1] M. A. Dudchenko и others, Diversification of the export potential of Ukraine. Ukraine and the world economy: the interaction on the brink of the millennium. Kyiv: Lybid, 2002.

[2] J. S. Tukhtabaev и др., «Econometric modeling and forecasting of the increase in the export potential of small businesses and private enterprises in the Republic of Uzbekistan», в Proceedings of the 6th International Conference on Future Networks & Distributed Systems, 2022, cc. 298–310.

[3] R. B. Tekin, «Economic growth, exports and foreign direct investment in Least Developed Countries: A panel Granger causality analysis», Econ. Model., т. 29, вып. 3, cc. 868–878, 2012.

[4] G. Bayar, «Estimating export equations: a survey of the literature», Empir. Econ., т. 54, вып. 2, cc. 629–672, 2018.

[5] M. Bahmani-Oskooee, «Export growth and economic growth: An application of cointegration and error-correction modeling», J. Dev. Areas, т. 27, вып. 4, cc. 535–542, 1993.

[6] M. Kırkın, A. Aktepe, и B. Toklu, «Export Potential Index for Textile Industry (EPIT) model proposal with structural equation modelling and application», Kybernetes, 2024.

[7] V. Y. Skripnichenko, A. N. Gerasimov, O. P. Grigoryeva, Y. S. Skripnichenko, и E. I. Lelikova, «Export Potential of the Region: Problems of Estimation, Modeling, and Forecasting», в Sustainable Development of the Agrarian Economy Based on Digital Technologies and Smart Innovations, Cham: Springer Nature Switzerland, 2024, cc. 233–239.

[8] S. V. Dubkov, «Formirovanie i otsenka eksportnogo potenciala promyshlennykh predpriyatii», Bankauski Vesn., вып. 28 (537), cc. 29–35, 2011.

[9] A. Dooranov, A. Asanova, Z. Zhumaliyeva, O. Pyroh, N. Duliaba, и N. Kolinko, «Instruments for the Development of the Country's Export Potential», Linguist. Cult. Rev., т. 5, вып. S4, cc. 1819–1829, 2021.

[10] O. A. Shestakova, «Metodicheskie aspekty otsenivaniya eksportnogo potenciala predpriyatiya», Vestn. NTU KhPI, вып. 7 (981), сс. 173–198, 2016.

[11] A. Dooranov, A. Asanova, Z. Zhumaliyeva, O. Pyroh, N. Kolinko, и N. Duliaba, «Tools for the Country's Export Potential Development», Econ. Aff., т. 67, вып. 4, сс. 573–578, 2022.

[12] S. V. Yu, «Models and forecasts of the export potential of the regional economic system», Regionology, т. 30, вып. 4 (121), сс. 762–782, 2022.

[13] O. A. Shestakova, «Metodicheskie aspekty otsenki eksportnogo potenciala predpriyatiya», Vestn. NTU KhPI, вып. 7 (981), сс. 173–181, 2013.

[14] M. Aucamp, «The estimation of export potential values in international market selection methods: a comparative analysis», PhD Thesis, North-West University (South Africa), 2020.

[15] L. C. Leonidou и C. S. Katsikeas, «The export development process: an integrative review of empirical models», J. Int. Bus. Stud., т. 27, сс. 517–551, 1996.