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## Development of border regions economic interaction: mechanisms and models

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**Abstract.** In order to develop cross-border circulation of goods and people, the authorities of a country or region can take various measures aimed at creating favorable conditions for cross-border exchange and reducing barriers and restrictions that impede its development. The article explores the mechanisms of cross-border cooperation and proposes a new grouping of them. The author made an attempt to develop a new methodological approach to modeling the development of commodity exchange in the border regions, based on the development of two complementary models — descriptive and prescriptive type. The peculiarity of the author’s approach is to distinguish between target impacts on the result and the “natural” trend in the development of commodity flows and assess the impact of the consequences of target impacts. The proposed descriptive model makes it possible to identify and explain the determinants of the advance or lag in the growth rates of the region’s import-export operations in comparison with the growth rates of the gross regional product. In the descriptive model, there are no estimated indicators that would reflect the level of administrative, logistical, and other barriers in the trade and economic relations of the border regions. To overcome this shortcoming, in combination with the first model, the author proposes to use another model — a normative one, in which the same estimated indicator is chosen as two factor indicators — an aggregated indicator of barriers to cross-border turnover. The idea is that the “height of the barriers” should be measured separately — on each side of the common border of the two border regions. The use of two models in combination allows a better understanding of the reasons for the change in indicators of cross-border transactions in the region. On this basis, decision makers can develop and implement a “road map” to reduce administrative, bureaucratic barriers at border checkpoints.

**Keywords:** border regions, interaction, development, mechanisms, models

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## Развитие экономического взаимодействия приграничных регионов: механизмы и модели

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**Аннотация.** С целью развития трансграничного оборота товаров и людей власти страны /региона могут предпринимать разнообразные меры, направленные на создание благоприятных условий трансграничного обмена и снижение барьеров, ограничений, препятствующих его развитию. Исследованы механизмы приграничного сотрудничества, предложена их новая группировка. Автором предпринята попытка разработки нового методического подхода к моделированию развития товарного обмена в приграничных регионах на основе разработки двух взаимодополняющих моделей — дескриптивного и прескриптивного типа. Особенность авторского подхода состоит в разграничении целевых воздействий на результат и «естественного» тренда развития товарных потоков и оценки влияния последствий целевых воздействий. Предложенная дескриптивная модель позволяет выявить и объяснить детерминанты опережения или отставания темпов роста импортно-экспортных операций региона в сопоставлении с темпами роста валового регионального продукта. В дескриптивной модели нет оценочных показателей, которые отразили бы уровень административных, логистических, а также иных барьеров в торгово-экономических отношениях приграничных регионов. Для преодоления этого недостатка, в комплексе с первой моделью, автор предлагает применять другую модель — нормативную, в которой в качестве двух факторных признаков выбран один и тот же оценочный показатель — агрегированный индикатор барьеров трансграничного оборота. Идея состоит в том, что «высоту барьеров» следует измерять отдельно — с каждой стороны общей границы двух приграничных регионов. Использование двух моделей в комплексе позволяет лучше понять причины изменения показателей трансграничных операций в регионе. На этой основе лица, принимающие решения, могут разрабатывать и реализовывать «дорожную карту» снижения административных, бюрократических барьеров в пограничных пунктах пропуска.

**Ключевые слова:** приграничные регионы, взаимодействие, развитие, механизмы, модели

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## Introduction

In conditions of political and economic instability, a rational approach to the development of trade relations in the border regions of many countries is often tested for strength. The opposing forces of globalization and divergence are causing the emergence of new barriers and incentives in the international exchange of goods and people. In such conditions, the relevance in the study of institutions, mechanisms, determinants of the development of regions, in relation to its export-import component, increases.

The logic of the study is based on an assessment of the relationship between institutions and applied mechanisms that form the conditions and barriers for cross-border commodity exchange. An important role is played by the differences between institutions-norms and institutions-structures. It is this distinction that predetermines the choice of specific mechanisms for the interaction of actors.

This or that degree of realization of economic and social interests of stakeholders of different levels is predetermined by the mechanism of cross-border cooperation — an integral set of institutions and incentives. The pace of economic development of the border region largely depends on the effectiveness of this mechanism, which promotes or hinders the growth of cross-border transactions. A set of private mechanisms (for example, the VAT refund mechanism) form an integral group of tax mechanisms, which, in turn, is part of a larger structure — financial and economic mechanisms. The quality of functioning of organizational, legal, financial, economic, technological and other mechanisms has a significant impact on practical results — the time of processing documents, the queue size at the border checkpoint, the efficiency of customs services, etc.

In modern conditions, the relevance of developing appropriate models that would allow us to separate exogenous factors from endogenous ones is increasing. Such models would allow regional authorities not only to state the ongoing changes, but also to actively influence the barriers to cross-border cooperation, reducing bureaucratic and technological obstacles in the way of goods and people.

The purpose of the study is to develop a new methodological approach to assessing and forecasting the development of export-import operations in border regions, based on the identification of cross-border cooperation mechanisms and relevant barriers.

## Materials and methods

Barriers and features of cross-border trade interactions have been deeply considered by researchers N. Hansen (Hansen, 1977); P. Krugman (Krugman, 1993, 1996, etc.); Oscar J. Martinez (Martinez Oscar 1994b, etc.). R. Guo (Guo, 1996); P.L. Elizondo (Elizondo, Krugman, 1996); Fujita M., A.J. Venables (Fujita, Krugman, Venables, 1999); J. Anderson & E. Wever (Anderson, Wever, 2003); R. Kanbur & Xiaobo Zhang (Kanbur, Zhang, 2005); L.N. Davydenko & A.I. Litvinyuk; Marius Brühlhart et al. (Brühlhart, 2019).

The mechanisms for the development of border regions and the interaction of economic agents in different years were considered J. Bröcker (Bröcker, 1984); G.H. Hanson (Hanson, 1994, 1998); C. Engel & Rogers J.-H. (Engel, Rogers, 1996);

Blatter Joachim (Blatter Joachim, 1997); Ganster Paul (Ganster, 2001); Z.I. Shalashaa & A.N. Bagba (Shalashaa, Bagba, 2013); Kenneth A. Schultz (Schultz Kenneth, 2015); Hirte Georg et al. (Hirte, 2018).

Various approaches to modeling the development of cross-border operations in border regions in different fields of science have been used by researchers Dokoupil, J. & Havlíček, T. (Dokoupil, Havlíček, 2002); T. Fullerton (Fullerton, 2003); A.V. Medvedev & P.N. Pobedash; Konoplev V.A., A.V. Medvedev (Konoplev, Medvedev, 2010); Saleh Shahriar et al. (Saleh Shahriar, 2019); Gil-Pareja et al. (Gil-Pareja, 2019); A.N. Tarasevich. An original method for weighing the criteria for selecting alternatives was proposed by Saaty T.L. (Saaty, 1980 et al.)

## Methods

An original approach to modeling the interaction of participants in innovative projects implementing innovative projects: an entrepreneur, investor and owner of an intellectual product who owns innovative know-how was proposed by V.A. Konoplev, A.V. Medvedev. They examined in detail the structure of “inputs-outputs”, taking into account the discounting of financial flows. However, the authors structured fixed and variable costs not quite reasonably. Current costs are calculated as a percentage of the average cost of selling products. The remaining costs (for example, the purchase of raw materials, equipment, rent of premises, etc.) are considered given, fixed values for the entrepreneur.

L. Davydenko & A. Litvinyuk (Davydenko, Litvinyuk, 2021) studied in detail and generalized the practice of European cross-border cooperation, based on two models used by regional and local authorities in the process of formalizing interaction. The first model is self-governing, when the creation of cross-border cooperation structures becomes the effect of local initiatives of self-government bodies. At the first stage, a border union of territorial units is created, then the parties enter into an agreement, and the corresponding regulatory and legal support is formed. The second model — administrative and self-governing — is characterized by active participation in the process of registration of cross-border cooperation of regional and / or central authorities, self-government bodies with the creation of a cross-border interregional union that has its own charter.

Z.I. Shalashaa, A.N. Bagba (Shalashaa, Bagba, 2013) solved the problem of identifying “...mechanisms of economic interaction between business entities operating within the framework of the regional economic system” and “development of effective mechanisms for cross-border regulation of the regional economy.” The authors examined in detail the direct and indirect methods of influence of state institutions on the activities of economic agents.

The range of tools and methods developed by the listed authors is very wide and potentially effective. However, these models poorly reflect the determinants of development that depend on the “height” of administrative and other barriers of the two bordering regions. The author of this article is trying to develop his own original approach that closes this gap.

### Three levels of cross-border cooperation mechanisms

In some economic systems that have a simplified structure and relationships, special mechanisms — for example, legal ones — may be redundant. But complex modern economic systems with multi-layer “inputs”, “outputs”, parameters of the external and internal environment, especially with the participation of the state, require a number of mechanisms that ensure the functioning of the relevant institutions, and the system itself. Mechanisms are formed, function and cease to exist on an institutional basis Table 1.

Table 1

#### Compliance of the mechanisms of cross-border economic relations with two types of institutions

Types of institutions	Types of mechanisms
Institutions-norms, "rules of the game"	Mechanisms: implementation, provision, control, adjustment
Structural Institutes	Mechanisms: functioning, development, termination

Sources: developed by the authors.

Mechanisms can have both a positive and a negative impact on the functioning of an institution.

The mechanism of cross-border cooperation, according to the author, is an integral set of institutions (including structures, norms, restrictions) and incentives that provide one or another degree of realization of the economic and social interests of actors and stakeholders of different levels: from the state, regional governments, municipalities, to individuals living in border regions. The effectiveness of the functioning of this mechanism depends on the degree of unity and consistency of the dynamics of its elements, changes in the operating environment, and is manifested in the volumes and rates of economic growth of export-import operations at the level of the country's regions.

The above definition is not only theoretical, but also applied in nature, as it allows you to determine the directions for the development of cross-border cooperation between actors of commodity exchange. Among them: creation and updating of organizational structures; development of a system of economic incentives; reduction of administrative, logistical, customs and other barriers; improvement of legislation, by-laws, norms and standards; monitoring the interests of key stakeholders of interaction; ensuring the unity and consistency of the elements of the mechanism, etc.

To model and solve practical problems, it is necessary to clarify the grouping of mechanisms at different levels — from particular to the most generalized.

At the top level of generalization, we distinguish groups of mechanisms:

- organizational and legal;
- financial and economic;
- technical and technological;
- others.

Of particular importance in the trade relations of the border regions are legal mechanisms, such as mechanisms for the adoption and implementation of laws at various levels.

The group of organizational and legal mechanisms includes a subgroup legal mechanisms, including mechanisms of a private nature, for example, the mechanism of legislative initiative.

The group of financial and economic mechanisms includes a tax subgroup of tax mechanisms, including the VAT (value added tax) refund mechanism.

The group of technical and technological mechanisms includes a subgroup of digital mechanisms, including mechanisms of a private nature — for example, the operation of a customs “single window” at border checkpoints. Another example is the mechanisms of “paperless cross-border trade”, which are currently being actively formed at the bilateral level, for example, the integrated “pull” and “push” subsystems in digital document management.

The author’s position is that the organizational and legal mechanisms of cross-border relations between regions are primary, and all other mechanisms, including financial and economic ones, are secondary. This contradicts the system of interests of interaction actors — for most of them, economic interests are primary, and all the rest are secondary. When studying practical problems, we proceed from the fact that the dynamics of economic interests (and their contradictions) should be the reason for an adequate change in legislation, adjustment of laws and by-laws. This is relevant, for example, in relation to modern forms of payment for supplies, including the use of “digital” currencies.

An important area of work for managers in this area is the unification and standardization of approaches to assessing the barriers and risks of cross-border contracts. There is a need for unified approaches and tools for minimizing risks in different regions, including — at the legislative level — the risks of non-fulfillment of the contract, etc.

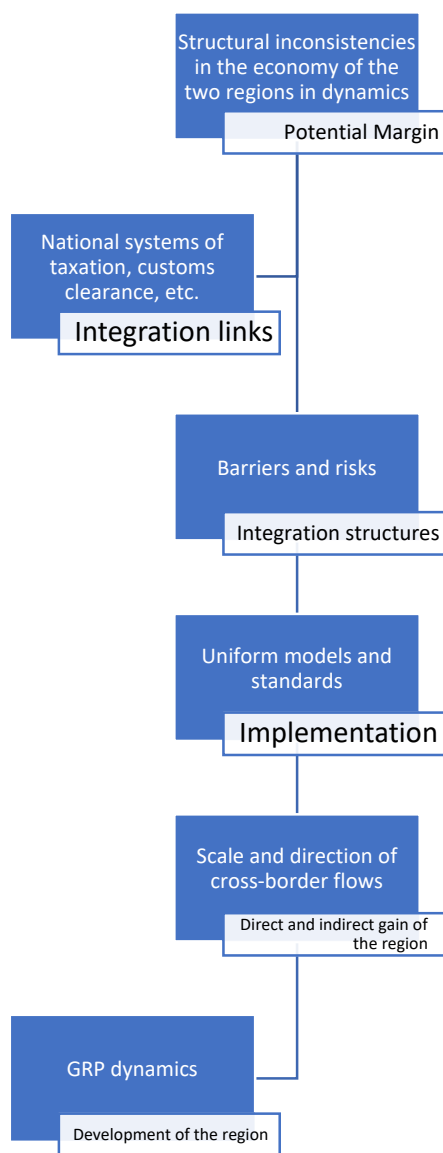
The mechanisms for unifying models, frameworks, regulations, standards for the formation and transmission of information, including the mechanism for converting the “inputs” and “outputs” of various databases — border, customs, tax, have particular importance in the modern world.

### **Methodological approach to modeling the development of trade relations in border regions**

The authorities of any region are aimed at quantitative and qualitative economic growth, an increase in the gross regional product (GRP), an increase in the number of enterprises in various industries, the improvement and development of infrastructure, social facilities, etc.

Border regions in this context have a competitive advantage — proximity to the state border. The border creates opportunities for people to travel to a neighboring country, including to work, or to purchase goods. One of the premises of cross-border commodity exchange is the differentiation of prices and assortment on both sides of the border (Figure 1).





**Figure 1.** Development of border regions in the structure of the model of cross-border flows

Source: developed by the authors.

The border is at the same time a barrier to the way of people and goods. Customs and border regulations, bureaucratic procedures increase the transaction costs of actors and increase the risks of commodity exchange.

The integration processes of the neighboring regions of the two countries, including the unification of databases, standards, software, can reduce the level of barriers, and, accordingly, reduce the explicit and implicit costs of the participants.

The economic opportunities of the actors and the above conditions together predetermine the scale and direction of cross-border flows of people and goods. They, in turn, determine the dynamics of many indicators of the development of the region, including the amount of value added and the regional product.

An effective tool for assessing and forecasting economic processes is modeling. Mathematical models make it possible to identify a general trend in the change of certain statistical indicators, evaluate the influence of numerous factors on the result, and determine the closeness of the relationship between various indicators. At the same time, correlation-regression and dispersion analysis are important tools for searching for stable relationships and dependencies in historically established data series.

The “gravitational model of trade” has become widespread.

In *Shaping the World Economy* (1962), Jan Tinbergen first proposed a mathematical model of gravity. This model later received many variations and interpretations.

The basic version of the gravity equation relates bilateral trade flows positively to the economic size of countries and negatively to the distance between them. Other factors that influence trade barriers can be included in the model, such as a common border, a common language, or participation in the same regional trade agreement.

Commodity flows show a directly proportional dependence on the significance parameters (the number of actors, GDP volumes, etc.) and an inverse dependence on the distance between the actors. We are in solidarity with the authors who introduce customs and other barriers into this model as an independent factor. In the institutional context, researchers have included mainly economic factors such as tariffs and non-tariff barriers in applications of the gravity model, but the model also allows the inclusion of “non-economic” factors such as cultural differences, differences in religion, linguistic (dis) similarity, the presence or absence of former colonial ties, differences in technological development, etc. This idea is successful from an empirical point of view and is able to show that many economic phenomena can be empirically described by the “gravity” equation.

Saleh Shahriar, Lu Qian, Sokvibol Kea, Nazir Muhammad Abdullahi (2019) proposed their own periodization of the genesis of this model:

1885–1962: The Historical Roots of The Gravity Equation

1962–1966: The Beginning of the Traditional Gravity Model

1966–2003: The Theoretical Foundations of the Gravity Model

2003–2017: The Revival of the Gravity Model.

“The gravity model describes one of the most stable relationships in the economy: the interaction between large economic clusters is stronger than between small ones, and nearby clusters attract each other more than distant ones. Economic factors, such as tariffs and non-tariff barriers, were included in the applications of the gravity model, but ‘non-economic’ factors were also included, such as cultural differences, differences in religion, linguistic (dis) similarity, the presence or absence of former colonial ties, institutional differences, differences in technological development, etc. The list of applications is long, and most notably, empirical tests show that this simple idea is very successful from an empirical point of view and is able to show that many economic phenomena in different places can be empirically described by the equation of gravity”.



In our opinion, the “gravitational” model has great potential, but it is not quite adequate for border regions — such regions are adjacent by default, therefore, the distance factor requires a different interpretation.

Trade relations of the border regions are natural, they are determined by the proximity of the two countries, the economic interests of people and companies. They have a strong substantive basis, numerous actors, stakeholders interested in their development. At the same time, these relations are subject to the influence of many factors of an exogenous nature related to the policies of states and supranational entities.

From the point of view of management, the economic process is the result of the action of many factors, including external variables, on which the decision maker has no leverage. To build an adequate model of trade relations of border regions, it is necessary to distinguish between external, independent (exogenous) variables and controlled (endogenous) variables.

In this context, it is advisable to use a “genetic” and “teleological” (target) approach to the development of an economic phenomenon. The genetic approach is focused on the search for a general trend, significant relationships and patterns in the existing time series. To a much lesser extent, it is focused on assessing the results of managerial influences. The teleological approach, on the contrary, is less focused on the development trend of the economic process, but allows predicting its change as a result of certain targeted transformations, including those of an institutional nature.

The author of this work proposes a new approach. On the one hand, it is necessary to assess the impact of barriers from each of the two regions on the way of commodity flows. On the other hand, it is necessary to assess the general trend in the development of import-export operations from the standpoint of the impact on the dynamics of the gross regional product. To solve these interrelated problems, one model is not enough. It is advisable to create two complementary models: descriptive and normative.

We are convinced that absolute indicators do not allow to fully reveal the existing dependences of the effective and factor signs, due to the discrepancy between their scale, autocorrelation, and other reasons. Therefore, we propose to use a model based on relative indicators.

View of the first model (descriptive):

$$Y_x = a_0 + a_1x_1 + a_2x_2 + a_3x_3 + a_4x_4 + a_5x_5 + a_6x_6 + a_7x_7 + a_8x_8 + a_9x_9 + a_{10}x_{10} + a_{11}x_{11} + a_{12}x_{12}, \quad (1)$$

where  $Y_x$  — the share of cross-border trade into the gross regional product;  $x_1$  — the volume of the gross regional product per capita in the region;  $x_2$  — population density of the region (persons per 1 sq. km);  $x_3$  — density of railways, index;  $x_4$  — the density of paved roads in the region, index;  $x_5$  — the share of the value added of industry in the total value added of the region;  $x_6$  — the share of the value added of wholesale and re-

tail trade enterprises in the total value added of the region;  $x_7$  — the share of the financial industry in the total value added of the region;  $x_8$  — electricity consumption index;  $x_9$  — the amount of foreign investment per capita of the region's inhabitants;  $x_{10}$  — disposable income per capita of the region;  $x_{11}$  — the share of expenditures on science and technology in the regional budget expenditures;  $x_{12}$  — the share of cross-border microtrade in the total volume of trade (according to customs statistics).

Linear regression dependence is the simplest and most understandable form of the model for use by managers who do not have special training. The additive nature of the proposed model allows, if necessary, to eliminate, exclude, or, on the contrary, increase factor characteristics. Such changes may be forced — the statistical reports of the regions often change, which makes one or another factor indicator available or inaccessible.

On the other hand, in the course of the practical use of the proposed model, there may be a need to increase the number of factor features. The author proposes as a criterion the indicator of the share of residual variance. If an empirical test shows that the twelve listed factors largely explain the variation in the resulting attribute, the model is adequate to the ongoing economic processes. If the residual variance is high, then factor features should be added to the model that can increase its adequacy.

We chose the specific weight (share) of cross-border trade in the total volume of the gross regional product as an effective indicator, which is an indicator that well characterizes the orientation of the region towards the implementation of cross-border trade. The absolute volume of cross-border trade largely depends on the scale of a particular border region. The territory and, especially, the number of inhabitants, the number of enterprises, have a significant impact on the size of commodity, migration, and investment flows. Therefore, a comparison of two or more border regions in terms of the absolute size of cross-border turnover will not be correct: large-scale regions will always have an advantage. The relative indicator has a different orientation — it allows assessing the development of cross-border trade in relation to other volumetric indicators.

This approach allows us to draw conclusions, among other things, about the performance of the business, the executive power of the region, other actors and stakeholders. The proposed descriptive model makes it possible to identify, accentuate, explain the advance or lag in the growth rates of the region's import-export operations in comparison with the growth rates of the gross regional product.

At the same time, one should take into account the problem of accounting for “transit” commodity flows for the region. To characterize the role of a particular border region, it would be correct to consider in the model not the entire cross-border turnover, but only those import or export operations that are formed by regional actors. Unfortunately, regular customs statistics of most countries of the world do not allow us to identify the share and amount of exports and imports in transit for the region. In this regard, the proposed model considers the entire cross-border turnover: the sum of exports and imports in the territory of the border region for a year or a quarter.

Customs statistics of the PRC in its current (2022) form makes it possible to calculate the share of cross-border microtrade in the total volume of trade. This is the only indicator of the descriptive model that directly reflects the export-import operations of individuals.

The remaining factor features of the model under consideration represent the following enlarged groups:

- a) share indicators of added value of individual industries;
- b) direct investments, foreign, per capita;
- c) other factors.

In the descriptive model, there are no estimated (expert) indicators that would reflect the level of administrative, logistical, and other barriers in trade and economic relations of the border regions. This was done deliberately: the descriptive model must operate with objective parameters, allowing one to state the presence or absence of statistically significant dependencies, and to obtain their quantitative assessment. However, this causes a certain limitation of the descriptive model.

To overcome this shortcoming, in combination with the first model, it is necessary to apply another model — the normative (prescriptive) one.

The author proposes a model of the form:

$$\Delta Y_{CD} = \Delta C^\alpha \Delta D^{(1-\alpha)}, \quad (2)$$

where  $Y$  — the increase in the volume of cross-border turnover;  $C$  — an aggregated indicator of barriers to cross-border turnover in the border region of country  $C$ ;  $D$  — an aggregated indicator of barriers to cross-border turnover in the border region of country  $D$ .

The normative model makes it possible to identify and quantify the “desired”, target trajectory of the development of the economic process. If the first model is aimed at application in statics, then the second one is focused on the dynamics of the process of cross-border exchange. Therefore, the author proposes to use the annual increase in the volume of cross-border turnover as an effective feature.

At the same time, the increase in the cross-border turnover of goods can be both positive and negative (decrease in the absolute size of the turnover), as well as the increase in each of the factor characteristics.

In order to develop the cross-border circulation of goods and people, the authorities of the country, the region can take a variety of measures aimed at: creating favorable conditions for cross-border exchange, and reducing barriers and restrictions that impede its development.

In the proposed model, the author singles out the same estimated indicator as two factor characteristics — an aggregated indicator of barriers to cross-border turnover. The idea is that the “height of the barriers” should be measured separately — on each side of the common border of the two border regions.

In order to identify the impact of positive and negative changes on both sides of the border within the framework of the proposed prescriptive model, a dynamic series of assessments is needed, over the course of a year, a triennium or a five-

year period, for example. An important condition is that the wording of each question of the questionnaire must remain unchanged. It is advisable to organize appropriate monitoring, which forms the basis for statistical calculations, with a predetermined frequency.

The result of the calculations will be the numerical parameters of the model: the value of the alpha coefficient and the beta coefficient (one minus alpha). These two values characterize the contribution of each province (region) to the increase in cross-border turnover

It is advisable to use the model for forecasting purposes, substituting the forecast values  $C$  and  $D$ .

This will allow the regions to develop a “road map” of changes aimed at overcoming the “bottlenecks” identified at the analysis stage at border crossings on both sides of the border.

In recent years, geopolitical factors at the macro level have had an increasingly noticeable impact on international economic relations. The influence of factors of an exogenous nature that do not depend on the actions of regional players, including executive authorities, should be estimated indirectly, as the difference between the actual increase in cross-border trade and the increase due to a change in two identified determinants:

$$\Delta Y_t = \Delta Y_{cd} + \Delta Y_{ex} \quad (3)$$

accordingly:

$$\Delta Y_{ex} = \Delta Y_t - \Delta Y_{cd}, \quad (4)$$

where  $\Delta Y_t$  — increase in cross-border turnover, total;  $\Delta Y_{cd}$  — increase in cross-border turnover, calculated according to the model;  $\Delta Y_{ex}$  — “residual” increase in the cross-border turnover of the region (equates to the influence of all other factors, except for the determinants of  $CD$ ).

If the necessary historical data in dynamics is not accumulated, this model can be used in statics, for the same observation period. This will make it possible to compare the level of barriers at checkpoints in two bordering regions using the same set of indicators.

Both selected factors are discrete. The form of the proposed model — to the power of  $\alpha$  and  $(1-\alpha)$  — allows us to explain the dispersion of the resulting feature ( $\Delta Y_{pb}$ ): firstly, by the influence of a change in factor  $C$ ; secondly, the influence of the change in factor  $D$ ; thirdly, the combined influence of factors  $C$  and  $D$ .

The complex application of the two proposed models makes it possible to distinguish between the influence of factors of an exogenous and endogenous nature — in relation to the selected two border regions.

At the next stage of the study, we plan to develop a scale corresponding to this model, which allows experts to evaluate individual parameters of customs clearance, document flow, organization of transport from both sides of the border checkpoint. To substantiate the “weight” of each of the parameters, we plan to apply the method of analytical hierarchy T. Saaty (1980).

## Conclusion

This study is a novel attempt to create two complementary models for the development of trade in border regions.

The hierarchy of mechanisms of cross-border interaction of border regions was revealed; the institutional basis of such mechanisms is defined.

The author has developed two complementary models.

1. A descriptive model that allows you to identify and extrapolate the development trend of the border region in terms of the share of foreign trade turnover in the gross regional product, and twelve factor signs, the calculation of which is based on the indicators of regular statistical reporting of the PRC provinces.

2. A prescriptive model for the development of trade and economic relations in border regions, which makes it possible to assess the dependence of the growth rate of the region's foreign trade turnover on the "height" of endogenous barriers on both sides of the border.

The first model is based on the genetic approach, the second one allows implementing a teleological approach to the development of trade and economic relations.

The proposed methodological approach makes it possible to calculate aggregate indicators of cross-border exchange for each of the bordering regions. Comparative analysis of private and aggregate indicators allows you to compare the level of barriers in statics, as of a specific date. The variation of these indicators in dynamics makes it possible to carry out predictive calculations and justify tasks for the executive authorities of the regions to overcome the identified "bottlenecks" of border crossings, developing "road maps" to eliminate problems.

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