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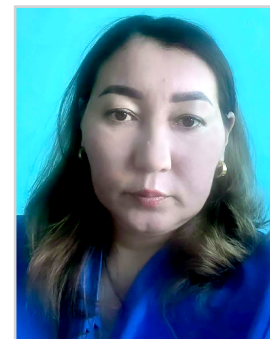ORCID ID: https://orcid.org/0000-0002-0609-6256

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Interregional interaction in the industrial sector of the economy: assessment methods and intensification factors

Abstract. This article presents the results of a study of interregional interaction in the industrial sector of the economy of the Republic of Kazakhstan. The authors propose a methodical approach to assessing the interaction of regions through the cargo traffics of industrial goods. The most important parameters reflecting the intensity of interregional interaction are determined, and an index is proposed, on the basis of which it is possible to control both the level of interregional interaction in general and each parameter separately. The substantiation of the factors influencing the level and intensity of interregional economic interaction is given.

Based on a comparative analysis of the structures of regional economic systems and cargo traffics of industrial goods in Kazakhstan, it was revealed that the highest intensity of interaction is observed between regions with a similar economic structure. At the same time, such indicators as the value of the gross regional product and the level of economic diversification do not significantly affect either the volume of interaction or the number of connections.

Keywords: Interregional Interaction; Logistics; Integration; Region; Industry; Cargo Turnover; Intensification; Cluster; Traded Sector

JEL Classification: R11; R12

Contribution: The authors contributed equally to this work.

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1. Introduction

Interregional economic interaction is a set of economic relations between regions that arise in the process of social production, solving common problems, accumulation and circulation of intellectual capital. Such interaction makes it possible to intensify the use of the country's internal resources and achieve a synergistic effect in the development of the national economic system, and is also one of the most important conditions for ensuring the integrity and competitiveness of the country's economy.

In recent years, the relevance of research on interregional interaction has increased due to the implementation of the concept of «smart specialization» of regions, developed by the expert group «Knowledge for Growth» of the Directorate-General for Research and Innovation of the European Commission. The idea is to eliminate duplication of competencies in the regions of fragmentation of innovation support funds in the EU (Foray & van Ark, 2007; Foray, David, & Hall 2009; Balland et al., 2019; D'Adda et al., 2019; Radosevic et al., 2018; Santoalha, 2019). The smart specialization strategy sets priorities for regional competitiveness based on the match between scientific and technological potential and business needs. This means that each region, by concentrating efforts on a limited set of areas that arise at the intersection of economic activities and scientific and technological areas, can find its own unique development path and achieve leadership without copying the development priorities of other territories (European Parliament, 2013). However, the implementation of such a strategy is possible only with a high level of interregional economic interaction, since it is necessary to ensure the receipt of benefits, in the production of which the region does not specialize, with minimal transaction costs.

Interregional economic interaction can be carried out through trade relations, the formation of horizontal and vertical ties between business entities, cooperation between government agencies, and market integration. At the same time, the exchange of finished products between the regions of the country is one of the weakest and most unstable types of interaction. More important types of interaction that ensure the development of the economy is the formation of horizontally and vertically integrated structures (Vicente, 2018).

It is logical to assume that economically developed regions have a fairly large number of strong external relations, since they can offer a significant range and volume of products and services for delivery, consume a large number of resources, and also have significant intellectual capital. However, the studies conducted in this area have not exhaustively answered the question: «What factors have a key impact on the scale and nature of interregional economic interaction?» (Balland & Boschma, 2021), «Is there a relationship between the strength of interregional ties and the level of economic diversification?» (Boschma, 2017; Whittle et al., 2020). Therefore, within the framework of this study, it is necessary to test the following hypothetical assumptions:
1. The number of interregional connections depends on the level of diversification of the region's economy - regions with a more diversified economy interact with a large number of territories.
2. The scale of interregional economic interaction is directly dependent on the size of the region's economy (GRP level).

2. Purpose

The purpose of this study is to assess the level of interregional economic interaction in the industrial sector of the Republic of Kazakhstan and to identify the factors of its intensification.

3. Brief Literature Review and Methodology

Interregional economic interaction (within one country) as a separate direction of the spatial economy is being developed to a greater extent by scientists from the post-Soviet space due to the peculiarities of the territorial organization of these countries, characterized by a high level of spatial and structural heterogeneity, remoteness of territories and a low level of integration (Granberg et al., 2007; Suslov et al., 2018; Suspitsyna, 2010). Scientists from Western countries are more focused on studying the interaction of countries and groups of countries - regions, or issues of cooperation of administrative-territorial units of one country in the framework of solving individual problems, for example, innovation and technological cooperation (Barzotto et al., 2019; Varga et al., 2020; Ascani et al., 2020; Hesse & Fornahl, 2020), knowledge sharing between regions (Hesse & Fornahl, 2020), development of new areas of activity (Balland et al., 2019; Hidalgo et al., 2018). At the same time, the interaction of non-integrated regions has certain similarities with relations between countries, especially those that are members of a certain coalition.

Therefore, the scientific methods used in studies of countries' integration processes can be partly applied in the study of interregional economic interaction.

In economic science, one can find several different approaches to assessing interregional economic interaction. One of the most common approaches is based on quantitative indicators of trade relations between regions and is characterized by the relative simplicity of calculations and the availability of data (Rukina, 2003; Latypov, 2009; Thissen et al., 2019; Shirov, 2020).

The second approach involves the use of price methods to assess interregional integration, since prices tend to equalize in integrated markets (Findlay, 2001; Kim, 2008; Gil-Pareja & Sosvilla-Rivero, 2005). Hence, according to Paul Krugman and Maurice Obstfeld, «with free trade and the absence of transport costs or other trade barriers, the same goods should be sold in different countries for the same price» (Glushchenko, 2004).

In accordance with the third approach, the assessment of interregional economic interaction can be made according to the characteristics of demand, reflecting the behavior of consumers (Friedman, 2007; Bilas, 2007; Christelis et al., 2008; L. Borisova & D. Borisova, 2021).

Unlike the three previous methods that characterize the integration of markets, the fourth method, which consists in «forming the effects of external shocks to GDP», characterizes the integration of economies from the standpoint of mutual penetration and mutual influence. The more integrated the economies of the regions, the more clearly can be seen the «transfer of shocks» as an element of the wave dynamics of non-linearly developing regional systems (Makhotaeva et al., 2018; Forbes & Rigobon, 2002; Altansukh et al., 2017; Moallemi & Melser, 2019).

As the fifth method, it is necessary to highlight the gravitational regression. This is a gravitational model, according to which the force of interaction (the flow of goods or factors of production) is directly proportional to the mass product (GRP) and inversely proportional to the square of the distance between them (Dubrovskaya & Kozonogova, 2019; Hjaltadóttir et al., 2020; Nijkamp et al., 2021). This approach serves not so much to measure the level of interaction as to explain the process of «thickening economic interconnections» (Glushchenko, 2012).

Despite the fact that a fairly large number of studies have been conducted on this topic, a generally recognized and easy-to-use methodology for assessing interregional economic interaction has not been developed (Iacobucci & Guzzini, 2016).

To achieve the goal of this study, the use of the method of direct assessment of interaction is required, since the results of the assessment using indirect indicators demonstrate to a greater extent the effects of interregional interaction, but do not allow us to identify the characteristics of the links. In this regard, to assess interregional economic interaction, it was decided to use indicators of the cargo turnover of industrial goods between the territories. In contrast to the statistics of trade between regions, the indicator of the volume of shipped industrial products demonstrates the movement of exactly goods produced in the regions, transit cargo traffic, as well as resold goods, are not taken into account. In our opinion, the state of cargo turnover well demonstrates not only the level of interregional economic interaction, but also its most important properties, and also allows us to identify the main trends and new opportunities for integration.

According to the proposed approach, each region has four important parameters of interregional interaction:
- a number of regions with which it interacts;
- a number of directions (industries) of interaction;
- the volume of shipment of industrial products to other regions;
- a share of raw materials and materials in the total volume of industrial products imported into the region.

Accordingly, the intensity of interregional interaction increases with the maximization of the above indicators. Therefore, the index of interregional interaction can be presented in the following form:

$$S_i = Q_i + A_i + V_i + R_i,\tag{1}$$

where:
S_i - index of interregional interaction of a particular region;
Q_i - the ratio of the number of industries in which the region has interactions (for supplies from the region) to the total number of traded industries;
A_i - share of raw materials and materials in the total volume of deliveries to the region;

V_i - the ratio of the volume of deliveries from the region to the average republican volume of inter-regional cargo turnover;

R_i - the ratio of the number of interactions of a region to the total number of regions in the country.

The convenience of using this method lies in the availability of information, the absence of complex calculations and the objectivity of the results obtained. The limitation of the method is its focus only on interaction within the industry, while it is impossible to catch the horizontal links formed in the service sector or agriculture, and it is quite possible that post-industrial centers will be among the outsiders in terms of the level of interregional interaction. However, this limitation is associated only with the lack of data, and, in case of gaining access to them, it is quite surmountable.

At the same time, within the framework of this study, the task was to determine the dependence of the number of connections in the region on the level of economic diversification. And since the most significant contribution to interregional relations is made by tradable industries, their number in the regional economy determined the level of diversification. To classify industries based on tradability, we used the methods of Michael Porter (Porter, 2003) and other scientists from the Harvard Business School (Delgado et al., 2014).

4. Results and Discussion

The total volume of cargo turnover of industrial goods between the regions of Kazakhstan in 2021 amounted to 17.3 million USD (Figure 1). Data for calculations were provided by the Information and Computing Center of the Bureau of National Statistics of the Agency for Strategic Planning and Reform of the Republic of Kazakhstan (ICC BNS ASPR RK).

The leading regions in terms of the volume of shipped industrial products were Karaganda, Pavlodar, Kostanay regions, as well as the cities of Astana and Shymkent.

The top 5 product groups with the largest shipment volume included the following:
1) basic metals (28.6%);
2) coke and petroleum products (19.8%);
3) crude oil and natural gas (16.7%);
4) metal ores (8.5%);
5) food products (6.1%).

The most intensively interacting regions in terms of cargo traffic are the city of Almaty and the city of Astana, East Kazakhstan and Karaganda regions, the city of Almaty and East Kazakhstan region, the city of Almaty and Almaty region, Mangistau and Atyrau regions (Table 1).
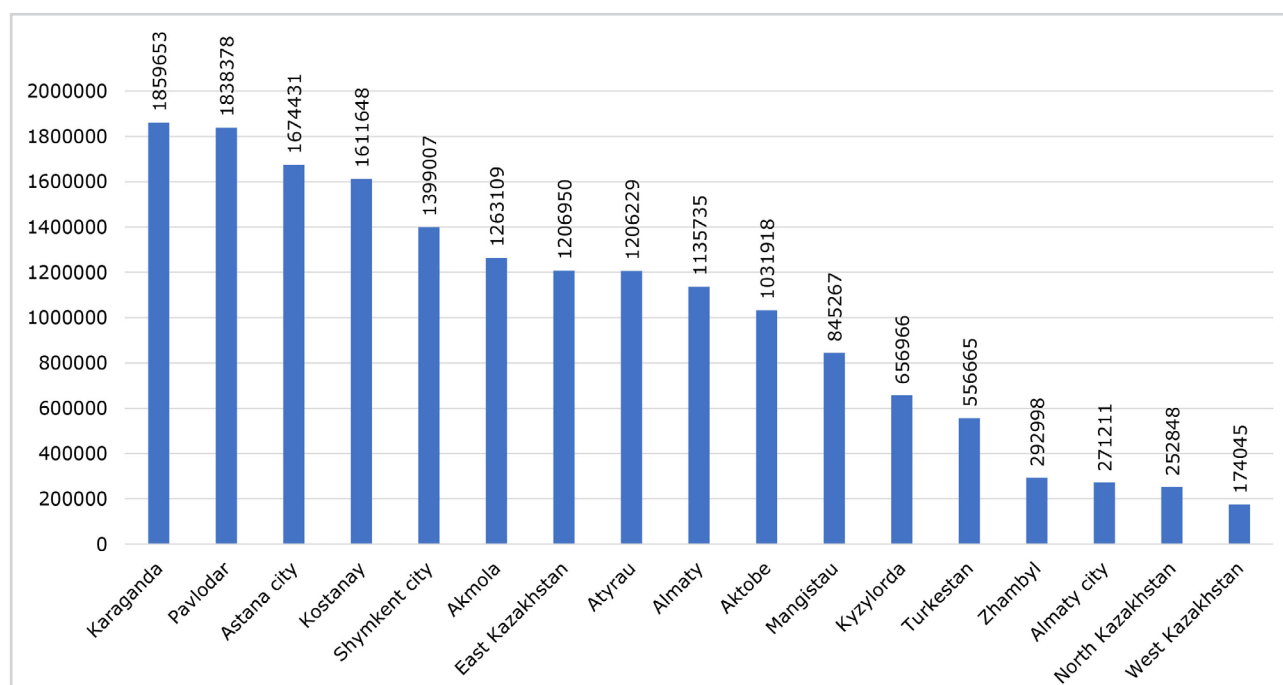

Figure 1:
The volume of shipped industrial products by regions in 2021, thousands USD
Source: ICC BNS ASPR RK

Three of the five pairs of regions listed above have similar economic structures, interaction between them occurs within the framework of specialization industries. Two pairs of regions interact in the framework of the supply of products in the field of subsoil use. Such connections arise in the process of formation of network structures and are the most effective.

Table 2 shows the results of calculations of the index of interregional interaction for the regions of Kazakhstan. According to calculations, the regions with the highest level of interregional interaction were Pavlodar, Karaganda, East Kazakhstan regions, as well as the cities of Astana and Shymkent

Outsiders in terms of interregional economic interaction included West Kazakhstan, North Kazakhstan, Kyzylorda, Mangistau and Zhambyl regions. It is noteworthy that the city of Almaty is also among the outsiders in this index, despite the fact that it has connections with almost all regions of the country. Being the core of the agglomeration and the largest city in Kazakhstan, Almaty attracts a large amount of resources, and its resources are mainly used to meet domestic needs. Given the fact that the city also forms the economic system of the territories located in close proximity, it would be logical to consider Almaty and the Almaty region as a single entity, and in this case the agglomeration would be among the top five in terms of interregional economic interaction.

However, the objective of the index is not only to demonstrate the overall level of interregional interaction, but also to identify the strengths and weaknesses of the region for each indicator of interaction. For example, the results of calculations show that within the framework of interregional interaction, the West Kazakhstan, Kyzylorda, Mangystau, Aktobe and Kostanay regions buy mostly finished products, and supply raw materials and materials to other regions, in addition, Atyrau, West Kazakhstan and Kyzylorda regions interact with less than a third of all regions of the country and only in a few areas (industries).

Thus, having identified the level of interregional economic interaction for each region by calculating the index, it is possible to assess its dependence on the value of the gross regional product. It is also necessary to check the dependence of the R_i sub-index on the number of traded industries in the region (the level of economic diversification).

In 2021, the difference between the highest and lowest GRP was more than 8 times (Figure 2). The top 5 regions with the highest level of gross regional product included: Almaty city, Atyrau region, Astana city, Karaganda and East Kazakhstan regions.

Table 1:
The most closely interacting regions in terms of cargo traffic for 2016-2021

No.	Regions		Volumes, thousands USD
1	Almaty city	Astana city	4789403
2	East Kazakhstan	Karaganda	3562167
3	Almaty city	East Kazakhstan	3243403
4	Almaty city	Almaty city	2809405
5	Atyrau	Mangistau	2763181

Source: Compiled by the authors on the basis of the official statistical information of the ICC BNS ASPR RK by the order of RATIONAL SOLUTION LLP

Table 2:
The results of the calculation of the index of interregional interaction in the industrial sector of the economy of Kazakhstan

Region	Q_i	A_i	V_i	R_i	S_i
Pavlodar region	0.38	0.92	1.81	0.53	3.64
Karaganda region	0.48	0.56	1.83	0.65	3.52
Astana city	0.17	0.55	1.65	0.82	3.20
Shymkent city	0.31	0.83	1.38	0.59	3.10
East Kazakhstan	0.28	0.63	1.19	0.53	2.62
Alma-Ata's region	0.45	0.15	1.12	0.88	2.60
Akmola region	0.34	0.24	1.24	0.71	2.53
Atyrau region	0.07	0.87	1.19	0.29	2.42
Kostanay region	0.24	0.05	1.59	0.47	2.35
Turkestan region	0.17	0.81	0.55	0.65	2.18
Aktobe region	0.21	0.03	1.02	0.53	1.79
Almaty city	0.10	0.17	0.27	0.94	1.48
Jambyl Region	0.28	0.41	0.29	0.47	1.44
Mangistau region	0.14	0.02	0.83	0.35	1.34
Kyzylorda Region	0.21	0.02	0.65	0.29	1.16
North Kazakhstan	0.24	0.10	0.25	0.41	1.01
West-Kazakhstan region	0.17	0.03	0.17	0.24	0.61

Source: Compiled by the authors

The structure of the economy of Kazakhstan is represented by 46 industries, including 12 industries of local importance (non-tradable), 9 industries of local and national importance (conditionally traded), 25 industries of national importance (traded).

The share of the employed population in the tradable sector of the economy of the Republic of Kazakhstan in 2021 amounted to 19.7%. This is a fairly low figure compared to the United States (58.1%) (Harvard Business School, 2020) and the European Union (46%) (Ketels & Protsiv, 2016). To some extent, this is due to the fact that some of the industries that are tradable in the US and the EU are still non-tradable in Kazakhstan (virtually the entire service sector).

The share of the tradable sector in the gross domestic product was 31.6%, which indicates the greater efficiency of the tradable sector compared to the non-tradable one (Figure 3).
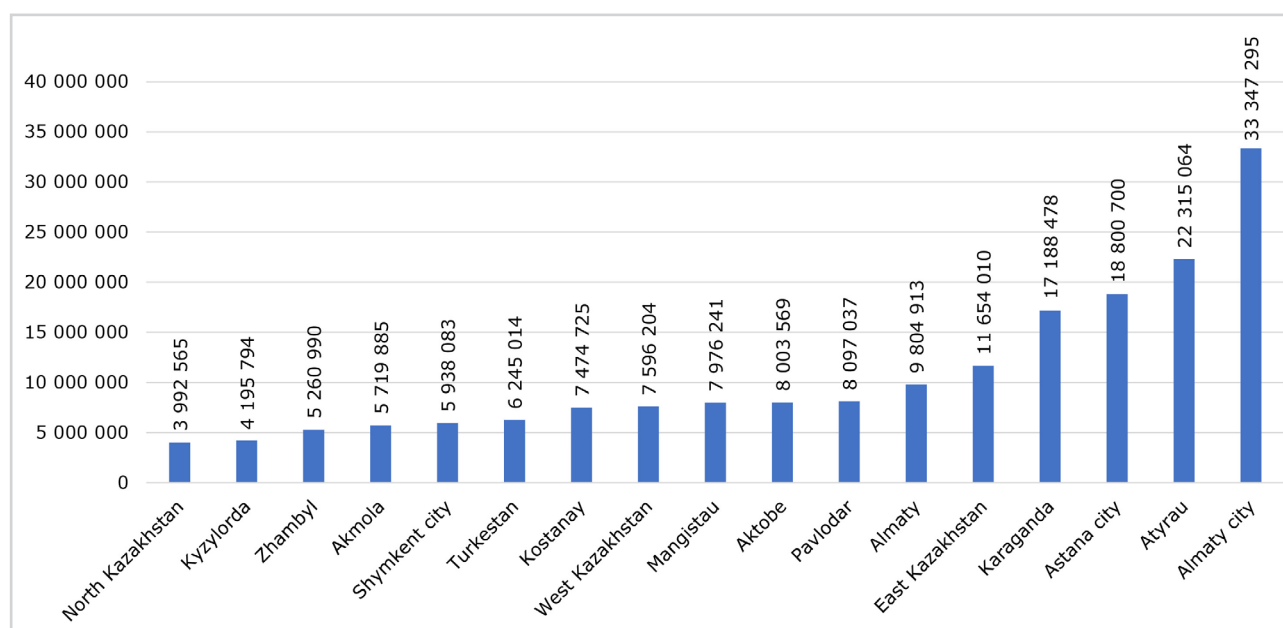
Figure 2:
GRP of the regions of Kazakhstan in 2021, thousands USD
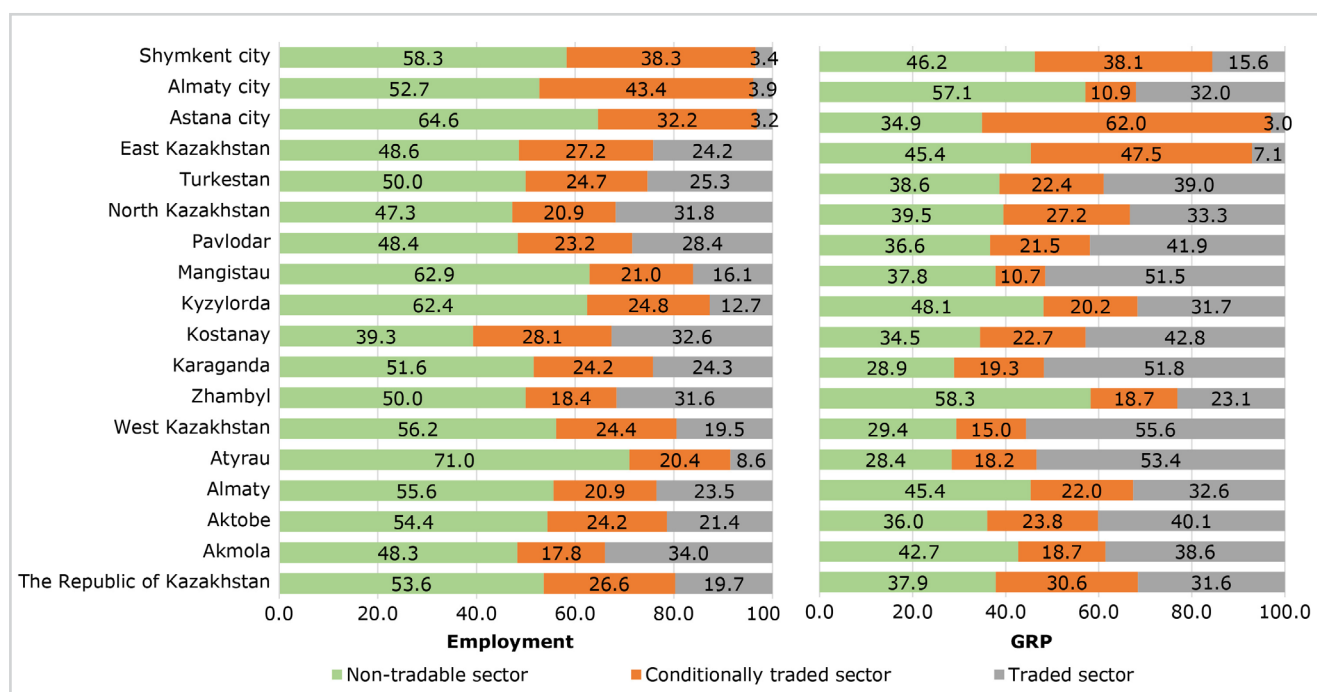Source: ICC BNS ASPR RK

Figure 3:
The share of the tradable sector in the economy of the regions of Kazakhstan
Source: ICC BNS ASPR RK

The regions with the largest share of employment in the traded sector are the following: Kostanay, East Kazakhstan, Akmola, North Kazakhstan, Pavlodar regions. To a greater extent, this is due to the fact that one of the branches of specialization of these regions is agriculture - the main branch of the traded sector of Kazakhstan.

The top 5 branches of the traded sector with the largest number of employed people included the following:
1) Agriculture, forestry and fisheries - 1176.4 thousand people (67.6%)
2) Metallurgical industry - 103.5 thousand people (6.0%)
3) Extraction of metal ores - 101.1 thousand people (5.8%)
4) Crude oil and natural gas production - 83.0 thousand people (4.8%)
5) Coal and lignite mining - 40.4 thousand people (2.3%).

This list demonstrates the sectors of specialization of the economy of Kazakhstan - low-productivity agriculture, mining and metallurgical and fuel and energy sectors.

Among the regions of Kazakhstan with the most diversified economies, one can single out the city of Almaty, Karaganda, Almaty, Aktobe, East Kazakhstan and Pavlodar regions (Figure 4). The regions with the most specialized economy were Shymkent, North Kazakhstan and Atyrau regions.

When comparing the leading regions in terms of GRP (Figure 5), the number of traded industries in the economy and the level of interregional interaction, a false impression may arise that there is a linear relationship between these indicators. However, calculations showed that there is no such dependence: the value of GRP does not affect the index of interregional interaction, and the level of economic diversification does not affect the number of external relations of the region.
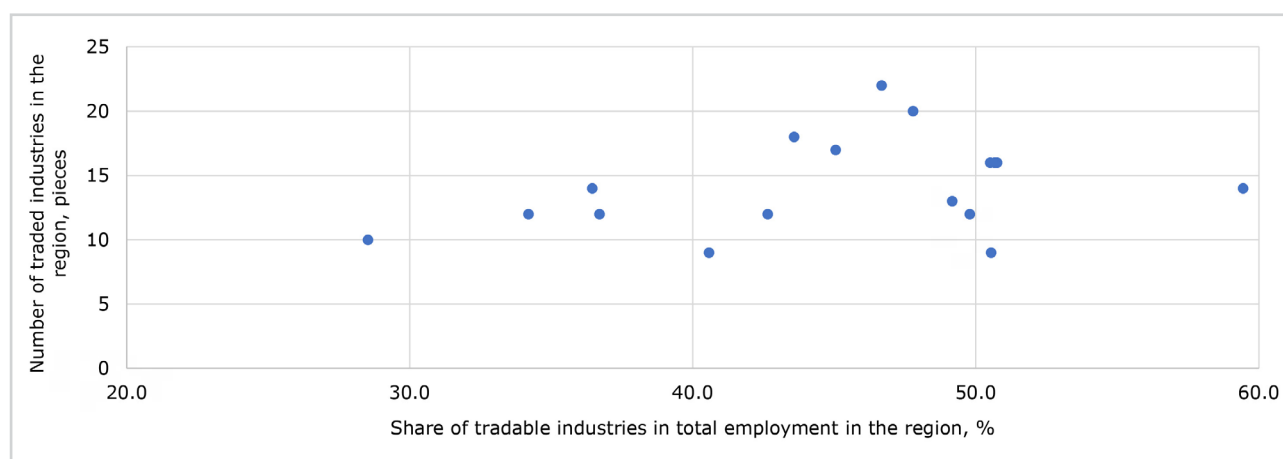

Figure 4:
**The number of traded industries and their share in the total employment
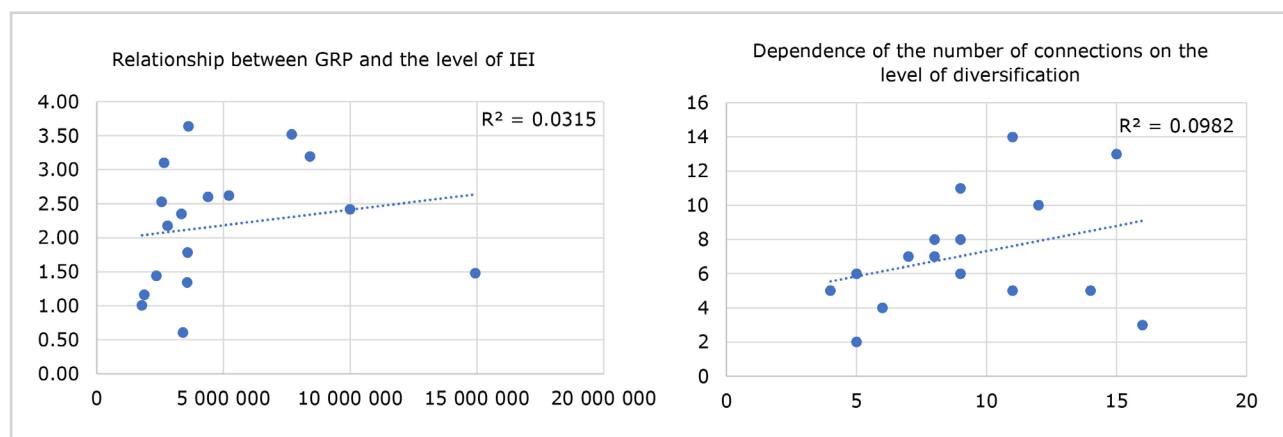of the regions of Kazakhstan in 2021**
Source: ICC BNS ASPR RK

Figure 5:
**The results of assessing the dependence of indicators
of interregional economic interaction on the level of GRP and diversification**
Source: Compiled by the authors

5. Conclusions
The conducted research allowed to obtain the following results:
1) It was revealed that interregional interaction in the industrial sector of the Republic of Kazakhstan is mainly carried out in the mining and metallurgical and fuel and energy sectors.
2) Calculations have shown that there is no dependence between the volume of the gross regional product and interregional economic interaction, as well as the dependence of the number of connections and the level of diversification of the region's economy.
3) It has been determined that a more important factor influencing the intensity of interregional interaction is the similarity of economic structures. At the same time, the regions between which horizontal and vertical network structures are formed have the closest and most effective connection.
4) The substantiated and proposed index of interregional economic interaction allows us to study in detail the characteristics and parameters of relations.

References

1. Altansukh, G., Becker, R., Bratsiotis, G. J., & Osborn, D. (2017). What is the globalization of inflation? Journal of Economic Dynamics & Control, 74, 1-27. https://pure.manchester.ac.uk/ws/portalfiles/portal/46274508/dpcgbcr224.pdf
2. Ascani, A., Bettarelli, L., Resmini, L., & Balland, P.-A. (2020). Global networks, local specialization and regional patterns of innovation. Research Policy, 49(8), 104031. https://doi.org/10.1016/j.respol.2020.104031
3. Balland, P.-A., & Boschma, R. (2021). Complementary interregional linkages and Smart Specialisation: an empirical study on European regions. Regional Studies, 55(6), 1059-1070. https://doi.org/10.1080/00343404.2020.1861240
4. Balland, P.-A., Boschma, R., Crespo, J., & Rigby, D. L. (2019). Smart Specialization policy in the European Union: Relatedness, knowledge complexity and regional diversification. Regional Studies, 53(9), 1252-1268. https://doi.org/10.1080/00343404.2018.1437900
5. Barzotto, M., Corradini, C., Fai, F. M., Labory, S., & Tomlinson, Ph. R. (2019). Enhancing innovative capabilities in lagging regions: An extra-regional collaborative approach to RIS3. Cambridge Journal of Regions, Economy and Society, 12(2), 213-232. https://doi.org/10.1093/cjres/rsz003
6. Bilas, V. (2007). Regional Economic Integrations & Capital Movement - Measuring the Level of Capital Mobility. Journal of Economics and Business, 25(2), 269-290. https://hrcak.srce.hr/file/28420
7. Borisova, L., & Borisova, D. (2021). Assessment of interregional economic integration based on the integral indicator of the level of socio-economic development. E3S Web Conferences, 273, 08102. https://doi.org/10.1051/e3sconf/202127308102
8. Boschma, R. (2017). Relatedness as driver of regional diversification: A research agenda. Regional Studies, 51(3), 351-364. https://doi.org/10.1080/00343404.2016.1254767
9. Christelis, D., Georgarakos, D., & Haliassos, M. (2008). Economic Integration & Mature Portfolios. CSEF Working Paper No. 194. Centre for Studies in Economics and Finance. University of Salerno. https://www.csef.it/WP/wp194.pdf
10. D'Adda, D., Iacobucci, D., & Palloni, R. (2019). Relatedness in the implementation of Smart Specialisation Strategy: A first empirical assessment. Papers in Regional Science, 99(3), 405-425. https://doi.org/10.1111/pirs.12492
11. Delgado, M., Bryden, R., & Zyontz, S. (2014). Categorization of Traded and Local Industries in the U.S. Economy. https://www.clustermapping.us/sites/default/files/files/page/Categorization%20of%20Traded%20and%20Local%20Industries%20in%20the%20US%20Economy.pdf
12. Dubrovskaya, Yu. V., & Kozonogova, E. V. (2019). Evaluation of the interregional cooperation influence on the spatial development of the national economy. The bulletin of the Far Eastern Federal University. Economics and Management, 209(3), 25-39. https://jem.dvfu.ru/index.php/jem/article/view/443/354 (in Russ.)
13. European Parliament. (2013). The Regulation (EU) 1303/2013 of the European Parliament and Council of 178 December 2013. Official Journal of the European Union, 347, 320-469. https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0320:0469:EN:PDF
14. Findlay, R., & O'Rourke, K. H. (2001). Commodity Market Integration, 1500-2000. NBER Working Paper No. W8579. University of Chicago Press. https://www.nber.org/system/files/chapters/c9585/c9585.pdf
15. Foray, D., & van Ark, B. (2007). Smart specialization in a truly integrated research area is the key to attracting more R&D to Europe. Knowledge Economists Policy Brief, 1, 1-4. https://ec.europa.eu/invest-in-research/pdf/download_en/policy_brief1.pdf
16. Foray, D., David, P., & Hall, B. (2009). Smart Specialization - the Concept. Knowledge Economists Policy Brief, 85(9), 1-5. https://ec.europa.eu/invest-in-research/pdf/download_en/kfg_policy_brief_no9.pdf
17. Forbes, K., & Rigobon, R. (2002). No contagion, only interdependence: Measuring stock market co-movements. The Journal of Finance, 57(5), 2223-2260. https://www.jstor.org/stable/3094510
18. Friedman, T. L. (2007). The world is flat 3.0: A brief history of the twenty-first century. N.Y.: Picador. https://www.chinhnghia.com/Friedman_the%20world%20is%20flat.pdf
19. Gil-Pareja, S., & Sosvilla-Rivero, S. (2005). Price Convergence in the European Car Market. FEDEA Working Paper No. 2005-22. https://doi.org/10.2139/ssrn.844144
20. Glushchenko, K. P. (2004). Integration of the Russian market: an empirical analysis. Moscow: EERC (in Russ.).
21. Glushchenko, K. P. (2012). Myths about β-convergence. Journal of the New Economic Association, 16(4), 26-44. http://www.econorus.org/repec/journl/2012-16-26-44r.pdf (in Russ.)
22. Granberg, A. G., Suslov, V. I., & Suspitsyn, S. A. (2007). Multiregional Systems. Economic and mathematical research. Novosibirsk: Sib. scientific publishing house (in Russ.).

23. Harvard Business School. (2020). U.S. Cluster mapping. https://clustermapping.us/cluster
24. Hesse, K., & Fornahl, D. (2020). Essential ingredients for radical innovations? The role of (un-)related variety and external linkages in Germany. Papers in Regional Science, 99(5), 1165-1183. https://doi.org/10.1111/pirs.12527
25. Hidalgo, C. A., Balland, P.-A., Boschma, R., Delgado, M., Feldman, M., Frenken, K., Glaeser, E., He, C., Kogler, D. F., Morrison, A., Neffke, F., Rigby, D., Stern, S., Zheng, S., & Zhu, Sh. (2018). The principle of relatedness. In Morales, A., Gershenson, C., Braha, D., Minai, A., & Bar-Yam, Y. (Eds.), Unifying Themes in Complex Systems (IX) (pp. 451-457). Springer Proceedings in Complexity. Springer, Cham. https://doi.org/10.1007/978-3-319-96661-8_46
26. Hjaltadóttir, R. E., Makkonen, T., & Mitze, T. (2020). Inter-regional innovation cooperation and structural heterogeneity: Does being a rural, or border region, or both, make a difference? Journal of Rural Studies, 74, 257-270. https://doi.org/10.1016/j.jrurstud.2019.10.008
27. Iacobucci, D., & Guzzini, E. (2016). Relatedness and connectivity in technological domains: Missing links in S3 design and implementation. European Planning Studies, 24(8), 1511-1526. https://doi.org/10.1080/09654313.2016.1170108
28. Kim, S., & Lee, J.-W. (2008). Real and Financial Integration in East Asia. ADB Working Paper on Regional Economic Integration, No. 17. Asian Development Bank. https://www.adb.org/sites/default/files/publication/28474/wp17-real-financial-integration-east-asia.pdf
29. Latypov, R. A. (2009). Methodology of regulation of regional trade and economic relations of Russia [Doctoral dissertation, Samara State Economic University] (in Russ.).
30. Makhotaeva, M. Yu., Bakumenko, O. A., & Malyshev, D. P. (2018). Interregional interaction as a tool for developing the region's strategic priorities. [Monograph, Pskov State University] (in Russ.).
31. Moallemi, M., & Melser, D. (2019). Examining the Economic Interactions Between Australia's Regions: Results from a Global VAR. The Economic Record, The Economic Society of Australia, 95(S1), 79-99. https://doi.org/10.1111/1475-4932.12458
32. National Bureau of Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. (2021). Gross regional product of the Republic of Kazakhstan in 2021, highlighting the uncontrolled economy. https://old.stat.gov.kz/api/getFile/?docId=ESTAT464501
33. National Bureau of Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. (2022). The volume of shipped industrial products to other regions for 2017-2022. https://stat.gov.kz/api/iblock/element/5811/file/ru/
34. Nijkamp, P., & Ratajczak, W. (2021). Gravitational Analysis in Regional Science and Spatial Economics: A Vector Gradient Approach to Trade. International Regional Science Review, 44(3-4), 400-431. https://doi.org/10.1177/0160017620980519
35. Porter, M. (2003). The economic performance of regions. Regional studies, 37(6-7), 549-578. https://doi.org/10.1080/0034340032000108688
36. Radosevic, S., Curaj, A., Gheorghiu, R., Andreescu, L., & Wade, I. (2018). Advances in the theory and practice of Smart Specialization. Academic Press.
37. Rukina, I. M. (2003). Interregional economic cooperation and integration processes in the Russian economy [Doctoral dissertation, Institute for Regional Economic Research] (in Russ.).
38. Santoalha, A. (2019). Technological diversification and Smart Specialisation: The role of cooperation. Regional Studies, 53(9), 1269-1283. https://doi.org/10.1080/00343404.2018.1530753
39. Shirov, A. A. (2020). Assessment of Interregional Economic Interactions Using Statistics of Freight Railway Transportation. Studies on Russian Economic Development, 31, 153-161. https://doi.org/10.1134/S1075700720020112
40. Suslov, V. I., Ibragimov, N. M., & Melnikova, L. V. (2018). Coalition analysis and effects of interregional integration. Economics of the region, 14(4), 1131-1144. https://www.researchgate.net/publication/329958625_Coalition_Analysis_and_Effects_of_Regional_Integration (in Russ.)
41. Suspitsyna, S. A. (2010). Optimization of territorial systems. Institute of Economics and Organization of Industrial Production of the Siberian Branch of the Russian Academy of Sciences, Novosibirsk. http://lib.ieie.su/docs/2010/Optimizaciya_territorialnyh_sistem_2010.pdf
42. Thissen, M., Ivanova, O., Mandras, G., & Husby, T. (2019). European NUTS 2 regions: construction of interregional trade-linked Supply and Use tables with consistent transport flows. JRC Working Papers on Territorial Modelling and Analysis No. 01/2019. European Commission. https://joint-research-centre.ec.europa.eu/system/files/2020-05/jrc115439.pdf
43. Varga, A., Sebestyen, T., Szabo, N., & Szerb, L. (2020). Estimating the economic impacts of knowledge network and entrepreneurship development in Smart Specialization policy. Regional Studies, 54(1), 48-59. https://doi.org/10.1080/00343404.2018.1527026
44. Vicente, J. (2018). Economics of clusters: A brief history of cluster theories and policy. Palgrave Pivot.
45. Whittle, A., Lengyel, B., & Kogler, D. F. (2020). Understanding regional branching knowledge diversification via inventor collaboration networks. Papers in Evolutionary Economic Geography No. 20.06. Utrecht University, Department of Human Geography and Spatial Planning. http://econ.geo.uu.nl/peeg/peeg2006.pdf