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Assessment of the Level of Economies' Foreign Trade Diversification

Oleksandr Popov, Sergiy Melnikov, Oleksandr Skachkov, Vasiliy Lyba

ABSTRACT

The aim of the study is to consider the concept of diversification in the context of foreign trade, to clarify the classification of types of foreign trade diversification, ways to assess the level and to conduct a mass assessment of the level of foreign trade diversification of countries. The justification of the undertaken topic is that the national economies of the modern world do not function autonomously, they are interconnected by trade, co-production, financial and migration flows, and following international integration, these relationships are only strengthening. Therefore, the disruption of foreign trade relations of countries can cause more problems, lower the level of their foreign trade diversification. However, despite of these, today the issue of foreign trade diversification is not sufficiently deeply studied, including ways to classify foreign trade diversification and assess its level. The research methodology includes methods for calculating indicators characterizing the level of the countries of the world are used. The results of calculation of indicators of the level of foreign trade diversification according to statistical data on the volume of imports and exports of the world are presented. Choropleth maps of the level of foreign trade diversification of the world are diversification.

KEY WORDS: diversification, foreign trade, commodity diversification, geographical diversification.

JEL Classification: F14, F43, O11.

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1. Introduction

The classic understanding of diversification is reproduced by the proverb "Do not put all your eggs in one basket". The maximum level of diversification corresponds to the situation when each egg is in a separate basket, then the damage from one dropped basket will be minimal. But at the same time, expenses for providing the necessary number of baskets will increase.

As Samuelson (1963) wrote in his work, there is safety in numbers, and an increase in the number of clients will help to reduce risks not only to insurance companies, but also to other economic subjects.

The Canadian economist Goldfarb (2006) tries to transfer the term "diversification", which has already been studied in finances, to other areas of economics. To explain the reasons for the diversification of Canadian exports, he uses modern theory of portfolio choice, according to which the diversification of shares helps to distribute risks amongst countries, currencies and markets. Going from a concentrated portfolio to a diversified one, you can get the same benefits with less risk. The key to reducing risk is that

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more diversified portfolio consists of assets that will behave differently, and when some lose value, others will compensate. Although, such an analogy is not entirely equivalent, the country's export portfolio can be diversified as well as financial.

Diversification is an important concept in many sciences, from environmental, cultural, sociological, to economics. In any science, this is a complex phenomenon including at least two components – the number of varieties in aggregate and the balance of their appearance frequencies (van Dam, 2019).

The national economies of the modern world do not function autonomously, they are interconnected by trade, co-production, financial and migration flows, and considering international integration, these relationships are only strengthening. Therefore, the disruption of foreign trade relations of countries can cause more problems if their foreign trade diversification level is low. However, at present the issue of foreign trade diversification is not sufficiently studied, including ways to classify foreign trade diversification and assess its level.

Export diversification can significantly affect country's productivity and economic growth. First, increasing the diversity of exports - a source of export diversification - can increase productivity, given that exporters are more productive than non-exporters. Second, export diversification can reduce the impact of external shocks, reduce macroeconomic instability, and ensure stable economic growth. Export diversification has been at the center of discussions about how developing countries can improve economic performance and generate more income. Evidence suggests that there are currently almost no developed countries with extremely high levels of export concentration. Of course, this simple observation says nothing about the causal link between per capita income and export diversification. Although, it can be argued that greater diversification has a positive effect on economic growth. Richer countries are also more likely to diversify their production structures. Empirical data in this regard shows the existence of a nonlinear relationship between income diversification and production: while with the growth of per capita income, the concentration of production decreases, but after reaching a certain level of income, production tends to be more concentrated.

The importance of the existing problems of countries that are excessively dependent on the export of a limited range of goods or on the supply of a small number of importers, makes the topic of studying foreign trade diversification particularly relevant. The purpose of the study is to consider the concept of diversification in the context of foreign trade, to clarify the classification of types of foreign trade diversification, ways to assess its level and to conduct a mass assessment of the level of foreign trade diversification of countries.

Many international organizations are constantly monitoring the economic condition of the world, for example, they assess the level of competitiveness of countries (The Heritage Foundation, 2019), their economic freedom (World Economic Forum, 2019) etc. According to the authors, it is advantageous to use as an indicator also an indicator of the level of foreign trade diversification. The data center of the United Nations Conference on Trade and Development [UNC-TAD] (2019) has an index of diversification of foreign trade of national economies, which characterizes how the structure of exports or imports differs from the generalized structure of the world trade. But this indicator considers only commodity diversification.

Considering the concept of "foreign trade diversification", it can be divided into two components: diversification and foreign trade. While the terminology of foreign trade is well known, the concept of diversification relative to foreign trade relations is relatively weakly worked.

According to Hashimzade (2017), diversification is defined as "A spread of the activities of a firm or a country between different types of products or different markets. The truly single-product firm is highly exceptional and practically all firms are diversified to some extent. The advantage of diversified markets is that a firm or a country will be at less risk, as its markets are unlikely all to slump at the same time". In turn, foreign trade is trade of one country with other countries, consisting of paid import and export of goods and services.

If we consider the concept of diversification of exports and imports separately, then, according to the dictionary of economics (Hashimzade, 2017), export diversification is an increase in the number of types and names of products and services intended for export. Diversification of exports creates conditions for economic maneuver, expands the possibilities of overcoming the negative impact on the economy of unfavorable economic conditions. It ensures its efficiency and optimal structure, expanding the range of goods, gradually increasing the share of high-tech products and goods with a high degree of processing, as well as the development by manufacturers and exporters of new goods, technologies, capital and services for international markets. In turn, the diversification of imports involves reducing dependence on imports of raw materials (energy and other strategic raw materials) and expanding sources of supply, as well as the creation of import-substituting industries based on the latest advanced technologies.

Based on the above definitions, we can give the following definition of foreign trade diversification: this is the direction of economic development within and outside the main specialization, which is carried out through effective geographical and commodity distribution of export-import flows, development and expansion of their quantity and quality.

Considering the types of diversification, the processes of diversification in economic activity in general can be classified into three areas: (a) diversification of the investment portfolio; (b) diversification of business areas (activities and production); (c) diversification of foreign trade of a particular country. If the first and second directions are studied and regulated at the microeconomic level, then the diversification of the country's foreign trade is carried out at the macroeconomic level. However, at the level of the international economy, it will depend on the international micro and macroeconomics, as the former involves the movement of specific goods and factors of production between countries, and the latter - the functioning of open national economies and the world economy as a whole in global financial markets.

The following types of diversification are distinguished by direction:

1. Vertical. Provides for the development of new products for the production of which as raw materials or semi-finished products using traditional products, or the production of goods that are raw materials or semi-finished products, components in the manufacture of traditional products. This type of diversification is associated with the creation of technological chains "extraction and processing of raw materials - production of intermediate products - production of products with high consumer properties - sales" both in full and in reduced form with the absence of some links. As a part of the country's foreign trade diversification strategy, it is a process of processing raw materials and semi-finished products, which will end with the production of finished products, which significantly increases the country's total exports and is sometimes used for import substitution. This leads to accelerated economic growth and increased stability, because the prices of processed goods are more stable than the prices of materials. Vertical diversification requires skilled labor, but this type of diversification can have a greater effect than horizontal one.

2. Horizontal. In this case, a new product is created on the basis of existing or new technologies within the main profile, expanding sales channels. There are new comparative advantages, the already well-known specialization of the country in the world market is used. In this case export expansion policy is used. Horizontal diversification is carried out in order to replace raw materials in exports to neutralize the volatility of world prices.

3. Conglomerate. Growth is provided by the production of products that are completely unrelated to traditional, it is followed by the specialization in a new type of product, the conquest of previously unclaimed niche in the world market.

4. Crossed. It is a combination of horizontal and vertical diversification.

5. Mixed. It is a combination of horizontal, vertical and conglomerate diversification.

The following types of diversification are distinguished by industry:

1. Mono-industry - within one industry.

2. Polysectoral (related) – within several industries related to the production of traditional products.

3. Polysectoral (unrelated) – within several industries not related to the production of traditional products.

Among the types of diversification of foreign trade, we single out geographical diversification. It is defined as the distribution of export and import flows in different areas of trade geography in order to attract partners with different economic conditions. As we can see in the mentions of diversification in the literature, this concept was traditionally considered regarding enterprises or industries, and only in the past few decades has been expanded to international trade. At the same time, researchers do not provide the classification of countries diversification suitable for use with international trade. Therefore, clarifying the classification of foreign trade diversification is a relevant topic.

On the one hand, the diversification of foreign trade is an important indicator that characterizes the level of possible risks that the country may encounter in the event of significant changes in world economy conjuncture. On the other – today there are few developed methods for calculating this indicator. Usually only the diversification of commercial exports is considered, estimated only by the breadth of the commodity range.

Hence, the main purpose of the study is to develop the method of comprehensive assessment of the level of foreign trade diversification of the countries of the world that will be suitable for analyzing their current state in order to find out how big is the risk caused by too low level of the indicator.

2. Review of Literature

Different researchers consider diversification in different ways. Most researchers in their work consider foreign trade diversification as a positive phenomenon, the way to reduce macroeconomic instability for most countries (Caselli et al., 2020; Gelb, 2010; Gnangnon, 2021). According to the International Monetary Fund (2016), the growth of diversification allows the creation of new jobs in some countries. On the other hand, del Rosal (2019) argues that the concentration leads to increased efficiency of exports.

According to the research of some economists (De Benedictis et al., 2009; Saviotti et al., 2020), in the world the processes of foreign trade diversification is currently prevailing over the processes of specialization. On the other hand, Imbs & Romain (2003) argue that in the process of stable economic growth, countries first increase their level of diversification, but after reaching a certain level of economic development again begin to increase the level of specialization to the detriment of diversification.

Many modern economists study factors that determine diversification level, and the impact of diversification on the economies of the world. Some scholars monitor the impact of foreign trade diversification on the economies of individual countries - France (Becuwe et al., 2018), Canada (Beine & Coulombe, 2007; Goldfarb, 2006), Naira (Alley, 2018), Rwanda (Chandra et al., 2007), China (Felipe et al., 2013; Zafar, 2007), Brazil (Nassif et al., 2015), South Africa (Petersson, 2005), Italy (Coniglio et al., 2016). Other scholars are considering the diversification of foreign trade of groups of countries - the Gulf Cooperation Council (Alsharif, 2018; Mahroum & Al-Saleh, 2013), North Africa and the Middle East (Bensassi et al., 2012; Diop et al., 2012), Asia (Hafner, 2020; Naudé & Rossouw, 2011), European Union (Jaud et al., 2013), developing countries (Lall, 1998; Martin, 2003), Caribbean countries (Mohan, 2016), Oil-Producing Countries (Ross, 2019), Eastern Europe and CIS (Shepotylo, 2013). Mauritius (Raja Vinesh Sannassee, 2014).

Attempts are being made to broaden the notion of foreign trade diversification, for example Bagci (2016) proposes to consider diversification not only between product groups but also within product groups. Lederman et al. (2021) suggest considering latent diversification, which is also important for maintaining macroeconomic stability. Regolo (2013) proves that diversification is more developed in trade relations between countries of approximately the same level of development than between countries with different levels of development.

Studies of the various consequences of foreign trade diversification are underway, Bahar & Rapoport (2018) consider the impact of diversification on the process of international migration of workers, Hesse (2008) concludes that low export diversification has been detrimental to the economic growth performance of developing countries in the past decades.

A number of researchers study the factors that determine the higher or lower level of foreign trade diversification of countries. Some researchers suggest that a surplus of natural resources in a country may lead to low level of export diversification (Bond & Malik, 2009; Lashitew et al., 2021; Lederman & Maloney, 2003). Cadot et al. (2013) trace the relationship between the level of foreign trade diversification, economic freedom and labor productivity in countries. Cuberes & Jerzmanowski (2009) argue that there is a direct link between the level of development of democracy and diversification of the economy.

In the OECD/WTO publication (2019) it is said that 91% of respondents stated that economic diversification is a priority in national or regional development strategies of their countries. Gnangnon (2019a, 2019b) discovered a significant positive impact on the level of foreign trade diversification of the Aidfor-Trade World Trade Organization Initiative, as well as regional bilateral trade agreements, Munemo (2011) came to a similar conclusion regarding foreign economic aid. Jetter & Hassan (2012, 2015) analyzed many factors influencing the level of diversification, the results of their study show that diversification is most strongly influenced by the relative level of natural rent, also significantly influenced by the level of primary education, population and foreign direct investment. Parteka & Tamberi (2011) in their study showed that in a group of countries with the same GDP per capita, the level of diversification can vary greatly.

3. Methods of the Study

Let us consider the indicators that can be used to assess the level of foreign trade diversification. The decile ratio of differentiation is a coefficient calculated as the ratio of 10% of the highest and lowest levels of the indicator. It characterizes how many times the minimum level of 10% of the highest levels of the indicator exceeds the maximum level of 10% of the lowest levels of the indicator. It is used mainly in sociology as a tool for comparing the distribution of material wealth in society. But it can also be used to simplify the assessment of the level of diversification in the economy.

The decile ratio of differentiation is calculated by the formula:

$$R_D = \frac{D_9}{D_1} \tag{1}$$

where D_1 is the first decile, the boundary between the first and second tenths of the aggregate; D_9 is the ninth decile, the boundary between the ninth and tenth tenths of the aggregate.

Imbs and Romain (2003) in their study of the evolution of sectoral concentration in relation to the level of per capita income suggest using GINI and Herfindahl indexes.

The Herfindahl index, or the Herfindahl-Hirschman index, is an indicator commonly used to assess the degree of monopolization of an industry. Calculated as the sum of the squares of the fractions of the levels of the indicator in the total:

$$HHI = \sum_{i=1}^{n} \left(\frac{x_i}{X}\right)^2 \tag{2}$$

where *n* is the number of values of the indicator; x_i is the *i*-th value of the indicator; *X* is the sum of all values of *x*.

In the case of full concentration of the indicator *x*, HHI = 1. For two equal values of *x*, HHI = 0.5. For 100 equal values of HHI = 0.01. Thus, the Herfindahl index responds to the share of each value of the indicator in the aggregate.

When simple statistical frequencies are used for calculation, the Herfindahl index is limited at the top by 1.0 and by 1/n at the bottom in the case of equal distribution of elements in the aggregate.

The Gini index is a statistical indicator that is often used to assess economic inequality in society. The Gini index can be calculated by Brown's formula:

$$G = \left| 1 - \sum_{i=2}^{n} (X_i - X_{i-1})(Y_i - Y_{i-1}) \right|$$
(3)

or by Gini's formula:

$$G = \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} \left| y_i - y_j \right|}{2n^2 \overline{y}}$$
(4)

where X_i is the accumulated share of aggregate units (previously ranked in ascending order of significant indicator); Y_i is the share of the indicator, which corresponds to the unit x_i , n is the number of aggregate units; y_i , y_j are the shares of the indicator of the corresponding unit of the aggregate in the total value of the indicator for the aggregate; \overline{y} is the arithmetic mean of shares of indicators of aggregate units.

The Gini index varies from 0 to 1. The greater the deviation of its value from zero and the closer to 1, the higher the concentration of the indicator in individual units. The Gini index is used by some researchers (Basile et al., 2018) to assess the level of foreign trade diversification.

The Tayle index is an indicator proposed in 1967 by Dutch economist Henri Tail to measure social inequality. The Tayle index is based on Shannon's notion of information entropy. Index T1 is calculated by the following formula:

$$T_{1} = \frac{\sum_{i=1}^{n} \left(\frac{x_{i}}{\overline{x}} \cdot \ln \frac{x_{i}}{\overline{x}} \right)}{n}$$
(5)

where x_i is the indicator of the *i*-th unit of the aggregate; \overline{x} is the average value of the indicator; n is the number of units in the aggregate.

If the indicators of all aggregate units are equal, then the Tayle index is zero. If the indicator of the whole aggregate is concentrated in one unit, then the Tayle index is equal to ln n. The Tayle index is also used (Basile et al., 2018) to assess the level of foreign trade diversification.

The following conclusions can be drawn from the considered indicators:

1. The decile rate of differentiation can be used as a simple way to estimate the level of foreign trade diversification, but it anticipates only extreme levels in the data set, so it is not accurate enough. Moreover, if a country has a very narrow range of foreign trade, the value of the first decile will be zero, namely, it will be possible to analyze only a partial range to avoid division by 0.

2. The Herfindahl index allows to estimate the degree of concentration of the indicator and characterizes all units of the aggregate. In this case, aggregate units with indicator equal to 0 are allowed, this will not distort the results of the analysis.

3. When using the Gini index, two indicators must be used. Some researchers use GDP or population as a second indicator, but these are not indicators that clearly characterize the size of trading partner countries. In addition, this index cannot be used to assess the level of commodity diversification. The more groups selected in the aggregate, the higher will be the value of the Gini index, that is, the principle of comparability of evaluation results will not be respected. All these reduce the convenience of using the Gini index.

4. The Tayle index characterizes well the level of concentration of the indicator in the aggregate and allows the use of only one factor. But it is impossible to use aggregate units with a sign equal to 0 to calculate the index, because it will lead to a logarithm of 0. Therefore, this indicator can be used only to analyze the diversification of aggregates where all units have

Figure 1





a value greater than 0. If we discard the units with zero value, this will lead to the fact that the Tail index will characterize the diversification only of non-zero units, and therefore the index of different countries will not be comparable.

Thus, from the listed indicators, the decile rate of differentiation gives too an approximate result, and both the Jini and Tayle indexes have significant limitations of the initial data values. This lets us conclude that it is most appropriate to use the Herfindahl index in the evaluation of the diversification level, because on the one hand, it estimates the entire range of foreign trade values, on the other, allows to obtain a fairly accurate result.

4. Results

According to the authors, it is expedient to additionally allocate in the aspect of foreign trade diversification its classification by the direction of export, import and by the criterion of geography and commodity (see Figure 1).

The main tasks of all types of diversification are: consolidation of investment resources; reducing the risks of environmental uncertainty; ensuring social and economic stability; crisis prevention; preservation of existing and identification of new specialization; fuller use of all types of resources; obtaining a synergistic effect due to the growth of market potential; reduction of transaction costs; improving the business image of the country; achieving multivector foreign economic relations of the national economy.

According to the United Nations Economic Commission for Europe [UNECE] (2008):

1. Vertical diversification requires the presence of effectively functioning relationships with different customers in highly profitable markets. It can contribute to the implementation of export-oriented strategies. Countries need to develop customerspecific products, production and marketing technologies.

2. The scale and pace of diversification is influenced by the degree of complexity of the market structure to which goods are supplied (domestic, international).

3. There is a two-way link between diversifica-

Table 1

The Most Common Threats to the Economic Security of Countries with too Low Level of Certain Types of Foreign Trade Diversification

The level of	Type of foreign trade diversification			
economic de- velopment of the country	Commodity export	Geographic export	Commodity import	Geographic import
Low	Limiting the country's abil-	The level of dependence of	The country's level of de-	The country's level of
	ity to increase its export	the country on a narrow	pendence on the supply	dependence on a narrow
	potential, predominant spe-	circle of buyers is too high	of high-tech goods is too	circle of sellers is too high
	cialization in the production		high	
	of labor-intensive, low-tech,			
	environmentally hazardous			
	goods			
High	Increased sensitivity to	Lack of significant sales in	The country's level of de-	The country's level of
	global crises and price	large new markets	pendence on the supply	dependence on a limited
	changes in world markets		of raw materials and min-	number of suppliers of
			eral resources is too high	raw materials and min-
				eral resources is too high

tion and integration: diversification is a means to achieve stronger integration, and integration is one of the key means by which diversification is achieved.

4. Diversification and integration are not a final goal in themselves, but should be seen as a means to achieve better economic performance. In essence, diversification and integration strategies must be a part of an appropriate overall economic development strategy.

There are a number of threats to the economic security of countries with too low level of certain types of foreign trade diversification (see Table 1).

The problems of low level of diversification listed in Table 1 can be solved with the help of the diversification strategies proposed by UNECE (2008):

1. The export of a wide range of high value-added goods should be a priority, especially for small countries with economies in transition. For larger countries, significant benefits from diversification can also be achieved within the national non-market sector.

2. Even with the development of exports, the process should not be limited to the diversification of the processing sector: there are also ample opportunities to diversify the export of services.

3. Diversification should be gradually concentrated on more high-tech industries.

4. For some economies, the challenge of diversification is not so much to end dependence on natural resource exports, but rather to move from low-efficiency agricultural production to a wider range of higher value-added activities.

In accordance with the above, it was decided to use the Herfindahl index to assess the level of diversification of foreign trade. It was also used in the study of export diversification of Mauritius (Raja Vinesh Sannassee, 2014).

To obtain indexes that directly characterize the level of foreign trade diversification of the country, the formulas were used (the inverse of the Herfindahl index):

$$I_{fi.s.c} = 1 - \sum_{i=1}^{n} \left(\frac{ec_i}{E}\right)^2; I_{fi.s.g} = 1 - \sum_{i=1}^{n} \left(\frac{ep_i}{E}\right)^2$$

$$I_{fi.i.c} = 1 - \sum_{i=1}^{n} \left(\frac{ic_i}{I}\right)^2; I_{fi.i.g} = 1 - \sum_{i=1}^{n} \left(\frac{ip_i}{I}\right)^2$$
(6)

where $I_{ft,ec}$ is the index of commodity export diversification of the economy; $I_{fi,i,c}$ is the index of commodity import diversification of the economy; I_{free} is the index of geographic export diversification of the economy; $I_{ft.i,g}$ is the index of geographic import diversification of the economy; ec, is the volume of exports of *i*-th commodity from the economy; *ic*, is the volume of imports of the *i*-th commodity to the economy; ep, is the volume of exports of goods from the economy to the *i*-th foreign trade partner; *ip*, is the volume of imports of goods to the economy from the *i*-th foreign trade partner; *E* is the total volume of exports of goods from the economy; I is the total volume of imports of goods into the country; *n* is the number of goods or foreign trade partners of the country.

Data on the annual volume of exports and imports of 210 countries and territories of the world, 255 product groups and 210 trading partners were collected for calculations (UNCTAD Data Center, 2019). Indexes of commodity export, geographic export, commodity import, geographic import diversification were calculated for all considered economies. To summarize the results, the indicators of commodity and geographic diversification of exports were combined into one indicator of commodity-geographic diversification of exports by finding the arithmetic mean. Similarly, the indicator of commodity-geographic diversification of imports was obtained. According to the results of calculations, the number of countries in the world was divided into 4 groups by finding quartiles (using MS Excel QUARTILE.INC function) (Tables 2, 3).

Not surprisingly, due to its relatively closed economy, North Korea is in a group of countries with a very low level of diversification of exports, and it is also obvious that many islands and geographically distant from the rest of the world countries fall into the same group. But, as can be seen from the table, even some economically developed or economically strong countries are characterized by a level of diversification of exports below average.

The profile of foreign trade diversification of countries can be considered in more detail by drawing a cumulate based on the data of the structure of foreign trade. As an example, Figure 2 shows the cumulative commodity structure of exports of coun-

Grouping of Countries by Level of Commodity/Geographic Diversification of Exports

The level of commod- ity/geographic diver-	The boundaries of the interval of foreign	List of countries included in the group
Very low	0.34 - 0.76	North Korea, Brazil, Faroe Islands, Ireland, Angola, Saint Vin- cent and the Grenadines, Kuwait, Central Asia, Guyana, North- ern Mariana Islands, Liberia, Fiji, Mauritania, Saudi Arabia, Venezuela, Bolivia, Micronesia, Azerbaijan, Lithuania, Costa Rica, Chile, Saint Kitts and Nevis, Turks and Caicos Islands, Somalia, Sweden, Zambia, Wallis and Futuna, Malta, Bulgaria, Slovakia, Gabon, Kenya, Andorra, New Zealand, Turkmeni- stan, Eritrea, Netherlands, Laos, Panama, Burundi, Nepal, Saint Pierre and Miquelon, Mali, Ecuador, Japan, Antigua and Bar-
Low	0.76 – 0.86	buda, Latvia, Belgium, Morocco, Denmark Cook Islands, Cayman Islands, Saint Lucia, Honduras, Zim- babwe, Malaysia, Iraq, Brunei, Montenegro, Guatemala, Mol- dova, Romania, Norway, Gambia, Nauru, Pakistan, Dominican Republic, Guinea-Bissau, Senegal, Haiti South Africa, Libya, Greece, Bahamas, Aruba, Bermuda, Algeria, Kyrgyzstan, Sierra Leone, Bhutan, American Samoa, Hungary, Hong Kong, Ser- bia, Suriname, India, Barbados, Afghanistan, Thailand, Croa- tia, Egypt, Trinidad Cambodia, Benin, Cameroon, East Timor,
Average	0.86 – 0.92	Peru, Ionga, Paraguay, Bangladesh Comoros, Bosnia and Herzegovina, Uzbekistan, Sao Tome and Principe, Yemen, Myanmar, Namibia, Saint Helena, Oman, Czech Republic, China, Guam, Estonia, Samoa, Israel, Canada, Mauritius, Armenia, Belarus, Rwanda, Philippines, Marshall Is- lands, Albania, Tajikistan, Equatorial Guinea, Dominica, Chad, Guinea, Nigeria, Vietnam, Vanuatu, Austria, Australia, Finland, Uganda, Macau, Falkland Islands, Niger, Tajikistan, Uruguay, Thailand, Kiribati, Argentina, Malawi, Mongolia, Togo, Syria, Palau Slovenia Maldives
High	0.92 – 0.97	Palestine, Greenland, Madagascar, Singapore, the Democrat- ic Republic of the Congo, Cyprus, Seychelles, Mexico, Sent Maarten, Italy, Iran, Papua New Guinea, British Virgin Islands, Spain, Nicaragua, Qatar, Mozambique, UAE, Germany, Sudan, France, Tunisia, Iceland, Kazakhstan, Botswana, Jordan, Portu- gal, Ukraine, Djibouti, Lebanon, Belize, USA, Russia, Solomon Islands, South Korea, Switzerland, Bahrain, Polynesia, Lux- embourg, El Salvador, Ethiopia, United Kingdom, Indonesia, Cuba, New Caledonia, Sri Lanka, Lesotho, Ghana, Republic of the Congo, Burkina Faso, Jamaica, Turkey

Note: Calculated by the authors using the data of United Nations Conference on Trade and Development (2019)

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Grouping of Countries by Level of Commodity/Geographic Diversification of Imports

The level of commod-	The boundaries of	List of countries included in the group
ity/geographic diver-	the interval of foreign	
sification of imports	trade diversification	
Very low	0.50 – 0.88	Mauritania, Bahamas, Bolivia, Slovakia, Libya, Liberia, Turks and Caicos Islands, Bhutan, Guatemala, CAR, Saint Vincent and the Grenadines, Brazil, Nepal, Netherlands, Brunei, An- dorra, Faroe Islands, Saint Kitts and Nevis, Saint Kitts and Nev- is Lucia, Grenada, Latvia, Sudan, North Korea, Honduras, Bel- gium, Anguilla, Saudi Arabia, American Samoa, Saint Pierre and Miquelon, Norway, Morocco, South Africa, Hungary, Zimbabwe, Haiti, Costa Rica, Cayman Islands, Northern Mari- ana Islands, Nauru, Wallis and Futuna, Dominican Republic, Moldova, Antigua and Barbuda, Aruba, Pakistan, Montenegro, Palarus, Japan, Guana, Eiji Loos, Hung Kong, Fast Timor,
Low	0.88 – 0.93	Bulgaria, Cameroon, Trinidad and Tobago, Namibia, Croatia, Marshall Islands, Paraguay, Guinea, Kenya, Macau, Guam, Macedonia, Tonga, Peru, Zambia, Panama, Micronesia, Niue, Vietnam, Thailand, Papua Finland, Samoa, Equatorial Guin- ea, Dominica, Israel, Vanuatu, Ecuador, Austria, Myanmar, Czech Republic, New Zealand, Sao Tome and Principe, Benin, Bermuda, Sweden, Qatar, Somalia, Guinea-Bissau, Falkland Islands Syria, Togo, Comoros, Tajikistan, Niger, Georgia, Uz- bekistan, Nigeria, Gambia, Eritrea, Sierra Leone
Average	0.93 – 0.95	Argentina, China, Philippines, Tanzania, Mali, Sent Martin, Chile, Cook Islands, Barbados, Maldives, Kuwait, Armenia, Egypt, Albania, Malta, Palau, Uruguay, Palestine, Afghanistan, Mexico, Romania, Iran, Venezuela, Venezuela Congo, Poland, Malaysia, Bosnia and Herzegovina, Kiribati, Australia, Malawi, Uganda, Bangladesh, Mongolia, Spain, Ireland, Turkmenistan, USA, Iceland, Denmark, Iraq, Jordan, Indonesia, Slovenia, Mauritius, Bahrain, Seychelles, Djibouti, Cambodia, Chad, In- dia, British Virgin Islands
High	0.95 – 0.97	Greenland, Colombia, Serbia, Yemen, Belize, Montserrat, Lux- embourg, Portugal, France, Estonia, Angola, Tunisia, South Korea, Greece, Lebanon, Kazakhstan, Burundi, Lesotho, Bo- tswana, Italy, Ukraine, Mozambique, Rwanda, Azerbaijan, Switzerland, Cyprus, Cuba, Germany, Solomon Islands, New Caledonia, Lithuania, Suriname, Saint Helena, UAE, Singa- pore, Senegal, Ethiopia, Algeria, Madagascar, Kyrgyzstan, Canada, UK, Polynesia, Oman, Jamaica, Taiwan, Buran Faso, Sri Lanka, Republic of the Congo, Turkey, El Salvador, Ghana

Note: Calculated by the authors using the data of United Nations Conference on Trade and Development (2019)

tries belonging to each of the selected groups (Saint Vincent and the Grenadines for a very low level of exports diversification, Peru for low, Belarus for medium, USA for high).

As it can be seen from Figure 2, the closer the curve of cumulative commodity structure of the country's exports is to the line connecting points 0;0 and 255;0 of the graph, the higher the level of commodity diversification of the country's exports.

The corresponding indicator for Saint Vincent and the Grenadines is 0.871, for Peru – 0.885, for Belarus – 0.942, for USA – 0.984. Such a ratio of the inversion of the Herfindahl index corresponds to what we see in Figure 2. Thus, we can claim that this indicator allows us to estimate the level of diversification of the export of the country's goods. Similarly, this indicator can be used to assess the level of geographic export diversification and import diversification.

According to the calculated indexes (details provided in Appendix 1), choropleth maps of diversification of the world by imports and exports were built (see Figures 3, 4). As can be seen from Figures 3, 4, even some economically developed countries with diversified exports (USA) are much less diversified in imports, and vice versa (Canada).

Thus, we have proven that the inversion of the Herfindahl index can be used to assess the level of foreign trade diversification of the countries of the world.

5. Conclusions and Recommendations

The foreign trade diversification of countries is distinguished into a separate variety of diversification and studied by economic experts relatively recently and the publications do not describe the full range of foreign trade diversification types, including the diversification of imports.

According to the authors, it is advisable to additionally distinguish export, import, geographic and commodity foreign trade diversification and constantly monitor the level of diversification of countries to minimize a number of threats to their economic security.

There is usually no doubt about the positive impact of export diversification on the productivity and stability of

100 90 % 80 Share of commodity in exports, 70 60 50 40 30 20 10 0 Commodity # -- Saint Vincent and the Grenadines --- Peru - - - Belarus United States of America

Figure 2 *Cumulates of the Commodity Structure of Exports*

Figure 3

The Choropleth Map of the Level of Export Diversification of the World



Figure 4

The Choropleth Map of the Level of Import Diversification of the World



the national economy. Export diversification is seen as one of the important recommendations of international economic organizations to countries with economies in transition and developing countries.

This emphasizes the importance of the calculations carried out, the results of which can be used to assess the dependence of the countries of the world from the fluctuations of prices for the goods they buy or sell, deficits in world markets, breaking relationships with traditional foreign trade partners.

A list of indicators that can be used in estimating the level of foreign trade diversification was considered. In simplified cases, the decile ratio of differentiation can be used. Also it is convenient to use the Herfindahl coefficient to assess the level of foreign trade diversification of countries. This indicator allows to cover the entire range of possible export quantities and is not too demanding on source data. Formulas for using the Herfindahl coefficient when estimating the level of foreign trade diversification were derived.

The proposed method for calculating the level of foreign trade diversification can be used by international organizations and governing institutions of individual countries to monitor potential risks for the economy. In addition, the indicator can be used to study the dependence between it and other aggregating macroeconomic indicators, for example, the increase in GDP, inflow and outflow of investment, income of the population.

Countries with too low levels of diversification of exports of goods should think about maintaining the development of alternative industries. Countries with too low levels of geographic diversification of exports or imports of goods should try to develop foreign trade relations with those countries of the world with which they have not previously traded.

As far as we know, there have been no previous studies on the assessment of the separate import and export, commodities and geographical level of foreign trade diversification of the countries of the world. Thus, this work can represent a certain value for future studies in this direction. The paper addressed the diversification of only foreign trade in goods. In addition to this type, the diversification of foreign trade in services can be considered, diversification on different types of markets, diversification of different groups of goods (low-, medium and high-tech, etc.), the dynamics of diversification indicator can be considered, but it may be the subject of our future research

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Appendix

Table

The Foreign Trade Diversification Indexes (the Inverse of the Herfindahl Index) by the Countries and Territories of the World (2019)

Countries and	Foreign trade diversification indexes			
territories	Commodity export	Geographic export	Commodity import	Geographic import
Afghanistan	0,80	0,88	0,98	0,90
Albania	0,90	0,88	0,98	0,89
Algeria	0,73	0,93	0,99	0,93
American Samoa	0,80	0,87	0,77	0,87
Andorra	0,94	0,48	0,97	0,54
Angola	0,08	0,91	0,99	0,92
Anguilla	0,79	0,43	0,97	0,63
Antigua and Bar-	0,76	0,75	0,94	0,80
buda				
Argentina	0,93	0,88	0,98	0,88
Armenia	0,90	0,86	0,98	0,89
Aruba	0,87	0,78	0,97	0,77
Australia	0,88	0,92	0,98	0,91
Austria	0,99	0,81	0,99	0,85
Azerbaijan	0,29	0,92	0,98	0,93
Thailand	0,98	0,92	0,97	0,92
Bahrain	0,82	0,90	0,98	0,91
Bangladesh	0,80	0,88	0,98	0,89
Barbados	0,95	0,81	0,94	0,80
Belarus	0,94	0,57	0,96	0,63
Belgium	0,98	0,92	0,98	0,93
Belize	0,90	0,81	0,97	0,87
Benin	0,83	0,83	0,93	0,91
Bermuda	0,90	0,77	0,68	0,72
Bhutan	0,81	0,37	0,97	0,27
Bolivia	0,82	0,90	0,98	0,90
Bosnia and Herze-	0,98	0,91	0,99	0,92
govina				
Botswana	0,20	0,56	0,90	0,56
Brazil	0,95	0,91	0,98	0,92
British Virgin Is-	0,83	0,72	0,78	0,71
lands				
Brunei	0,57	0,81	0,97	0,80
Bulgaria	0,98	0,95	0,98	0,95
Burkina Faso	0,54	0,95	0,97	0,94
Burundi	0,77	0,93	0,96	0,94
Cambodia	0,88	0,83	0,94	0,83
Cameroon	0,86	0,90	0,98	0,94

The Foreign Trade Diversification Indexes (the Inverse of the Herfindahl Index) by the Countries and Territories of the World (2019) (Continued)

Countries and	Foreign trade diversification indexes			
territories	Commodity export	Geographic export	Commodity import	Geographic import
Cayman Islands	0,21	0,82	0,56	0,86
Central African Re-	0,85	0,94	0,98	0,92
public				
Chad	0,40	0,89	0,97	0,90
Chile	0,87	0,89	0,98	0,89
China	0,98	0,94	0,95	0,95
Colombia	0,85	0,86	0,98	0,87
Comoros	0,64	0,88	0,98	0,89
Cook Islands	0,62	0,67	0,94	0,75
Costa Rica	0,90	0,79	0,98	0,81
Croatia	0,98	0,93	0,99	0,93
Cuba	0,92	0,93	0,99	0,93
Cyprus	0,81	0,94	0,91	0,93
Czech Republic	0,97	0,88	0,98	0,90
Democratic Repub-	0,58	0,94	0,94	0,95
lic of the Congo				
Denmark	0,97	0,92	0,99	0,91
Djibouti	0,94	0,84	0,98	0,85
Dominica	0,79	0,80	0,98	0,74
Dominican Repub-	0,94	0,77	0,98	0,79
lic				
East Timor	0,71	0,78	0,97	0,86
Ecuador	0,81	0,89	0,97	0,90
Egypt	0,96	0,95	0,98	0,96
El Salvador	0,93	0,85	0,98	0,85
Equatorial Guinea	0,52	0,92	0,97	0,89
Eritrea	0,87	0,89	0,98	0,92
Estonia	0,98	0,93	0,98	0,94
Ethiopia	0,89	0,91	0,98	0,87
Falkland Islands	0,30	0,60	0,91	0,60
Faroe Islands	0,53	0,66	0,95	0,87
Federated States of	0,29	0,86	0,93	0,83
Micronesia				
Fiji	0,93	0,88	0,95	0,88
Finland	0,96	0,91	0,98	0,93
France	0,98	0,93	0,98	0,94
French Polynesia	0,61	0,79	0,97	0,88
Gabon	0,67	0,90	0,98	0,88
Gambia	0,76	0,85	0,96	0,89
Georgia	0,93	0,94	0,98	0,94
Germany	0,98	0,95	0,99	0,96

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The Foreign Trade Diversification Indexes (the Inverse of the Herfindahl Index) by the Countries and Territories of the World (2019) (Continued)

Countries and	Foreign trade diversification indexes			
territories	Commodity export	Geographic export	Commodity import	Geographic import
Ghana	0,76	0,88	0,98	0,92
Greece	0,88	0,95	0,95	0,95
Greenland	0,66	0,59	0,95	0,60
Grenada	0,93	0,82	0,98	0,83
Guam	0,79	0,77	0,64	0,78
Guatemala	0,96	0,82	0,97	0,82
Guinea	0,71	0,88	0,96	0,89
Guinea Bissau	0,22	0,84	0,95	0,80
Guyana	0,75	0,86	0,92	0,77
Haiti	0,70	0,83	0,96	0,61
Honduras	0,93	0,74	0,97	0,80
Hong Kong S.A.R.	0,89	0,78	0,89	0,78
Hungary	0,97	0,90	0,98	0,91
Iceland	0,75	0,93	0,96	0,94
India	0,96	0,95	0,94	0,95
Indonesia	0,96	0,89	0,98	0,90
Iran	0,67	0,88	0,99	0,90
Iraq	0,10	0,83	0,99	0,90
Ireland	0,90	0,86	0,97	0,87
Israel	0,93	0,93	0,97	0,94
Italy	0,99	0,95	0,98	0,94
Jamaica	0,72	0,79	0,96	0,79
Japan	0,96	0,92	0,97	0,92
Jordan	0,95	0,93	0,98	0,93
Kazakhstan	0,61	0,80	0,99	0,81
Kenya	0,92	0,90	0,97	0,91
Kiribati	0,14	0,88	0,98	0,89
Kuwait	0,72	0,94	0,98	0,94
Kyrgyzstan	0,83	0,62	0,97	0,79
Laos	0,91	0,60	0,97	0,59
Latvia	0,98	0,91	0,98	0,93
Lebanon	0,97	0,95	0,95	0,96
Lesotho	0,89	0,26	0,98	0,39
Liberia	0,80	0,83	0,49	0,79
Libya	0,35	0,94	0,97	0,94
Lithuania	0,97	0,94	0,97	0,93
Luxembourg	0,97	0,83	0,98	0,83
Macau S.A.R	0,93	0,68	0,97	0,84
Macedonia	0,93	0,91	0,97	0,95
Madagascar	0,93	0,89	0,97	0,92
Malawi	0,66	0,89	0,97	0,91

The Foreign Trade Diversification Indexes (the Inverse of the Herfindahl Index) by the Countries and Territories of the World (2019) (Continued)

Countries and	Foreign trade diversification indexes			
territories	Commodity export	Geographic export	Commodity import	Geographic import
Malaysia	0,93	0,90	0,95	0,92
Maldives	0,61	0,88	0,97	0,90
Mali	0,45	0,93	0,96	0,92
Malta	0,87	0,90	0,86	0,92
Marshall Islands	0,33	0,83	0,20	0,79
Mauritania	0,87	0,88	0,97	0,93
Mauritius	0,93	0,92	0,96	0,92
Mexico	0,96	0,60	0,98	0,74
Moldova	0,94	0,88	0,98	0,91
Mongolia	0,77	0,79	0,95	0,79
Montenegro	0,93	0,89	0,98	0,92
Montserrat	0,84	0,67	0,96	0,70
Morocco	0,95	0,92	0,98	0,93
Mozambique	0,87	0,86	0,96	0,87
Myanmar	0,93	0,81	0,95	0,83
Namibia	0,90	0,67	0,96	0,75
Nauru	0,77	0,72	0,77	0,70
Nepal	0,96	0,48	0,97	0,52
Netherlands	0,98	0,94	0,98	0,93
New Caledonia	0,58	0,84	0,94	0,90
New Zealand	0,95	0,92	0,98	0,92
Nicaragua	0,92	0,88	0,98	0,88
Niger	0,84	0,95	0,96	0,90
Nigeria	0,36	0,87	0,92	0,90
Niue	0,04	0,65	0,92	0,65
North Korea	0,97	0,15	0,92	0,78
Northern Mariana	0,77	0,80	0,88	0,78
Islands				
Norway	0,83	0,92	0,98	0,94
Oman	0,77	0,81	0,98	0,76
Pakistan	0,93	0,89	0,97	0,90
Palau	0,58	0,88	0,96	0,86
Panama	0,96	0,90	0,94	0,89
Papua New Guinea	0,89	0,83	0,97	0,82
Paraguay	0,85	0,86	0,97	0,85
Peru	0,88	0,88	0,98	0,89
Philippines	0,91	0,90	0,96	0,92
Poland	0,99	0,90	0,99	0,92
Portugal	0,98	0,89	0,98	0,86
Qatar	0,74	0,93	0,98	0,92
Republic of Serbia	0,98	0,95	0,99	0,95

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The Foreign Trade Diversification Indexes (the Inverse of the Herfindahl Index) by the Countries and Territories of the World (2019) (Continued)

Countries and	Foreign trade diversification indexes			
territories	Commodity export	Geographic export	Commodity import	Geographic import
		J		
Republic of the	0,67	0,90	0,98	0,90
Congo				
Romania	0,97	0,93	0,99	0,93
Russia	0,84	0,92	0,99	0,92
Rwanda	0,82	0,92	0,98	0,93
Saint Helena	0,75	0,58	0,95	0,58
Saint Kitts and	0,85	0,68	0,98	0,54
Nevis				
Saint Lucia	0,75	0,74	0,87	0,78
Saint Pierre and	0,57	0,46	0,98	0,46
Miquelon				
Saint Vincent and	0,87	0,88	0,96	0,87
the Grenadines				
Samoa	0,85	0,88	0,96	0,88
Sao Tome and Prin-	0,48	0,68	0,97	0,64
cipe				
Saudi Arabia	0,66	0,94	0,98	0,93
Senegal	0,92	0,93	0,96	0,94
Seychelles	0,78	0,88	0,96	0,91
Sierra Leone	0,92	0,92	0,98	0,94
Singapore	0,91	0,94	0,93	0,94
Sint Maarten	0,95	0,44	0,89	0,37
Slovakia	0,93	0,90	0,97	0,92
Slovenia	0,97	0,93	0,98	0,93
Solomon Islands	0,46	0,88	0,96	0,89
Somalia	0,79	0,83	0,96	0,69
South Africa	0,96	0,94	0,97	0,94
South Korea	0,94	0,92	0,96	0,92
Spain	0,98	0,94	0,98	0,95
Sri Lanka	0,94	0,89	0,98	0,90
State of Palestine	0,94	0,93	0,96	0,61
Sudan	0,77	0,90	0,98	0,93
Suriname	0,47	0,87	0,97	0,88
Sweden	0,98	0,93	0,98	0,93
Switzerland	0,91	0,91	0,93	0,92
Syria	0,92	0,89	0,98	0,95
Taiwan	0,87	0,91	0,95	0,90
Tajikistan	0,90	0,78	0,98	0,84
The Bahamas	0,79	0,85	0,93	0,30
Togo	0,92	0,90	0,94	0,92
Tonga	0,87	0,84	0,97	0,84

The Foreign Trade Diversification Indexes (the Inverse of the Herfindahl Index) by the Countries and Territories of the World (2019) (Continued)

Countries and	Foreign trade diversification indexes			
territories	Commodity export	Geographic export	Commodity import	Geographic import
Trinidad and To-	0,85	0,85	0,89	0,88
bago				
Tunisia	0,96	0,91	0,98	0,92
Turkey	0,98	0,95	0,98	0,95
Turkmenistan	0,55	0,88	0,98	0,90
Turks and Caicos	0,92	0,41	0,97	0,40
Islands				
Uganda	0,90	0,90	0,97	0,91
Ukraine	0,96	0,93	0,98	0,93
United Arab Emir-	0,92	0,95	0,97	0,95
ates				
United Kingdom	0,97	0,94	0,98	0,94
United Republic of	0,93	0,88	0,96	0,90
Tanzania				
United States of	0,98	0,91	0,98	0,91
America				
Uruguay	0,92	0,88	0,97	0,90
Uzbekistan	0,85	0,88	0,98	0,88
Vanuatu	0,91	0,88	0,98	0,85
Venezuela	0,44	0,74	0,99	0,89
Vietnam	0,94	0,85	0,97	0,86
Wallis and Futuna	0,61	0,74	0,97	0,74
Yemen	0,82	0,91	0,98	0,93
Zambia	0,51	0,84	0,97	0,85
Zimbabwe	0,81	0,73	0,98	0,71

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