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## STATISTICAL ANALYSIS OF THE INFLUENCE OF TNC ON THE FUNCTIONING OF NATIONAL ECONOMICS ON THE GLOBAL MARKET

### СТАТИСТИЧНИЙ АНАЛІЗ ВПЛИВУ ТНК НА ФУНКЦІОНУВАННЯ НАЦІОНАЛЬНИХ ЕКОНОМІК НА ГЛОБАЛЬНОМУ РИНКУ

The conducted study showed that transnational corporations (TNCs) play a decisive role in the process of adaptation of countries to the challenges of economic globalization, especially for countries with a low level of economic development. Correlation analysis confirmed the hypothesis regarding the importance of foreign direct investment (FDI) in the economy of countries due to the expansion of TNCs. This contributes to scientific and technical progress, the increase of production capacities and the activation of the international movement of factors of production, which positively affects the gross domestic product (GDP). Two-factor cluster analysis showed that the country's position in the world economy depends significantly on the activities of TNCs and the volume of FDI. Based on the results of the Euclidean distance calculation, four clusters were formed, each of which contains countries with a different level of economic development. This confirms the dependence of national economies on financial investments made by TNCs.

**Keyw ords:** TNC, national economy, globalization, economic globalization, correlation analysis, cluster analysis, statistics, transnationalization.

Дослідження аналізує критичну роль транснаціональних корпорацій (ТНК) у посиленні трансакцій капіталу через кордони, головним чином через прямі іноземні інвестиції (ПІІ), та їх вплив на адаптацію країн до економічної глобалізації. Попри переваги глобалізації – такі як прискорення технологічного прогресу, створення інтеграційних груп і формування економічних систем – існують суттєві загрози для національних економік. Серед них – зростаюча взаємозалежність, яка призводить до соціальної нерівності та криз в імпортозалежних країнах, а також ерозія національних кордонів, що робить економіки вразливими до зовнішніх шоків, таких як фінансові кризи та конфлікти. Рівні економічного зростання значно різняться між країнами, причому розвинені економіки отримують більше вигод від глобалізації, ніж розвиваються. Ця різниця відображається в рівнях виробництва та економічних показниках, що вимагає дослідження того, як діяльність ТНК впливає на економічну ефективність країн і чи збільшення кількості філій ТНК пришвидшує процес глобалізації для певної країни. ПІІ є ключовим показником для вимірювання інтеграції країн у глобальний ринок і їх зовнішньоекономічних відносин. Аналіз проводиться у два етапи: перший – загальний кореляційний аналіз для оцінки лінійної залежності між обсягами ПІІ та розміром ВВП у 28 країнах з різними рівнями економічного розвитку в 2022 році. Це дозволяє встановити зв'язок між темпами економічного зростання та фінансовими надходженнями. Другий етап використовує двофакторний кластерний аналіз, застосовуючи метод k-середніх для категоризації країн на основі обсягів ПІІ та кількості філій ТНК, що дозволяє вияви-

ти закономірності в адаптації до економічної глобалізації. Кластерний аналіз, що використовує формулу евклідового відстані, виявив чотири кластери країн з різними рівнями економічної глобалізації: високий, середній і низький. Результати показують, що країни, такі як США та Китай, з великою кількістю філій ТНК та значними ПІІ, є високоприспособленими до глобалізації. Натомість розвиваються країни, особливо в Африці, демонструють обмежену адаптацію, попри високі надходження ПІІ. Це класифікація підкреслює різноманітні впливи діяльності ТНК на глобальну економічну інтеграцію і необхідність цільових стратегій для підвищення вигод глобалізації для менш розвинених економік. Проведене дослідження показало, що транснаціональні корпорації (ТНК) відіграють вирішальну роль у процесі адаптації країн до викликів економічної глобалізації, особливо для країн з невисоким рівнем економічного розвитку. Кореляційний аналіз підтвердив гіпотезу щодо значущості прямих іноземних інвестицій (ПІІ) в економіку країн завдяки експансії ТНК. Це сприяє науково-технічному прогресу, збільшенню виробничих потужностей та активізації міжнародного руху факторів виробництва, що позитивно впливає на валовий внутрішній продукт (ВВП). Двофакторний кластерний аналіз показав, що позиція країни у світовому господарстві суттєво залежить від діяльності ТНК та обсягів ПІІ. На основі результатів розрахунку Евклідової відстані було сформовано чотири кластери, кожен з яких містить країни з різним рівнем економічного розвитку. Це підтверджує залежність національних економік від фінансових вкладень, здійснених ТНК.

**Ключові слова:** ТНК, національна економіка, глобалізація, економічна глобалізація, кореляційний аналіз, кластерний аналіз, статистика, транснаціоналізація.

**Statement of the problem.** Economic globalization is a complex of interconnected processes, the successive emergence of which, as a result of the deepening of the international division of labor, contributed to the diversification of foreign economic relations between different countries of the world. The absorption by the globalization processes of the economies of other countries during the last decade had a significant impact on the activities of TNCs, which today are the main drivers of economic growth.

It was economic globalization that became a prerequisite for the emergence of TNCs as new business entities; it determined the trajectory of their formation and created the conditions for their development, which consists in the quantitative growth of subsidiaries abroad. The amalgamation of these subsidiaries has rapidly transformed into global networks that support global production.

It should be noted that during the long period of formation of TNCs in the world, they have turned into key catalysts of economic growth, which today are able to influence economic globalization, determining the pace and scale of development of its processes in the world. This is confirmed by the fact that TNCs provide 50% of global production, finance 80% of scientific research, and also own 80% of registered patents [41]. According to statistics, at the current stage, TNCs control up to 90% of direct investments, and their aggregate currency reserves are several times higher than the reserves of all central banks in the world [1].

**Analysis of recent research and publications.** The following scientists dealt with the impact of TNCs on the functioning of national economies on the global market: Korolenko N.V., Bila D.V. [30], Tarasevich N.V. [31], Marusiak N., Ratushnyak D., Kulko K. [32], Nechiporuk O.V. [34], Bakadorova A.E., Bilotserkivskiy O.B. [35], Moshlyak I.O. [36], Pochueva T.V., Filatova G.A., Samusenko S.O., Filatova I.V., Bobrus A.B. [38], Humenyuk K.V., Khmelivskiy Yu.S. [39].

**Formulation of the research.** To analyze with the help of statistical methods the influence of TNCs on the functioning of national economies in the global market.

**Summary of the main research.** Taking into account the fact that TNCs play a key role in the intensification of cross-border capital, which is mainly carried out in the form of financial resources, it is necessary to consider in more detail the peculiarities of the penetration of TNCs into the foreign market with the help of direct foreign investment and to find out how these investment flows can influence the process adaptation of countries to the conditions of economic globalization [30].

The adaptation process is due to the fact that despite the positive aspects of economic globalization, which include the acceleration of scientific and technological progress, the creation of integration groups and the formation of economic systems, there are a number of threats to national economies. The main threat arising in the context of the strengthening of globalization processes in the economic dimension is the transformation of interaction between countries into interdependence, which causes social inequality and crisis in import-dependent countries. In addition, the erosion of national borders as a result of this increased interdependence causes economies to weaken due to the tangible impact of external factors such as financial crises and war.

Considering the fact that the rates of economic growth of different countries of the world differ significantly, we can claim that the benefits from the absorption of national economies by economic globalization are also distributed unevenly in the world. Countries with a high level of development have significantly more advantages in the world economy than underdeveloped countries, which is evidenced primarily by a significant difference in the number of goods produced and the amount of receivables, which makes it necessary to investigate how the activities of TNCs are reflected in the indicators of the economic activity of countries with different levels of development, and whether the increase in the number of TNC branches accelerates the process of involvement of a particular country in globalization processes.

In the context of characterizing the factors of influence of TNCs on the adaptation of countries to the challenges of the controversial phenomenon of economic globalization, it is important to focus attention on direct foreign investments, since they are one of the key indicators that demonstrate

the involvement of countries in the world market and the development of its foreign economic relations [42]. The degree of intensity of the international movement of direct foreign investments depends significantly on the number of TNCs in the world. This can be explained by the fact that as a result of the integration of financial markets and the transnationalization of production, direct foreign investment has become the most common form of international business used by TNCs to go beyond the borders of the base country [31]. The essence of the use of foreign direct investment by TNCs is to make long-term investments of material resources in the country's economy for the implementation of large projects [32], which are related to the acquisition of a business in a foreign country or the expansion of an already existing business in the target market [31].

We decided to study the impact of foreign direct investment as the main tool of TNC expansion into foreign markets in two stages. The first stage refers to the determination by means of a general correlation analysis of the degree of linear dependence between the volume of inflows of foreign direct investment ( $y$ ) and the size of GDP in a sample of 28 countries with different levels of socio-economic development in 2022 ( $x$ ). In this way, we will be able to establish a relationship between the rates of economic growth of countries under the condition of increasing financial inflows into their economies.

The second stage involves conducting a two-factor cluster analysis, which, unlike most statistical and mathematical methods, developed by the k-means method [33] allows for the distribution of a set of countries with different levels of development that belong to the statistical sample according to certain characteristics [34]. As a result of conducting this type of statistical research, «clusters» or groups of very similar objects are formed [35]. The clustering of countries will help to determine whether the place of a particular country will change according to the typification of countries by the degree of economic development, if we take into account 2 key economic indicators when evaluating it, namely the volume of foreign direct investment and the number of TNC branches. The choice of these indicators, which will be used to segment the set of selected countries, is due to the fact that the volume of direct foreign investment indicates the degree of internationalization of business and integration of the country's financial markets, which, in combination with the transnationalization of production, which is directly expressed in the number of subsidiaries of TNCs, characterizes the level adaptation of the national economy of one or another country to the globalized space.

For correlation analysis, we took a sample from 28 countries of the world, namely the USA, the United Kingdom, Japan, Germany, France, Belgium, Canada, Argentina, Brazil, Singapore, South Korea, China, India, Mexico, Malaysia, Turkey, Pakistan, Vietnam, Philippines, Egypt, Morocco, Senegal, Bangladesh, Cambodia, Liberia, Ethiopia, Mozambique, Democratic Republic of Congo (DRC). The choice of the countries listed above is due to the need to cover countries with different levels of economic development, which confirms the uneven development of globalization processes in the world.

During the correlation analysis, we obtained a correlation coefficient equal to  $r=+0,90$ . Evaluating this

coefficient according to the Chaddock scale, we can conclude that the strength of the linear dependence of the two variables, in our case the size of foreign direct investment and the volume of GDP, is high. A positive value of the coefficient indicates a direct relationship between the variables, and therefore, during the increase in the volume of foreign direct investment, we will also observe a significant increase in the volume of GDP at the global level. This can be explained by the fact that an increase in the inflow of foreign direct investment into the economy is a prerequisite for ensuring the technical progress of the recipient countries and improving the indicators of their economic activity at the macro and micro levels due to the creation of new enterprises and the expansion of existing ones [36].

The result of the correlation analysis shows us the confirmation of the hypothesis that the attraction of direct foreign investment directly contributes to the growth of the world economy. Given the fact that TNCs are currently the main providers of capital, including investments, we decided to investigate on the basis of cluster analysis how exactly their number determines the country's position on the world market.

We will conduct a cluster analysis on 28 countries with different levels of economic development, which were previously used as a statistical sample in the correlation analysis. We will characterize the countries selected for the study by two factors, namely by the amount of foreign direct investment inflows in 2022 ( $x$ ) and by the number of subsidiaries of the 27 leading TNCs in terms of profit ( $y$ ) (table 1).

It is these economic indicators that we will use to combine countries into homogeneous groups based on the calculation of the Euclidean distance. The resulting clusters will be used to compare the socio-economic situation of countries, which will serve as a conceptual basis for building strategic priorities for the development of selected countries in the conditions of accelerated economic globalization of the world economy.

Euclidean distance in cluster analysis is a metric used to measure the distance between two points in space. It is calculated as the square root of the sum of the squared differences between the corresponding coordinates of the points.

In cluster analysis, this distance indicates how close or far apart objects (such as countries or companies) are based on quantitative attributes like investment volumes or GDP levels. A smaller Euclidean distance between objects suggests greater similarity between them.

Before subjecting the raw data to two-factor cluster analysis, we need to characterize the set of objects according to established features. Analyzing the numerical values of the countries selected for the cluster analysis, we see that among the recipient countries of direct foreign investment, the largest inflow of foreign capital in 2022 was observed in the United States (\$388,08 billion), which leads the ranking of highly developed countries in the world, as well as China (180,17 billion US dollars) and Singapore (140,84 billion US dollars), which according to the rates of economic growth belong to the newly industrialized countries. The least developed country of Liberia had the smallest volume of direct foreign investment in 2022 (USD 0,07 billion) (figure 1).

Source database for cluster analysis, 2022

Name of the country	Volumes of foreign direct investments, million dollars. USA	The total number of TNC subsidiaries, units
USA (1)	388,08	34838
UK (2)	44,13	3774
Japan (3)	47,52	5558
Germany (4)	47,37	2095
France (5)	105,42	2142
Belgium (6)	9,79	233
Canada (7)	53,71	4501
Argentina (8)	15,41	404
Brazil (9)	91,5	1463
South Korea (10)	18	2566
Mexico (11)	38,93	1485
Singapore (12)	140,84	478
India (13)	49,94	1318
China (14)	180,17	18510
Malaysia (15)	14,73	1505
Turkey (16)	13,09	1106
Morocco (17)	2,18	120
Pakistan (18)	1,34	218
Egypt (19)	11, 4	479
Philippines (20)	9,2	1474
Vietnam (21)	17,9	322
Senegal (23)	2,59	10
Cambodia (24)	3,58	36
Liberia (25)	0,07	11
Ethiopia (26)	3,67	3
Mozambique (27)	2,54	17
Democratic Republic of the Congo (28)	1,85	9

Source: compiled on the basis of data [2–28; 37]

The second economic indicator worth considering is the number of TNC subsidiaries. 27 leading TNCs operating in 9 different sectors of the economy were selected for analysis. The total number of their subsidiaries located in 28 countries of the world equals 84,723 branches.

As mentioned earlier, the top three countries with the highest concentration of TNC branches include the USA (34,838 branches), China (18,510 branches) and Japan (5,558 branches). Their total number is about 69% of the total number of TNC subsidiaries used in the study. The least number of subsidiaries of TNCs are located in underdeveloped countries, namely in Ethiopia; their number is equal to only 3 branches. Such a number of subsidiary companies is critically small, which greatly complicates the process of transnationalization of capital and production in the country, as well as slows down the development of other processes of economic globalization. This also confirms the need to study countries with different levels of economic development, because in this way we will be able, based on statistical studies, to determine the peculiarities of the influence of TNCs on the economic growth of countries and establish key trends in the process of their adaptation to the challenges of economic globalization.

Returning to the cluster analysis, it is important to emphasize that we performed it using the iterative k-means

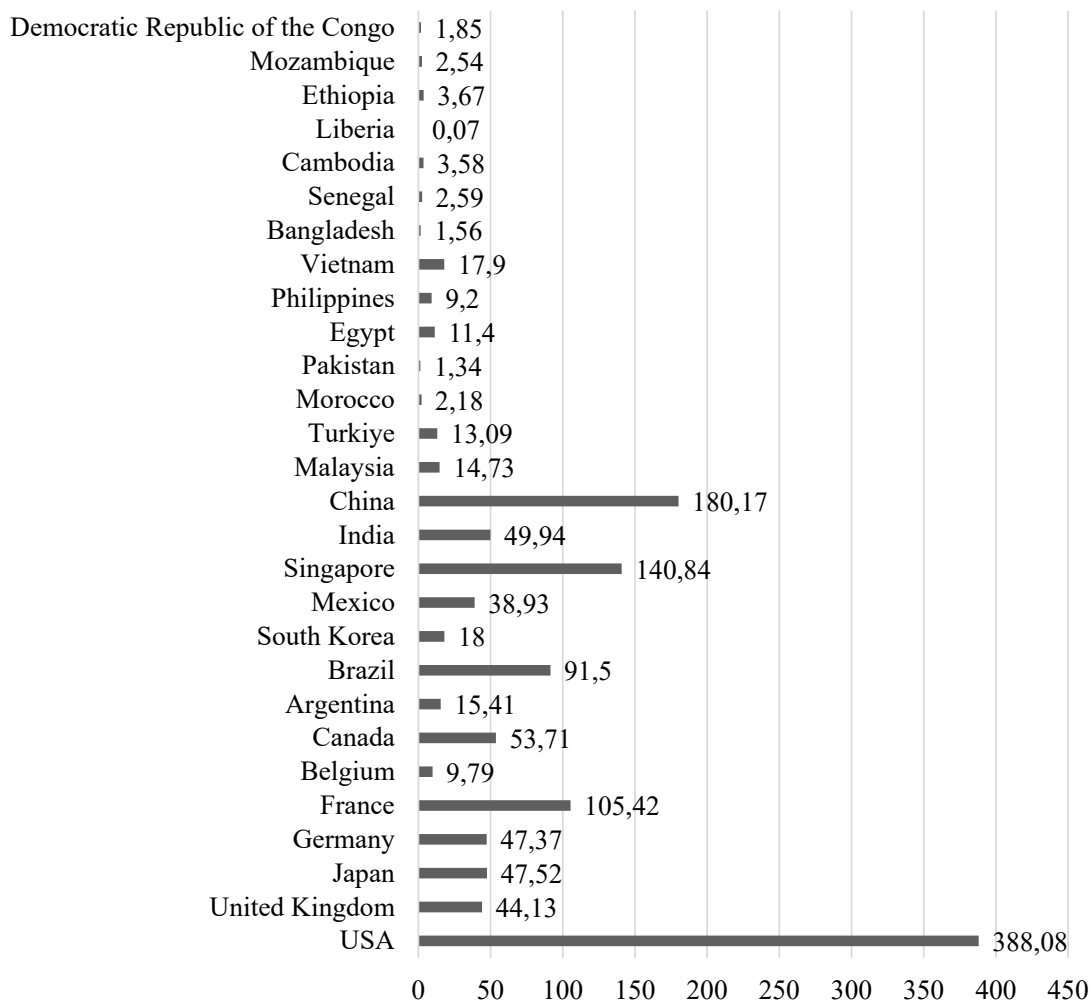
algorithm [38], which aims to divide the data set into k different clusters [39], using the Euclidean distance formula [40], the feature of which is the ability to take into account two features for grouping a set of objects at once. After calculating the Euclidean distance formula of each country in the Excel program, we received a certain set of data that correspond to the number of objects taken for statistical sampling (figure 2).

Column numbers with the sum of Euclidean distances obtained as a result of cluster analysis correspond to the country number in the table (table 1).

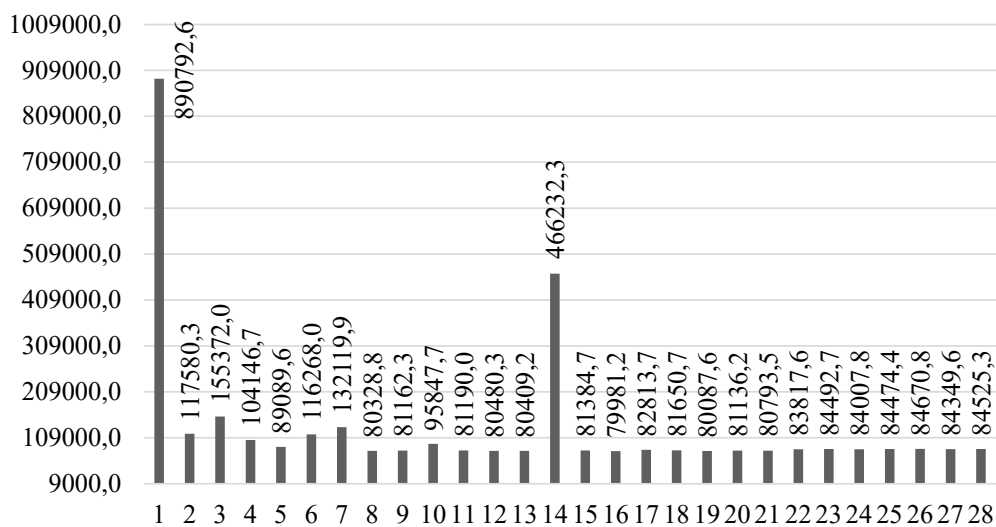
After analyzing the numerical values of these distances separately for each country of our statistical sample, we formed 4 different clusters, which can be conventionally called:

- countries with the highest degree of economic globalization (cluster 1);
- countries with a high degree of economic globalization (cluster 2);
- countries with an average degree of economic globalization (cluster 3);
- countries with a lower than average degree of economic globalization (cluster 4).

This classification of countries can be used only in this type of static analysis and only with the list of countries that were selected for the statistical sample. This classification



**Figure 1. Volumes of foreign direct investments by countries of the world for 2022, million dol USA**  
 Source: compiled on the basis of data [37]



**Figure 2. Sum of Euclidean distances of countries selected for cluster analysis for 2022**  
 Source: compiled on the basis of data [2–28; 37]

**Two-factor clustering of countries with different levels of economic development**

Cluster number	Cluster name	Name of country	Country category according to the UN classification
The first cluster	Countries with the highest degree of economic globalization	USA	Highly developed country
		China	A newly industrialized country
The second cluster	Countries with a high degree of economic globalization	Japan	Highly developed country
		Canada	Highly developed country
		UK	Highly developed country
		Belgium	Highly developed country
		Germany	Highly developed country
		South Korea	A newly industrialized country
The third cluster	Countries with an average degree of economic globalization	France	Highly developed country
		Ethiopia	A least developed country
		Democratic Republic of the Congo	A least developed country
		Senegal	A least developed country
		Liberia	A least developed country
		Cambodia	A least developed country
		Mozambique	A least developed country
		Bangladesh	A least developed country
		Morocco	A developing country
		Pakistan	A developing country
		Malaysia	A developing country
		Mexico	A newly industrialized country
		Brazil	A newly industrialized country
		Philippines	A developing country
The fourth cluster	Countries with a below-average degree of economic globalization	Vietnam	A developing country
		Singapore	A newly industrialized country
		India	A newly industrialized country
		Argentina	A newly industrialized country
		Egypt	A developing country
		Turkey	A developing country

Source: compiled on the basis of data [2–28; 37]

cannot be applied to the total number of countries in the world, as it is necessary to increase the size of the statistical sample.

Each of the above clusters contains a different number of countries with different levels of development (table 2).

The uneven distribution of countries confirms the thesis that the activities of TNCs as drivers of economic globalization have different effects on countries.

The first cluster, which is the smallest in terms of the number of countries, includes the USA and China. These two countries, despite the different level of economic development, have the largest Euclidean distance, which significantly exceeds the others (figure 2).

Such high numerical values indicate that the economies of these countries have long been adapted to the conditions of the globalized world economy, and have a number of advantages from accelerating the processes of economic globalization.

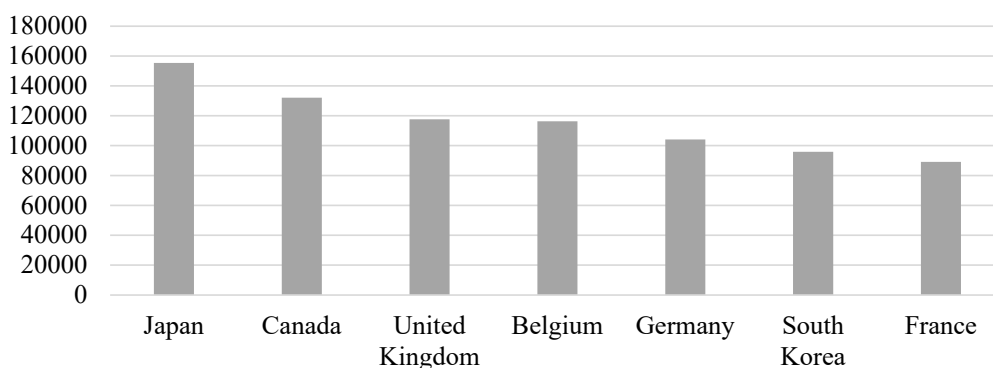
It should be emphasized that the United States and China, which are competing countries seeking to capture as large a share of the world market as possible, have the largest number of subsidiaries of TNCs. In addition, these countries have the largest amounts of investment income, which indicates the presence of an attractive investment

environment within them, which directly consists of developed infrastructure, high transparency of business conduct, low level of inflation, as well as a competitive workforce.

It can be assumed that it is this factor that determined the high rates of economic growth of China as a new industrial country, as well as the preservation of the leading position of the USA in the global market as a highly developed country.

We assigned 6 countries to the second cluster, 5 of which are highly developed countries and only one country is a newly industrialized country (figure 3)

Characterizing the countries of the second cluster, it is worth noting that they are also quite well adapted to economic globalization, as they have a high degree of transnationalization of production and internationalization of business, as evidenced by the large concentration of subsidiary companies of TNCs in various fields of human activity. These countries are not only large recipient countries of subsidiaries of foreign TNCs, but at the same time most of them are base countries of leading TNCs. The model of the national economies of the countries of the second cluster is open, which is the main condition for the penetration of new TNCs into their national market.



**Figure 3. Countries with a high degree of economic globalization (cluster 2)**

Source: compiled on the basis of data [2–28; 37]

Focusing mostly on the export of services, these countries are actively developing the private sector by attracting foreign direct investment.

The constant inflow of investments to these countries is a key incentive for their dominance in the global market, since additional financial sources from abroad allow these countries to introduce innovative solutions in production and thus increase work productivity, expand the customer segment, expand the range of goods and services, which is directly proportional increasing the demand, and therefore the incomes of the located TNCs.

The third cluster is the largest, because it includes 13 countries with different socio-economic conditions. Most of them are underdeveloped African countries (figure 4).

The most important in the group is Ethiopia, the country with the smallest number of subsidiaries, and at the same time with the largest amount of foreign direct investment inflows among underdeveloped countries, which can be explained by relatively low production costs, namely labor. In addition, this country has a transition economy, and needs large investments in its development, which is complicated by numerous foreign debts of the country. Other underdeveloped countries also have quite unstable economies, since they are directly dependent on developed countries, which causes social inequality and poverty within these countries.

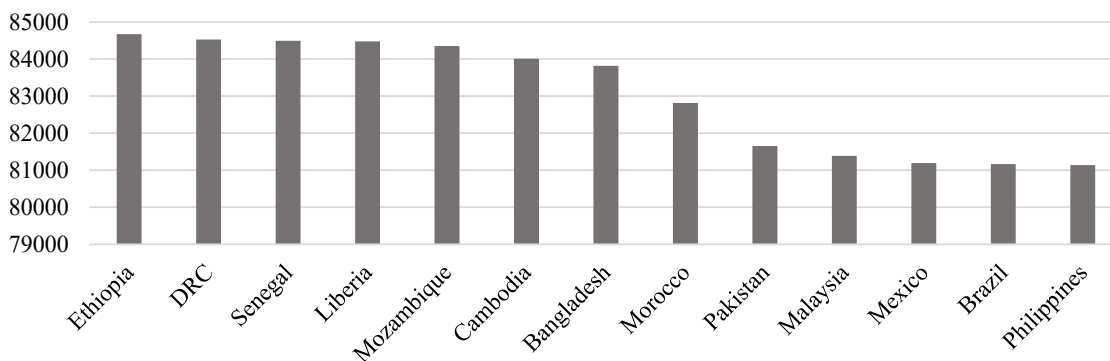
Differences in the Euclidean distances of the countries in the cluster are insignificant, which indicates the same level of involvement in global economic processes.

Developing countries and newly industrialized countries have lower numerical values obtained during the bivariate cluster analysis despite high levels of foreign direct investment and number of subsidiaries. This suggests that the countries belonging to the third cluster are not yet fully adapted to the challenges of economic globalization. They are at the stage of a doctrinal transition from the past command economic system to a competitive market economy based on the principles of free trade.

The fourth cluster includes 6 countries, which can be evenly divided into developing and newly industrialized countries (figure 5).

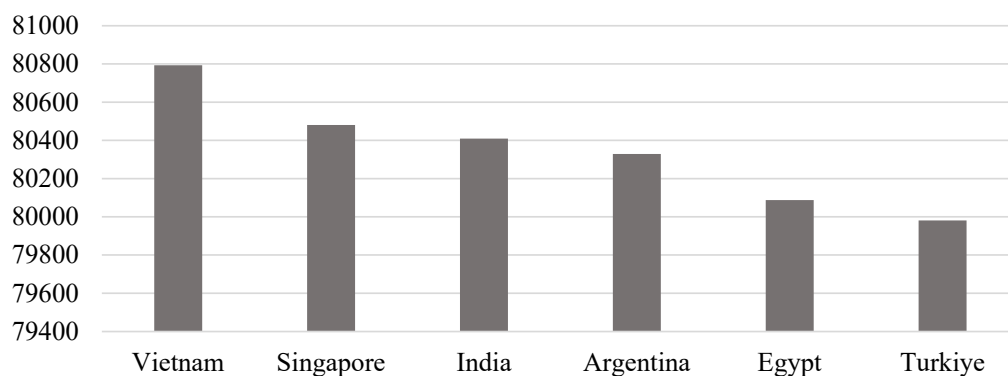
Newly industrialized countries are often singled out in international classifications, because their growth rates significantly exceed the growth of other countries, including highly developed ones. The low value of the Euclidean distances of Singapore, India and Argentina compared to underdeveloped and developing countries demonstrates the low degree of their involvement in the processes of economic globalization based on a combination of two factors: the volume of foreign direct investment and the number of subsidiaries. Despite this, countries have rich natural resource potential, which gives them the opportunity to widely involve it in economic activity [29].

**Conclusions.** Summarizing the results of the research, we can conclude that TNCs play a decisive role in the process of adaptation of countries to the challenges of economic globalization, and this particularly applies to countries with a low level of economic development.



**Figure 4. Countries with an average degree of economic globalization (cluster 3)**

Source: compiled on the basis of data [2–28; 37]



**Figure 5. Countries with a below-average degree of economic globalization (cluster 4)**

Source: compiled on the basis of data [2–28; 37]

Conducting a correlation analysis confirmed the hypothesis regarding the significance of the inflow of foreign direct investment into the country's economy thanks to the expansion of TNCs, as it accelerates the country's scientific and technical progress, contributes to the increase of production capacity, activates the international movement of production factors, which is positively reflected in the country's GDP, the main macroeconomic indicator of the country's development. Carrying out a two-factor cluster

analysis allowed us to discover that the country's place in the world economy depends significantly on TNCs as leading players on the global market and the volume of foreign direct investments. As a confirmation, as a result of calculating the Euclidean distance taking into account the factors described above, we formed 4 clusters, each of which contains countries with a different level of economic development, which confirms the dependence of national economies on financial investments made by TNCs.

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