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Globalization and development of infrastructure: the case of agricultural market

Abstract

The paper aims at investigation of factors that influence infrastructure development stakeholders in their search for reasoning the volumes of investments that globally lack 1 trln USD every year, which constitutes a problem for sustainable development of markets and regions. Development of infrastructure of agricultural sector of national and global economies has been taken as the object of the research. Market economy has never been able to develop infrastructure that could function on sustainable basis and the situation remain in times of globalization. Evolution of infrastructure has passed several stages since 1870 and led to increase in international trade, but it is still in need, when talking about global food security and global food problem. Research of infrastructure and its components is one of the objects that every year becomes the theme of increasing number of research papers. We propose four stages of development of global markets infrastructure – prerequisite, emergence, flourishing and dominance. Global agriculture markets infrastructure consists of several groups of structural components – trading, financial, social, institutional, information, scientific and educational, innovation and ecological. In our understanding the lack of complex development of all of these components lead to global food instability, market violations and sectoral crises. There is a matrix model of relationships of factors and infrastructure components of infrastructure market proposed.

The specific purpose of the paper is to check the hypothesis which tells us that low or absent direct relationships between infrastructure development indicators and economy's ones lead to under-investments. The findings are that there are too low levels of correlation between a) infrastructure development indicators and GDP of countries; b) infrastructure development index in Ukrainian regions and their gross volume of agricultural production. We conclude that among factors of infrastructure development the major role play those that demonstrate indirect relationships.

1 Statement of the problem

Development of the agricultural sector as sensitive in many economies, the drawbacks of the market economy, the lack of coordination of efforts

and the challenges of globalization cause the aggravation of the global food problem, the low security and the cyclicity of development of the global market. The main problem of the classical market – the absence of an internal mechanism

Keywords

agriculture, global market, investment, Ukraine, infrastructure, evolution, components, matrix model

JEL: Q17, H54, O18

to prevent economic crises – has now become the characteristic of the global economy. For example, this led to the fact that in Greece gross investment in fixed assets in agriculture decreased by almost half from 1980 to 2007, when the priorities were not infrastructure, but consumption and urban real estate [18]. The problem of confident prediction of the consequences of entrepreneurial initiatives was partly solved by the creation after the Second World War of unified information networks based in banks and commodity exchanges.

During the 1870-1914, industrialization and infrastructure development have undergone profound transformations in the economic history. The beginning of the 20-th century became the apogee of industrially organized production and shaped the basements for infrastructure. During 1945-1980 in implementation of the Marshall plan the countries of Western Europe have absorbed about 13 bln USD of infrastructure investments. It is precisely this period that became the stage of the growth and flourishing of infrastructure sectors, which is confirmed by the growth of international trade. In 1973 the share of exported products globally amounted to 15% on average; for France – 20%, Germany – 28%, Japan – 13%, USA – 7% [13, p. 29].

Unfortunately, the long-term investment in infrastructure development constrains the active participation of the private sector, and therefore it has to be replaced by the state. For example, for Harvard University and the Texas A & M University (more than 750 buildings) it has been discovered that investments in energy efficiency of infrastructure, even with affordable capital at 2% rate, will yield benefits only after 12 years [6]. One of the vectors is also the search for effective forms of public-private partnership, which is in lack.

Manifestations of the global food problem have existed for many decades. That is why in 1945 FAO (UN Food and Agriculture Organization) was founded and in 1972 a report was prepared by the Rome Club "The limits to growth". According to the FAO, today there are more than 800 million people suffering from malnutrition, each year 30 million die of hunger. To substantiate the directions of ensuring food security in terms of forming the global agricultural market infrastructure (GAMI) the following challenges should be noted:

- due to insufficient level of infrastructure development, especially innovation, the dependence of agriculture on the natural and climatic conditions remains;
- ineffective regulation of the agricultural market and natural monopolies, causes an increase in price disparity of agricultural and industrial products;
- significant deformation of inter-sectoral economic relations, disintegration of certain branches of agriculture is due in part to the insufficient level of development of

institutional and information infrastructure.

Thus, the food problem is not whether the Earth can produce the right amount of food for a larger population, but will it be possible in the coming decades to meet the needs of humanity in exchange of food products, the demand for which will be the highest. The infrastructure of the agrarian market is designed to answer whether it can be implemented at reasonable prices, which will be adequate to the income of the poor stratum of society in many countries [26, p. 8].

2 The purpose of research

Insufficient investments directed towards infrastructure development require comprehensive consideration and explanation. The purpose of the paper is to test the hypothesis that the absence or low levels of direct linear dependencies between the indicators of infrastructure development and the economies lead to underinvestments and underestimation of its role in the formation of high levels of indicators of socio-economic development.

3 Latest scientific progress and publications review

The process of globalization of the world economy has been the subject of research by many scholars. Bibliographic analysis shows that "globalization" as a keyword is found at least 2 mln times in ScienceDirect database, and the annual number of publications since 1997 has been steadily increasing and got the peak in 2018. A similar trend is observed if "agriculture" and "agricultural market" is added to the keywords, but with the difference that number is 16-20 times smaller, while "infrastructure" lags behind only 5 times. This generally corresponds to the place of agriculture in the structure of the global economy, but does not take into account its increased importance in ensuring food security.

Most researchers agree that 3-4 stages of the evolution of the global economy could be segregated. Clark B. calls 1870-1914 – the period of dominance of micro-level regulators, in 1914-1945 bilateral intergovernmental regulatory institutions prevailed; 1945-1980 – the emergence of multilateral intergovernmental integration management bodies and supranational institutions; and since 1980 – the formation of a global management system started [19]. Such an understanding does not fully reveal the state the development of the GAMI. Therefore, it is important to study alternative views.

The World Bank experts argue that only three stages of globalization can be observed: 1870-1914, the growth of the share of international trade in GDP; 1950-1970 – restoring the level of international

relations to the pre-war level; since 1970 till now – powerful development of modern information and transport technologies [22]. Obviously, this refers only to periods characterized by dominant growth trends. Yunusov L. distinguishes stages, which began later: 1944-1976 – formation of a new world monetary system with IMF; 1976-1991 – introduction of the Jamaican currency system, the bipolar world ceases to exist; since 1991 - till now – the existence of one "superpower", strengthening the positions of TNCs and TNBs, the growth of the international capital movement [30].

Some view the stages through the prism of the functioning of global markets, but considers these processes since 1980 only [9]. The 1980-1990 period is characterized by a global market economy model; 1990-2001 – liberalization of the system of borrowing on international markets and overcoming the monetary monopoly of the state, and international markets are intended to unite national markets into global market, national economies in

the global economy; 2001 - 2008 – connecting the major players of global capital (international financial organizations, TNCs and TNBs); since 2008 - till now – construction of a new architecture of the global economy, based on a multipolar world in geopolitics and geoeconomics, expanding the roles and functions of international regulators.

From our point of view, the process of globalization began much earlier, so it is worth allocating the first stage of the formation of the GAMI as a stage of "Preconditions" (Fig. 1.). At this stage, there was still a classic market that was already in action by the early XIX century, and its characteristics were: huge set of independent economic entities, who freely determine the aims and forms of activity; free trade, providing interaction of producers and consumers of goods and services; free movement of capital.

The systematization of scientific papers allowed to group the structural elements of the GAMI (table. 1). Active participation of the state in

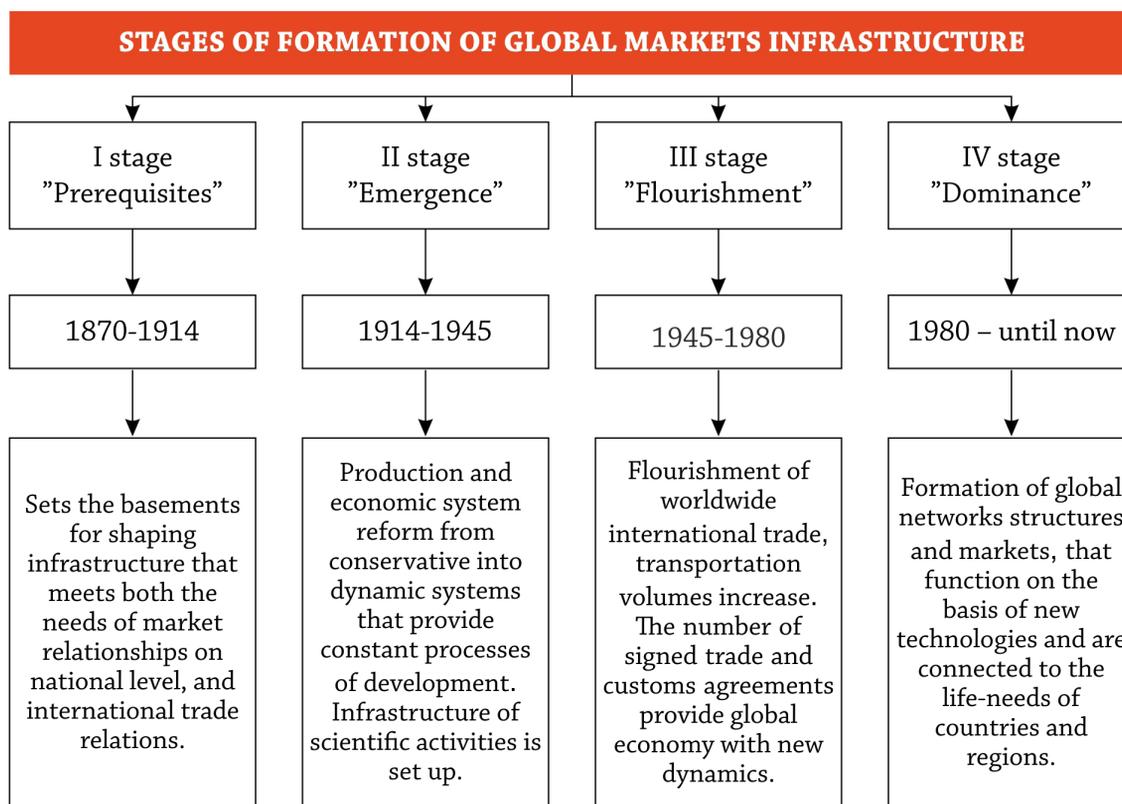


Figure 1 Stages of formation of global markets' infrastructure

development of all GAMI groups contributes to increasing the international competitive positions of enterprises of the country. Aghion P. & Schankerman M. demonstrated a microeconomic model where well-structured infrastructure development both increased competition and contributed to the growth of production [2, p. 80].

The structure of the infrastructure, its diversification in breadth and depth, has a

significant impact on the development of national economies, sectors and enterprises. For the first time in world history, the largest investments in research infrastructures in universities and following collaboration with industry and military during the Cold War led to the convergence of universities and end users [4 s. 10]. One of the outcomes was the development of ICT and mass informatization. That is why within the system of

factors of global leadership of USA the development of infrastructure plays an important role. For instance, research universities are largely responsible for the development of knowledge

infrastructure [10].

Investments in technological infrastructure are an integral part of the policies for development of scientific, technological and innovation policies

TABLE 1 Groups of the structural elements of the GAMI

group	components
trading	trade and intermediary enterprises, agricultural exchanges, agro-trading houses, wholesale food markets, auctions, exhibitions, fairs
financial	financial institutions, credit organizations, commercial banks, credit unions, agribusiness financial groups, insurance companies
social	institutions that ensure social standards of consumption and overcoming hunger; NGOs
institutional	international organizations, supervisory bodies, legal entities, state surveillance
logistical	warehousing and storage companies, transport and forwarding companies, logistic services enterprises, ports, elevators
informational	consulting and advertising agencies; information enterprises, advisory services, price monitoring centers, mass media
scientific and educational	universities and institutions of vocational education, research institutions, foundations and funds
innovative	zones of intensive scientific and technical development, agroparks, laboratories, innovation centers, venture firms
ecological	ecological institutions; environmental compliance monitoring inspections and regulators

according to the theory of growth by Schumpeter, neoclassical, neomarkshalian, systematic institutional and evolutionary theories [15]. In particular, in the Netherlands over the past 100 years, the agricultural research system has undergone significant transformations in structure and functions. The government has integrated the infrastructure of universities, institutes and research stations and created a unique space that successfully meets the modern international competitive challenges [24].

Since social development takes place in different phases, it is not surprising that countries can be approached at different levels of development. For example, India and Indonesia are believed to be at the agrarian phase, which precedes infrastructure phase (China and Algeria) [23]. Most developed countries are at the distribution and information stages. Meanwhile, even in countries, where intellectual capital is actively developing, much attention is paid to the development of the virtual and physical infrastructure [16].

Development of critical infrastructure (CI) could be viewed from academic, industrial and governmental aspects, which are vital for agriculture too [14]. One of the most common is the definition of the CI through its performance of one or more government or public functions; or creation of the space for citizens' survival, security and high quality of life, so stakeholders should be named to develop an effective strategy. We must report that in many cases governments do not understand the whole complex of infrastructure functions [12]. Moreover, key factors that increase the vulnerability of CI suffer from the lack of

staffing competencies and training [11]. Although the US Department of Homeland Security does not classify the system of science and education as CI, but recognizes its crucial role in implementing 11 vital functions [17, p. 49]. However, food and agriculture sector is one of the 16 critical infrastructure sectors in the USA.

The study of global infrastructure is of particular relevance, which can be seen on the example of the agricultural market, where is not only intensification of international trade in agriculture, changes in the structure of production and consumption, and population growth take place, but also because its modern understanding is quite diverse, but not systematic. In particular, Ukrainian scientists consider it through the main function of the global food market – support through the system of cross-border trade of the interaction of all elements of the world agricultural system and all parts of the food chain to supply the planet's population with the nutrients necessary for life [1, p. 124]. At the same time, one should be aware of their full variety – regulatory, informational, production, trading, logistics, financial, innovation and civilization functions. Russian authors consider it more institutionally – as a complex of enterprises and activities in the sphere of agriculture that streamline the flow of food and products and meet the needs of market actors [29]. This should envisage not only the complex of various institutions, but their stratification and co-operation.

4 Results of the research

The need for investments to modernize outdated

systems and meet the growing demand for infrastructure development around the world in the period up to 2030 will amount to 41 to 95 trillion USD [25]. At the same time, the territorial cost of infrastructure will be distributed as follows: Middle East - 2-3%; Africa 2-3%; USA / Canada - 15-16%; South America - 18-19%; Europe - 22-23%; Asia / Oceania - 38-39%. The sectoral structure of investments in the development of global universal and product-specific infrastructure is as follows: water and drainage - 55%, energy infrastructure - 21-22%, roads and roads - 19-20%, ports and airports - 3-4%. Unfortunately, many experts agree that the global economy will face many challenges of a lack of sufficient investment in the development of global infrastructure. According to the World Economic Forum experts the investment deficit in infrastructure development in the global economy will amount to 1 trillion USD each

TABLE 2 Global leaders in infrastructure development

countries	2018			2017		
	GCI rank	infrastructure development rank ↓	infrastructure development assessment (100 max)	GCI rank	infrastructure development rank	infrastructure development assessment (100 max)
Singapore	2	1	95,7	2	1	95,4
Hong Kong, SAR	7	2	94,0	7	2	94,8
Switzerland	4	3	93,3	4	3	93,2
Netherlands	6	4	92,4	5	4	92,7
Japan	5	5	91,5	8	5	92,1
Korea	15	6	91,3	17	7	90,5
Germany	3	7	90,2	3	6	91,0
France	17	8	90,1	18	8	90,1
USA	1	9	89,5	1	10	89,5
Spain	26	10	89,1	25	11	89,0
UK	8	11	89,0	6	9	89,9
Austria	22	12	88,3	21	12	88,7
Belgium	21	13	86,5	19	13	87,4
Denmark	10	14	86,3	11	15	86,1
UAE	27	15	86,2	27	14	86,6
Luxembourg	19	16	84,7	22	16	84,8
Sweden	9	17	84,4	9	17	84,3
Czech	29	18	83,5	29	19	83,8
Portugal	34	19	83,3	33	21	83,1
Israel	20	20	83,3	20	23	82,8
Italy	31	21	83,1	31	20	83,6

Source: compiled after [8]

infrastructure provision we should analyse the country's place in the structure of agricultural production. After all, the latter is the starting point for the formation of the global agricultural market and GAMI. Synthesis of possible directions of interaction between the factors and components of

year. Most probably it will make the global infrastructure gap wider [3].

In virtually none of the countries there is such a level of infrastructure development that could serve as a model for imitation (tabl.2). This is due to differences in the structure of economies, their place in global chains, and the depth of regional implementation of the scientific and technological achievements. Probably besides infrastructure there is a rather large number of factors that determine the global competitiveness of national economies and the level of their socio-economic development. One can observe that with the growing distance of countries' positions from the leaders the influence of the infrastructure is no longer a close link.

Sectoral dimension of global infrastructure's research on the sample of agricultural markets should be considered in complexity – along with the study of the country's position in terms of

the GAMI allowed to propose a matrix model that could become the basis for a comprehensive study of the complete system of interactions (Table 3).

The analysis of one of the factors of the model revealed the complexity of the interrelations that should be obvious. High food prices, as it turned

TABLE 3 Matrix model of the interaction of factors and components of the GAMI

factors	elements of infrastructure								
	trading	financial	social	institutional	logistical	informational	innovative	ecological	scientific and educational
population growth	+++	+++	+++	+++	++	+	+	-	++
climate change	+++	++	+++	+++	++	+	+++	+++	+
changes in the volume and nature of personal demand	+++	+++	+++	+	++	++	++	+	++
global struggle for major resources	+++	++	+	+++	++	+++	++	+++	++
changes in the values and moral priorities of consumers	-	-	+++	++	x	+++	+	+++	+++
political situation in the world	-	-	+++	+++	+++	+++	-	++	+
development of transport and communication	+++	++	+	++	++	+++	+++	-	+
world market conjuncture	+++	+++	++	+	++	++	++	++	+
global hyper-competition	+++	+++	++	++	+++	+++	+++	-	++
expansion of global sectoral TNCs	+++	+++	-	+	+++	++	+++	-	+
international commitments and international organizations	++	+++	++	+++	+	++	+	+++	+
distribution of the latest technologies and innovations	++	++	+	+	+++	+	+++	+++	++
international labour migration growth	+	+	+++	++	+	++	++	-	++
globalization of productive forces	+++	++	+++	+++	++	++	++	+	+
internationalization of trade and capital movement	+++	+++	++	+++	+++	++	+++	++	++
influence of production and consumption on the environment	-	x	+++	++	+	+	++	+++	++

Note:

+++ - decisive influence of the factor on the infrastructure element;

++ - significant influence of the factor;

+ - partial influence of the factor;

- factor has a negative impact ;

+ - partial influence of the factor;

x - absence of influence on the element

out from generalization of scientific publications, did not create the opportunity for the development of agricultural infrastructure of developing countries. FAO's monitoring of agricultural prices from 1990 to 2016 showed significant volatility – the price index in prices of one period fluctuated from 89,6 to 229,9 [27]. At the same time, for the last 12 years there is a global upturn trend for prices. Countries did not seize this opportunity to invest in assets, increase production and productivity, because the high price effect did not reach them, access to financially acceptable means of production was limited, only traditional technologies were available, there was no necessary infrastructure and institutional base, and, unfortunately, some measures of political response (such as price control and tariff reduction) have actually reduced incentives.

In order to test the hypothesis of the study on the sample of 139 countries, we calculated the density of correlation connection between the indicators of infrastructure development and GDP

of the countries (Table 4). Its analysis revealed that there is a rather low level of correlation between the indicators of infrastructure development and GDP of the countries. With an exception is the development of ports (sea and air).

The study of national features of infrastructure development should be carried out on the regional dimension too. Analysis of the regions of Ukraine on the level of infrastructure development allowed to divide them into clusters (Table 5). Unfortunately, the level of correlation between the index of infrastructure and value of gross agricultural output was only 0,061, indicating a virtual absence of a direct relationships.

Regional infrastructure differences have not been analysed for several years in Ukraine, so the most privileged is the position of those stakeholders, who use the chance to collect and analyse data on the field. Such a poor analytical support does not encourage investors, but the one, who take the risk, may become the first and get the cream.

TABLE 4 Correlation between indicators of infrastructure development and GDP of countries

	indicators	2018	2017
1.	airport connectivity	0,940	0,931
2.	liner shipping connectivity index	0,534	0,577
3.	efficiency of train services	0,315	0,297
4.	road quality index	0,268	0,268
5.	electrification rate (% of population)	0,362	0,244
6.	efficiency of seaport services	0,239	0,227
7.	quality of roads	0,224	0,213
8.	efficiency of air transport services	0,200	0,191
9.	railroad density	-0,001	-0,001
10.	global competitiveness index 4,0	0,304	0,297

Source: compiled after [5]

TABLE 5 Grouping the regions of Ukraine by level of development of infrastructure

level of infrastructure	infrastructure development index	region
high	4.16-4.56	Donetsk, Odesa, Kharkiv, Crimea
average	3.74-4.15	Dnipro, Zaporizhye, Kyiv, Lviv, Mykolayiv, Poltava, Rivne, Cherkasy, Chernihiv
low	3.31-3.73	Vinnysya, Volyn, Zhytomyr, Zakarpatska, Ivano-Frankivsk, Kirovograd, Lugansk, Sumy, Ternopil, Kherson, Khmelnytsky, Chernivtsi

Source: compiled after [20; 21]

5 Conclusions

Modern stage of development of the international economy is based on creating global network structures and markets, which operate on the basis of innovative technologies and relating to the sustenance of entire countries and regions. The GAMI is increasingly being identified as one of the numerous links of global markets, production networks and value chains. The global market that performs a function of system-integration element in the global economy should function as a reproductive mechanism of balancing global demand and global supply.

The study on the sample of the GAMI has found absent and extremely low levels of correlation between the performance of infrastructure and GDP for 139 countries and in Ukraine - between infrastructure development index and value of gross agricultural output. Such a state can have a number of explanations: a) the real absence of direct linear relationships, but the existence of a links of other types; b) the choice of indicators; c) the authenticity of the data. The authors of the study tend to the first substantiation, which can have a wide qualitative dimension, for studying

which researchers should diversify the system of indicators and carry out their monitoring.

The deficit and small volumes of investments directed by countries to infrastructure development are conditioned by the lack of evidence of their direct relationship with indicators of economic development.

At the national level, stakeholders need to understand that infrastructure development addresses two challenges: on the one hand, an increase in capital growth through domestic sources, and, on the other hand, the dynamics and pace of this growth is a prerequisite, from the point of view of national capital, for the impact on the establishment of optimal proportions of GAMI. Although Ukraine has begun to adapt EBRD methodology for infrastructure monitoring to the domestic conditions, but it should be developed in full [28]. To improve and evaluate the state of the commodity market, it's worth considering the experience and the current state of the agricultural market by the Department of Agriculture of the USA [7]. Their database contains the system of indicators characterizing the demand and supply structure and condition of the components of the US agricultural system.

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