CONSTRUCTION ECONOMICS AS AN INDICATOR OF MACROECONOMIC TRENDS

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Abstract: The article considers the dynamics and vectors of the construction development on a country and global scale, in the context of the macroeconomic impact and in the conditions of the corresponding dynamics of the environment. The role of sustainable construction in the modern world is shown. The role of the construction in the national wealth and well-being of individual countries is assessed. It is shown that investments in the construction produce a significant multiplier effect. Based on statistical data, it has been demonstrated that an increase in investment in housing construction can become a multiplier for the development of many related industries and regions, and one of the foundations of economic growth, including in the context of digitalization of the construction and the development of green building.

Keywords: construction; construction economics; macroeconomic indicators; housing investment; economic growth; green building.

1 Introduction

In any country, each branch of the national economy, in addition to the function of directly meeting the needs of society in certain types of goods or services, also performs specific macroeconomic functions. The most obvious of these is the function of interaction with other industries, i.e., the function of participation of any industry in the overall process of development of the economy as a whole. The second macroeconomic function primarily concerns the sectors that are part of the circle of fundamental, basic ones, and consists in their peculiar participation in the preparation of the "macroeconomic future" of the country. This means that the scale and "quality" of the development of any basic industry in the present to a large extent determine the possibilities of the national economy in the future, "preparing" for it either the preservation of the previous structure and pace, or accelerated development, or the emergence of new "bottlenecks" and restrictions which will remind of the inseparable connection of the present and the future with the past, of the need for timely macroeconomic regulation of proportions in the economy, etc.

The participation of basic industries in the preparation of the "macroeconomic future" directly predetermines the fulfillment by them of another macroeconomic function - the preparation of information on the possible macroeconomic prospects of the country in connection with the current volumes, structure and planned development forecasts for these industries, i.e., function of an indicator of possible macroeconomic prospects. At the stage of transition to the post-industrial era, the main sectoral indicators of macroeconomic prospects were the branches of science, education, telecommunications services and high technologies, since namely on their basis the process of qualitative transformations of the economy of advanced countries is taking place, the transition of civilization to a higher stage of development is being prepared. At the same time, the ongoing changes in the nature of basic and leading sectoral macroeconomic indicators, of course, do not mean that the function of such indicators is completely lost by traditional basic sectors, especially since for most countries of the world post-industrial sectors have not really become the most vital ones, since a very wide range of tasks of the previous stage of development remains.

Among all industries capable of performing the function of a macroeconomic indicator of future changes and prospects, it seems appropriate to highlight the construction, which, in our opinion, can successfully perform this function in economies of any type and at any stage of society maturity. Regardless of whether this society is industrial or post-industrial, the state of stagnation (or, moreover, recession) in construction will always signal a slowdown (in the present and near future) in the development of the economy of a given country as a whole, as well as an accelerated pace of development of this industry will serve as a sign of a change for the better in the country' economy.

Situational macroeconomic and geopolitical conditions have significantly actualized the issues of effective tactics, the possibility of flexible correction of goals, objectives, and indicators of the state of construction enterprises in world and especially regional markets. The strategic guidelines of the industry are to strengthen competitiveness, provide the material basis for the quality of life, and shaping a business environment.

In addition, trends in sustainable development and the digital economy are having a direct and critical impact on the construction. Thus, a systematic study of the relationship between the development vectors of the construction and the dynamics of macroeconomic indicators seems to be a very relevant scientific task.

2 Materials and Methods

In the course of the study, methods of a systematic approach, behavioral economics, forecasting, statistics, innovation studies, methods of analysis and synthesis, as well as the methodology of a value-oriented approach were used. The study was carried out using macroeconomic analysis and investment theories of economic growth.

3 Results and Discussion

In the 21st century, an investment and construction complex can be attributed to a complex self-organizing open system [2]. Periodic changes associated with improving the quality of the process of self-organization of the construction and investment complex are evolutionary, since the ongoing changes are of a bifurcation nature and lead to a change in development attractors. Bifurcation in this context refers to all kinds of qualitative changes (restructuring, metamorphoses) when changing the parameters of the objects under study. Moreover, such bifurcation changes can be caused in the system of the construction and investment complex both by internal contradictions and by various external factors.

The construction (and corresponding investment') complex has experienced more than one bifurcation change in its development, which was caused by contradictions that formed at the end of the 20th century. It is also possible to single out fundamental contradictions that, most likely, have developed between the goal of a market economy that makes profits, and the economic system as a whole, which creates high-quality objects using fixed assets.

Contradictions also arise between the quality of the production base and the dynamics of development in the construction industry. These contradictions are connected with investments and volumes of the complex. Such complexes also have structural imbalances, which in most cases are due to insufficient funding for especially unprofitable, but necessary areas in construction. Although an evolutionary stage is observed in the development of the construction complex, this does not mean the cessation of changes, since, based on the methodological approach to socio-economic development, economic processes are undulating.

The construction is often criticized for being too conservative, especially for bureaucracy in document management and standardization, so this industry is still considered to be lagging behind in the implementation of digital technologies. Difficulties in the use of advanced technologies in the construction segment are primarily associated with stringent requirements in the construction of facilities - these are increased safety requirements. Therefore, each new technology that is being introduced must have standardization taking into account safety precautions, a regulatory framework, and a final cost with self-sufficiency. The final cost, taking into account its development, necessarily must be adequate to efficiency, taking into account the reduction in the present and future costs, and prolonged in

time. Advanced technologies, like everything new, require the appropriate design of the complex and the work attached to it, with the involvement of qualified specialists (project team) as the project managers and quality control.

Although the use of digital technologies provides a large number of advantages in the implementation of the project, nevertheless, it requires qualified personnel and increased material resources, and it is the task of the state to provide an advanced regulatory and technical framework and a legal foundation.

One of the promising areas of digitalization in construction is 3D printing. Truck-based "printers" already exist that allow brick buildings and other technological solutions (for example, printing from concrete) to be "printed". So far, low-rise construction is the most promising with the use of this technology. First of all, this refers to the direction of "3D Concrete Printing", for which in the last decade a steady trend has been formed of an annual increase in the number of new scientific publications, that also contributed to the creation and development of a number of related areas of research in the field of building materials science related to the control of rheological and technological properties of dispersed building mixtures, control of the kinetics of hardening of materials based on mineral binders, dispersed reinforcement, and other ways to improve the strength characteristics of composites of hydration hardening in tension in bending, etc. [3].

A very effective and promising direction is the introduction of integrated building condition sensor systems that allow monitoring the main building parameters, energy efficiency, and the state of infrastructure networks. The use of such a system, built in advance, allows significantly reducing operating costs, carrying out repairs according to the actual state.

The use of robotics is another interesting and promising area of digitalization. Demolisher robots are already being used for demolition work in conditions that pose a danger to humans. The development of machine vision technologies, various sensors, and artificial intelligence systems makes it possible to create construction robots [3]. A collaborative robot (cobot) is an automatic device that can work in conjunction with a human to create or produce various products. This will bring robotics out of the existing narrow niche and launch a wide range of robotic construction equipment on the market. Other promising areas here are the following: automatic self-propelled carts, which are widely used in industry, but so far little used in construction; aerial drones that can be used as an effective tool for monitoring the progress of construction work. Manufacturers plan to launch a wide range of robotic construction equipment on the market in the near future.

Automation of business management in construction also involves the use of digital technologies: centralized control over the purchase and consumption of materials, the use of construction equipment and working hours. One of the innovations developed by small businesses is special bracelets for construction workers that track their movements, workload, and health status. The use of modern software allows carrying out more effective control and standardization of the construction process. Data show that digitalization can lead to a productivity increase in the construction industry between 14 and 15 percent [22].

Also, the role of the "green" (environmental-climatic) factor in stimulating and meaningful filling of qualitative changes in the structure of the world economy and its main subsystems, changes that make up the essence of the modernization process, is significantly increasing. Its nature and dynamics will be determined not only by the scale and intensity of the use of high technologies (NBIC) of the V and VI orders, but also by the "green" vector of the mentioned changes, as a result of which environmental and climatic factors should turn from (exclusively) a limiter into an accelerator of economic growth and thanks to eco-innovations, to stimulate the transition to a qualitatively new model of the "green" economy [14].

This is confirmed, in particular, by the results of an authoritative expert estimation of the most promising technologies that have not yet become widespread, but have significant potential to transform the traditional way of life and socio-economic effect and are already attracting significant investment. Half of the top ten such technologies are eco-innovations in the field of water supply, energy, agriculture, as well as construction and transport [16]. In recent years, the eco-building movement has become increasingly complex and large-scale, a clear example of which is the trend to build entire eco-cities, where the natural environment, urban planning, development, communications, and the lifestyle itself are in harmony with each other. Among the newest and largest urban development projects are Masdar City in the United Arab Emirates, Houguan Lake near the city of Wuhan in China, the city of Songdo in South Korea, and others.

The noted trend is clearly seen in the economic policy of the European leaders of "green" economic growth - Great Britain and Germany - whose governments and business circles consider the production of environmentally friendly and low-carbon products, equipment for protecting the environment, technologies for reducing climate risks and adapting to the consequences of climate change as the most promising direction of national exports, including in the field of building materials and technologies.

According to the UN-supported Principles for Responsible Investment (PRI), "responsible investment is an approach to investment that clearly recognizes the importance of the economic, environmental, social and governance factors of sustainable development, as well as the long-term health and stability of the market as a whole, to the investor" [5]. It recognizes that long-term sustainable income generation depends on stable, well-functioning and well-governed social, environmental, and economic systems.

Despite extensive efforts to assess sustainability aspects, few attempts have been identified in the academic literature to integrate and balance investors' and developers' responsibility for the local community, economy, and environmental issues with their financial expectations. However, it is very important to understand that from the point of view of developers and real estate investors, even if the investment is sustainable, it must be financially viable.

Methods based on a single criterion are unlikely to be effectively used to solve problems associated with a complex decision-making environment in choosing a suitable investment option. Therefore, the value and utility of various investment alternatives can be determined by multi-criteria decision-making methods (MCDM) [9]. There are many MCDM tools that can be successfully used to make decisions on various sustainability issues: Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), Fuzzy Analytic Hierarchy Process (AHP), etc. However, it is clear that the development of green building and related certification (LEED, BREAM and the like) is a growth driver for the share of the service sector and public administration in GDP.

Nevertheless, "green building has created millions of jobs and contributed hundreds of billions of dollars to the U.S. economy, with the construction of LEED-certified buildings accounting for about 40 percent of green construction's overall contribution to GDP in 2015" [18]. Moreover, there are evidence-based forecasts of significant growth in green building's contribution to individual states' tax contributions and environmental asset indicators at both the national and state levels [8].

Interestingly, if to look at statistics of quarterly GDP in volume terms for G20 countries (Figure 1) and correlate it with the data on green building market (Figure 2), simultaneous huge growth of GDP and green building volumes becomes evident.
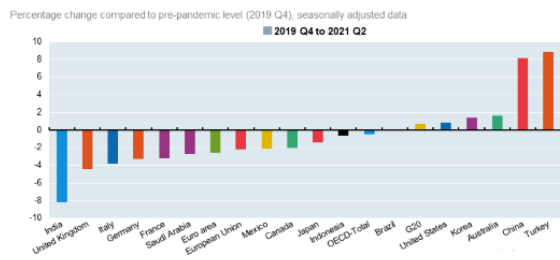
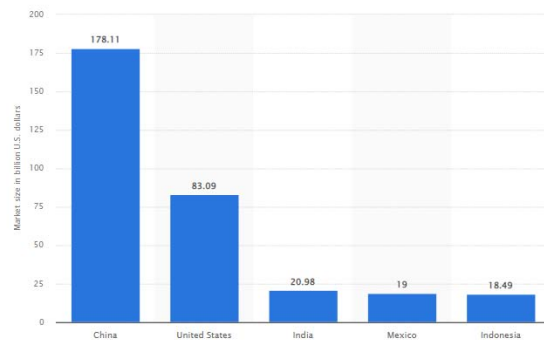*Figure 1. Quarterly GDP in volume terms for G20 countries*
[15]

Figure 2. Size of the green building market worldwide in 2021, in selected countries (in billion U.S. dollars) [19]

Trends and development prospects in the construction on a global scale are analyzed by a wide range of reputable consulting companies and expert groups. Forecasts and analyzes of the global and regional construction markets from GlobalData, Global Construction, PWC (Oxford Economics), and The Business Research Company, as a whole, despite the difference in quantitative forecasts and estimates, demonstrated a similar opinion on the results of 2020 and the forecast for the medium term.

While the global construction has been recovering from the COVID-19 crisis, it has suffered huge losses in terms of lost revenue, with total production in 2020-21 nearly $1.1 trillion lower than it would otherwise be the case. According to GlobalData's Global Construction Forecast 2025 Update Q1 2021 (UK), there is still a lot of uncertainty about how the COVID-19 crisis will 'play out' [8]. However, the forecast for global construction volume is based on the assumption that governments and health authorities will not reintroduce strict lockdown policies and that construction sites can continue to operate with minimal disruption.

At the same time, the recovery in many construction markets at the end of 2020 came as a surprise. This means that the annual result in 2020 was not as bad as it was previously expected. The global construction market showed growth from $11,491.42 billion in 2020 to $12,526.4 billion in 2021 at a CAGR of 9%. Growth is mainly due to companies restructuring their operations and recovering from the impact of COVID-19. According to a GlobalData report, the market is expected to reach $16,614.18 billion in 2025 at a CAGR of 7% [12].

The Asia-Pacific region was the largest region in the global construction market, accounting for 42% of the market in 2020. North America was the second largest region, accounting for 26% of the global construction market. Africa region was the smallest one.

According to the Global Construction 2030 (UK) report, 2020 was not the worst year for the construction, unlike for many other sectors of the economy. Construction has remained a priority industry in most countries, and this allowed it to continue operating during lockdowns. In addition, the "work

from home" order encouraged people to invest more in their own housing. Of the 90 countries included in the Global Construction 2030 report, 16 saw a double-digit decline in construction in 2020; with Panama (-30%), Singapore (-25%), and the Philippines (-22%) experienced the hardest hit. But there are countries where there was significant growth: in particular, Saudi Arabia (+15%) showed double-digit percentage growth [7].

According to Global Construction experts, construction is likely to lag behind the growth of the global economy in the coming years, especially as it is more affected by the lack of public finances, despite the fact that many countries have announced increased investment in infrastructure. Over the next two years, as the world emerges from the COVID crisis, construction volumes worldwide will increase by an average of 3.2% per year. In the term 2023-2030, construction is projected to increase by an average of 2.3% per annum globally, with annual growth rates varying from a decline in Japan (-0.5% per annum) up to an increase exceeding 8% per annum in Tanzania (+8.4% per annum), Ethiopia (+8.4% per annum) and Bangladesh (+8.0% per annum). According to the publication's experts, the value of global construction production in US dollars at constant exchange rates and in 2020 prices will increase from $11.6 trillion in 2020 to about $14.8 trillion in 2030, while the growth rate will average 2.5% per year. China is expected to remain the world's largest construction market, but will decline from 32.0% of the world's total in 2020 to 29.2% in 2030. Japan's contribution to the total is also expected to decline from 7.0% in 2020 to 5.4% in 2030, when it will be overtaken by India as it becomes the third largest construction market in the world. The publication expects Indonesia to surpass France and Australia to become the sixth largest construction market in 2030, while France will drop from the sixth largest in 2020 to the eighth largest in 2030 [8].

An important driver of the global construction market will be the fact that annually between 2020 and 2030 around 43 million new homes will be needed worldwide, of which 11 million in India, 7 million in China, 2 million in Nigeria, and 1.5 million in the USA. Brazil, Pakistan and Indonesia are expected to require over a million new homes each year [4].

According to the PWC (Oxford Economics, UK) report "Capital Projects and Infrastructure Spending: Forecast to 2025", infrastructure spending has begun to recover from the global financial crisis and is expected to increase significantly in the next decade. Experts draw a conclusion based on an analysis of 49 countries that account for 90% of world economic production. In developing this analysis, Oxford Economics used datasets to provide consistent, reliable, and repeatable measures of projected capital projects and infrastructure spending both globally and across countries. Historical spending data was taken from statistical sources of governments and multinational organizations. Forecasts are based on private economic models developed by Oxford Economics at country and sector levels.

According to experts from Oxford Economics, the world's spending on the construction of infrastructure facilities will increase to more than 2.5 times by 2025 compared to 2012 [16]. But the recovery will be uneven. Meanwhile, emerging markets, unburdened by austerity or weak banks, will see accelerated growth in infrastructure spending, especially in China and other Asian countries. At the same time, megacities in both emerging and developed markets - reflecting changing economic and demographic trends - will create a huge need for new infrastructure. These paradigm shifts will leave a lasting, fundamental imprint on infrastructure development for decades to come.

According to the forecasts of analysts from The Business Research Company (India, UK, USA), the trends in the global construction market until 2021 already included the use of autonomous construction machines, digital technologies to improve construction safety, and more. Global construction market data from The Business Research Company's latest study of the global construction shows that the market is expected to grow at a compound annual growth rate (CAGR) of 7.5% from

2021 to reach 15 trillion dollars in 2023 [12]. A growing trend in the global construction is the use of autonomous construction machines, digital technologies to improve construction safety.

Construction companies will increasingly use autonomous construction vehicles to increase productivity. These automated vehicles are equipped with sensors, cameras, and GPS. Real-time data from these devices helps to remotely monitor the jobsite and reduce construction time. Vehicles connected via the Internet of Things, RFID (Radio Frequency Identification) tracking technologies are also helping the construction to be more efficient and safer.

Leading manufacturers such as Komatsu, Caterpillar, and Volvo CE are constantly releasing new models of autonomous, semi-autonomous, and remote controlled excavators and other heavy equipment. Royal Truck & Equipment is conducting pilot tests with the Florida Department of Transportation (USA) for unmanned trucks for work areas.

According to a report by The Business Research Company, the construction market is highly fragmented with many small players. The top ten players account for about 4.7% of the market. This is mainly due to the presence of a large number of small players that serve the local population, since most clients use construction services located closer to their location. However, large companies play a leading role in large infrastructure projects. The main market players are China State Construction Engineering Co., Ltd., China Railway Group Ltd., China Railway Construction Corporation Limited, China Communications Construction Group Ltd., Vinci S.A., and others.

Strategies currently adopted by key players in the construction industry include, among others, investing in green building projects and expanding business through strategic partnerships and acquisitions of companies from developing countries. In addition, large foreign construction companies are increasingly using green building technologies to build energy efficient buildings and reduce construction costs. Green building refers to the practice of using sustainable building materials and building processes to create energy efficient buildings with minimal environmental impact. According to the 2018 Global Green Building Trends Survey, about 47% of surveyed companies believe that they will build about 60% of their projects using green technologies in the nearest couple of years [23].

With the implementation of the most favorable forecast (The Business Research Company and GlobalData), the volume of the global construction market from 2020 will increase by 25% in 2023 (from 12 to 15 trillion US dollars) and by 42% by 2025 (from 12 to 17 trillion US dollars). If a less favorable scenario is implemented, the threshold of 15 trillion US dollars will be reached only in 2030 [7].

Based on the estimates of international experts, it can be concluded that in the medium term, the projected growth of the world economy of 2.9-3.0% can be achieved, in particular, through the restoration of investment in construction projects, the revival of related industries and trade in construction services.

The pandemic has acted as a catalyst for innovative changes in business processes in construction, revealing the competitive advantages of remote working methods. Accordingly, in the coming years, the entire construction management system should change qualitatively in the direction of a digital format of work in a single information environment. The construction sector is experiencing significant difficulties and restrictions caused by macroeconomic and geopolitical changes, reduced demand and solvency. At the same time, socially oriented management will have a positive effect on the regional and global market in the face of strategic uncertainty. Meanwhile, in the US, residential construction spending, as opposed to non-residential and public, showed significant growth during the pandemic (2019-2020) (see Figure 3 below).
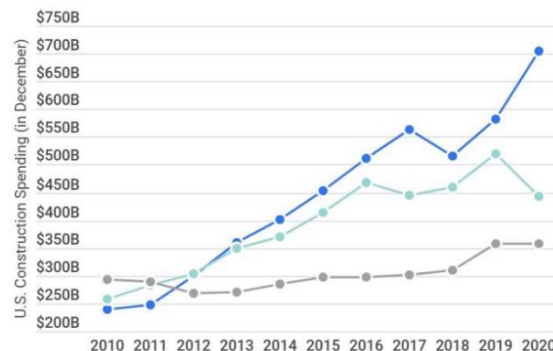

Figure 3. U.S. construction spending 2010-2020 [10]

"Since May 2020, about 931,000 jobs have been added back to the industry. From March to July 2020, the residential deck construction rate increased by 275%" [10]. It is predicted that there will be approximately 300,200 more construction jobs in 2029 than in 2019.

This phenomenon has its explanation: "Construction is typically much more volatile than the overall economy. Reduced economic activity results in less demand for new commercial or industrial facilities, and ambiguity further dampens investment. Loss of income and lack of consumer confidence negatively affect demand for housing construction or refurbishment. And as the value of buildings and infrastructure closely tracks GDP, the need for new construction activity is highly sensitive to GDP growth, even in longer-term models. A four-year slump, for example, could substantially reduce construction's share of GDP above and beyond the initial contraction—even though the current crisis is not primarily related to real estate, as it was in 2008. On the upside, unprecedented public-relief packages could not only support a rapid recovery but also be followed by public-investment programs" [13].

The modern world market for construction services has all the signs of a formed market: demand, supply, frequency of transactions and their significant volume, activities of specialized firms providing construction services. The activity of these commercial organizations is connected with the coordination of intersectoral relations and other commodity markets. At the same time, the construction services market should be distinguished from other related markets, for example, the engineering services market and the complete equipment market.

The development of the modern world market for construction services is associated with an increase in information and technological support; the price of construction services is increasingly less associated with material costs. The key methods of competition in the construction services market are logistics and engineering. The timely delivery of high-quality materials and complete equipment plays an important role in saving costs during construction [1].

Within the framework of the global economy, the construction services market has the following meanings that worth mentioning:

▪ In some countries, construction services also form completed real estate objects, which contribute to the growth of the socio-economic development of the state;
▪ Meeting the needs of people and society in housing;
▪ The construction forms an unfinished production cycle, which in the future will include, for example, reconstruction, repair, rental services, etc.;
▪ Due to labor intensity, the construction forms a large share of employment in the global economy.

Analyzing the trends in the functioning and development of the world market for construction services in the context of today's globalization, one can outline the following distinctive features [2]:

- The basis of foreign trade in construction services is the project-oriented internationalization of the economy;
- The largest exports of construction services are energy, transport and urban construction;
- The modern construction business is characterized by a complex organizational structure for the introduction of entrepreneurial activities;
- The world market of construction services is closely interconnected with such processes as investments, movement of individuals and intellectual capital;
- The modern market of construction services is being transformed from a construction market into an investment and construction complex;
- The world market of construction services does not have a high level of market share concentration in the hands of individual organizations. Reverse processes are inherent, such as flexibility and market competition;
- The trend in the development of the world market of construction services is the process of increasing privatization of the housing and communal complex in various countries, which leads to the creation of new enterprises;
- The modern market of construction services is faced with the process of increased liberalization of state regulation and creation of institutions of self-regulation.

The above processes give solid grounds to conclude that in the next 10-20 years, despite the decrease in the unit costs of construction work and vice versa, the impact of scientific and technological progress, the demand for construction services and works will only increase. In particular, this applies to the Asian region, where the process of demographic growth is many times higher than in other parts of the world, and thus, all the prerequisites are being formed that namely countries such as China and India will become world leaders in terms of volume and capitalization of the construction services market. Today, the world leader is the United States, followed by China. At the same time, Japan, the third country in the world in terms of capitalization of the construction market, is 2 times inferior to them. Among the other countries in the TOP-10 there are India, Germany, France, Italy, South Korea, and Spain.

Thus, the current trends in the functioning and development of the world market for construction services in the context of globalization provide prerequisites for an increase in the volume of capitalization of the industry, an increase in its share in GDP, and a shift in focus towards innovative technologies and environmental safety.

Back in 1993, a World Bank paper was published, that used data from many countries in the post-war period. It was determined that housing investment in GDP is very small, about 2-4% when GDP per capita is below 1000 USD, but quickly starts to grow, up to 8% of GDP when GDP per capita reaches 1000-5000 USD, then their growth in GDP slows down again and remains at a stable level when GDP per capita reaches a higher level [1].

More recent work by Berns and Grebler (cited in Abdulai et al. in the work published in 2018) hypothesized that the share of investment in residential construction in GDP is related to the stage of economic development in an inverted U-shaped manner: the ratio first increases with increasing GDP per capita, when the economy is gaining momentum, but peaks as the economy enters a middle-income period and then tends to decline as the economy becomes advanced. This hypothesis is currently confirmed theoretically and empirically and is used in research in this area [1].

In addition, in his article of 2007, Leamer proves that housing investment, being a key component of the developed countries' GDP, is the most important early indicator of an upcoming recession - the best predictive indicator of the economic cycle [11]. That paper concludes that residential investments in the US have a consumer rather than a production business cycle and, accordingly, their contribution to GDP depends on consumer expectations and preferences, while housing investment can have a random impact on normal economic growth. At the same time,

a weak housing sector increases the threat to economic growth during crisis and recession periods of economy development.

Many studies basically support the theory that GDP growth is a driver of housing investment growth. At the same time, a number of works substantiate the conclusion that housing investment in itself can be a multiplier of economic growth [6].

In developed countries, where a free housing market has existed for a long time, significant information material has been accumulated on the relationship between housing investment, housing market development, and economic growth. The main method for studying the relationship between housing investment and GDP is the Granger non-linear causality test based on the vector autoregression (VAR) method. According to this method, "the degree of influence of one system on another is estimated by the change in the accuracy of predicting the behavior of the first system when data on the fluctuations of the second system are introduced into the predictive mathematical model. A decrease in the forecast error is interpreted as a sign of the influence of the second system on the first one" [14]. To implement the Granger test, stationary data are selected, autoregressive parameters are formed with a certain lag length, and the vector autoregression model is evaluated. If the time series are not stationary, but integrated up to the first order, their difference is applied to bring them to a stationary form.

In more in-depth studies of the housing sector, Chinese economists apply the Granger method which allows tracing a deeper relationship between the studied phenomena, and use quarterly data to lengthen the time series. These studies show that housing investment is currently having a significant long-term impact on the Chinese economy [21].

According to independent analysts, the construction affects the activities of more than 20 related sectors [22]. In addition, defining a high-tech industry that is actively developing in this chain, one can single out the construction industry, the construction complex of specific regions. Namely in the construction, the transition to digital modeling of the construction process - BIM-design (Building Information Model) - is quite active. Studying covering the issue of digital processes in the construction in the scientific literature, it is possible to single out both publications that address issues of problematic aspects of the transition of construction organizations to the digitalization process [4], and works that describe the advantages of BIM technologies in the context of the prospective development of territories [2, 7, 16]. The construction industry is considered quite capital-intensive, it provides a significant number of jobs, and the product of its creation is intended to meet the basic needs of society (housing, infrastructure, roads, etc.), so the availability of scientific, technical, and production capabilities helps to form an order for search the best technological solutions, innovative technical developments, which affects the efficiency of the economy as a whole.

The innovative development of the construction sector is aimed at improving the main technical and economic indicators of the formation of construction products, including reducing the cost of facilities, reducing the standard construction time and improving the quality of facilities. As a result, it becomes possible to make the most optimal use of investments from other sectors of the economy in its development as a whole, including innovative ones [2].

There is a mutual influence of the macroeconomic situation and growth dynamics in the construction. In particular, massive government investment and tourism are prime drivers for construction in GCC countries (see Figure 4 below).

Figure 4. Drivers for construction growth in GCC countries

The level of development of the housing sector and its impact on the economic growth of the country and regions is an important factor in the formation of the economic and social policy of the state, that is, in particular, public spending as one of the important macroeconomic indicators. Investments in housing construction and renovation of residential buildings form housing investments, which are part of investment in the economy. The development of housing construction increases the gross domestic product, creates demand for the products of related industries and transport. Moreover, the development of the housing sector affects the mobility of the labor force, the efficiency of its use, as well as the level of human capital in general. Economic policy in developed countries largely pays attention to the state of the housing market and residential construction, using various types of indirect impact on its development. This attention to the housing sector is due to the multiplicity of empirical evidence of the multiplier impact of housing market development on the economic growth of countries and regions.

The main contentious point discussed by economists for a long time the question of which process is a predominant one: whether housing investment can allow a country to increase GDP, or whether GDP growth leads to an increase in housing investment, as well as the question of how this process works in developed and developing countries. This article does not aim to cover the entire spectrum of economic views on the role and place of the housing sector in economic development, but we made a selection of information on the issue of housing investment and economic growth. Although housing investments in general include not only investments in the construction of houses, but also investments in repairs and renovation of existing housing, the main focus of economists is on the segment of investments in residential construction.

Investments in the housing sector represent one of the areas of investment spending and this is the main factor in stimulating household savings. As studies by American scientists have shown, there is a relationship between housing affordability and demographic processes: if the cost of housing decreases by 10%, then the number of families increases by 0.25% [9]. If to consider this from the point of view of the theory of the life cycle of savings, then an increase in the share of the young population should entail an excess of savings over their expenditures, i.e., an increase in net total savings [2]. Thus, an increase in investment in housing should lead to an increase in the savings rate, which, as already noted, serves as a source of investment resources and acceleration of economic growth. This conclusion is, of course, not unambiguous. Speaking of the young population, in this case, apparently, the working population should be kept in mind. Therefore, at the initial stage, population growth may even lead to a relative decrease in economic growth (i.e., a decrease in per capita income). That is, one can talk about the long-term aspect of an increase in the savings rate, which, apparently, will occur with a significant time lag.

The improvement of living conditions affects the increase in production also from the other side. If to analyze the production function, which links the volume of output with the costs of production factors (resources) and with the level of technology (total productivity of factors), the improvement of housing conditions is seen both directly and indirectly a factor in economic growth.

According to the data of Statista Research Department, "the construction market in the United States is one of the largest in the world, with private spending still increasing on a year-to-year basis, and with roughly 8 million people employed in the industry. It is expected that new construction put in place will total 1,449 billion U.S. dollars by 2023. .... To maintain its competitive standing, the construction must overcome various barriers, including those within the industry and external complications like the state of the U.S. economy. Currently, a shortage in skilled labor has slowed the speed of on-site projects and making it even more difficult for encouraging new talent to begin [20]. Value added by the construction as a share of gross domestic product in the United States from 2000 to 2021 is shown in Figure 5 below.
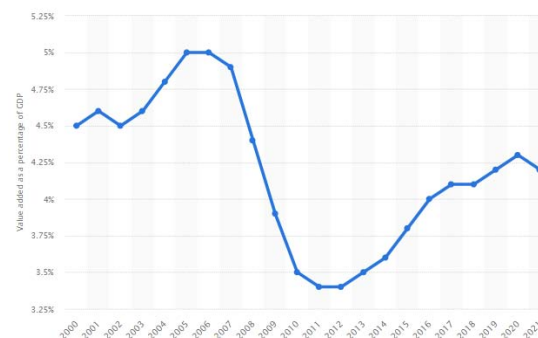

Figure 5. Value added by the construction as a share of gross domestic product in the United States from 2000 to 2021

Thus, overall systemic ties and correlations between construction and macroeconomic indicators appear exclusively complex, mutually determined, and regionally- and country- dependent, and to predict the overall effect of investments in the construction sector of the economy, as well as the corresponding generalizing (multiplicative) effect, it is necessary to develop a dynamic time model. However, the overall trend is evident – construction, uniting in itself digitalization and greening as drivers of Industry 4.0, occupies one of the core places among the factors of national economies' growth and is capable of improving macroeconomic indicators even during crisis time (as pandemic period evidence demonstrates). In general, the development of international trade in construction services is important for both the national and the world economy, providing an increase in added value and creating a basis for the development of other industries and the economy, stimulating the transfer of technologies and investments, ensuring an adequate level of employment, income, and level of the life of population.

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Primary Paper Section: A

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