

INNOVATIVE POTENTIAL AND DEVELOPMENT OF RESIDENTIAL CONSTRUCTION IN THE 10 BIGGEST CITIES IN THE REPUBLIC OF BULGARIA

TSVETELINA ATANASOVA

*University of Economics – Varna,
77, Knyaz Boris I Blvd, 9002 Varna, Bulgaria,
e-mail: tsvetelinaatanasova9@abv.bg*

Abstract. The development of the innovation potential in the stages of residential construction is of fundamental importance for the development of the construction sector. As a result of these innovations, the sector continues to grow and occupy an increasing market share in the country economy. For the purposes of the study we will analyze data on the volume and cost of residential construction in the 10 largest cities in Bulgaria. This sector is one of the fastest growing in production. Possibilities of investing in residential properties arise due to the lack of income in savings accounts and the low percentage on mortgage loans, and for reason of that their prices rise. With the development of the sector, gross domestic product also rises.

Keywords: innovations, residential construction, real estate, prices, Covid 19.

1. INTRODUCTION

The concept of innovation originates from the Latin word “novus” literally meaning new. The word has been implemented by Josef Schumpeter in 1911, in regard to entrepreneurship in labor economics “Theory of Economic Development”. The author presents the concept as “the implementation of new combinations”, i.e. the ability of man to create and implement new items [1].

Innovations in residential construction are directly related to the development of the construction sector and the country economy. The development of the sector has an impact on the increase of the Gross Domestic Product (GDP). The construction as a tangible basis ensures the functioning of other sectors. It is influenced by various factors and its analysing is of great importance for the development of the country.

In this regard, the study subject of this publication is the residential construction in 10 largest cities in Bulgaria, and the field of study is the innovation

DOI: 10.7546/EngSci.LIX.22.01.03

potential and development in residential construction, namely the changes in prices and volume of construction output.

The goal we set is to present the innovation potential in the stages of residential construction and to study the changes in prices and volume of construction output in the 10 largest cities in Bulgaria for 2020 compared to 2015, and on this basis to outline the reasons for their deviation.

Author's working hypothesis is that innovations in the respective stages of residential construction affect a number of factors, such as production costs, profit, return on investment, level of completed project, exterior and interior, etc., they are of particular importance for the development of the construction sector. The changes in the volume and prices of residential construction in the 10 largest cities in Bulgaria are crucial for increasing the country GDP and increasing competitiveness.

2. METHODS AND DATA FOR INNOVATIONS IN RESIDENTIAL CONSTRUCTION

Construction is “a sector of the national economy in which particular economic units (construction enterprises) are engaged in conscious and purposeful activities, combining individual elements into one whole unit, thus creating completely new fixed tangible assets, performing repairs, reconstructions, modernization, overhauling or liquidating existing fixed assets having production or non-production purpose” according to [2]. The separation of construction as a sector of the national economy requires that it is being statistically monitored and reported by other sectors. The end result of construction activities is construction output. It represents sites and complex sites constructed in accordance with the investment projects and stages (subprojects) that are being put into operation, after issuing a permit for use by the competent authorities, i.e. this is “construction products in final consumption” – a specific commodity that can satisfy real or potential needs and desires and once it is being realized (or built) it is offered on the investment market for exchange. The construction output realized on the market of exchange relations is offered as real estate, which is presented in the appraisal standards as a physical plot of land with the adjacent improvements made by humans. In other words, immovable property is a tangible item in aggregation with all the facilities on the ground, as well as those below or above it [3]. In the literature there are many and diverse concepts of innovation presented according to their field or field of application, economic, social, legal, etc. The concept of innovation is “Innovation means launching a new or significantly improved product (good

or service) or production process, a new marketing method or a new organizational method in commercial practice, the organization of workplaces or external relations that create market advantages while increasing the competitiveness of companies” according to Eurostat [4].

Innovations are “... the end result (product, process, service, method, organization, etc.) of a creative and purposeful activity, characterized by the presence of improved or progressive qualitative change – a novelty that better satisfies already existing or artificially created needs, imposed mainly by the scientific and technological development of society” as presented in [5]. The concept of innovations in construction is defined as “new or improved construction products, services and methods for organization and management of construction production, arising from the application of new materials, new technologies, information and communication technologies in construction process management” [6].

Due to the specific features of the construction sector, its production process, investment process and its commissioning, we define the concept of innovation in construction as innovation in the form of methods, technologies, products or services in the construction stages of a construction product, aiming at satisfying the needs and benefits of the participants in the investment process, the construction process even and after its commissioning. Construction innovations for the purposes of this study should be divided into three main groups:

- Investment innovations (investment research, investment design);
- Construction innovations (construction of construction products);
- Innovations related to the realization of construction products.

Investment innovations in construction should be understood as the implementation of innovations in the stages of the investment process – investment research and investment design [7]. In the first stage of investment research, the innovations are in the prospective studies, in the representative studies and in the studies during the design and construction. Such innovations are in the field of selecting survey contractors, innovative products and technologies in engineering surveys, geodetic surveys and specific surveys (reconstruction, superstructure, extension) and etc.

In the second stage of investment design, there are innovations in the conceptual design, technical design and working design. Innovations in the conceptual design are represented by innovations in the architecture, interior and exterior of the project. Innovations related to the technical elements of the project are being applied in the technical projects. In the working projects innovations are related to the more accurate, faster and easier preparation

of the detailed technical documentation, supported by specialized software or programs for drawing, sizing, etc. As a possibility for an innovative approach in the investment part we can propose the choice of a company performing all investment activities preceding site construction, including investment research and investment design, presented by the latest technologies such as virtual reality and augmented reality. Virtual reality in construction can help in two main ways:

- Projects made in virtual reality demonstrate the overall appearance and individual parts of the building. In the process of working on the use of such software we could detect and improve various disadvantages of the project.
- The use of such virtual reality software can be used by participants in the investment process – architects, designers, managers thus facilitating their communication.

On the other hand, Augmented Reality (AR) is an even better tool compared to virtual reality, allowing 3D visualization of future projects within their surrounding environment, automatic building measurements, fast and accessible simulation of architectural and structural changes, safety training and hazard simulations.

Another technology used in more advanced countries is Blockchain [8], first used for mining the cryptocurrency bitcoin (a medium of exchange based on blockchain technology and cryptography for transaction reporting and control over new units creation). Cryptocurrencies are a subspecies of alternative currencies or in particular digital currency representing a way of recording information. It is widely used in the management of construction projects. This new technology offers an intuitive way to increase project efficiency. Using it allows all data related to the project to be encrypted and the stored information to be really protected, thus helping to keep it securely stored in one place, but accessible from any place on the planet. In the forthcoming years, construction industry anticipates that blockchain technology is likely to affect many aspects of construction process management, from contracts and asset management to payments and supplies of materials.

Innovations in construction comprise innovations directly related to construction and construction works. “Innovations in construction” it means “a set of assignor activities and other contractors related to the implementation of construction and installation works and services necessary to authorize the use and commissioning of a building” according to [7]. Innovations in the construction phase of the building are related to the type and amount of construction and installation works and their value, the construction technology and

its duration, the implementation, the organization and the workforce of the construction. Such innovations comprise of new materials, machines, building technologies, and new models for organizing the work on the construction site.

We can present examples of innovations in construction such as the introduction of robots as a workforce in construction such as the prototype of the company Printstone that invented a multifunctional construction robot [9]. It was created in order to support and automate construction activities. The robot is with electric drive, all-terrain. It can be controlled manually using a smartphone application or be set to follow pre-programmed commands. The robot is able to climb stairs, go through doors and is able to work eight hours on a single charge. The Baubot multifunctional arm has a range of 1000 mm, an accuracy of less than 1 mm and can hold a number of different tools to help with construction tasks such as milling and drilling, screwing, plasma cutting, welding, bricklaying, sanding and painting surfaces, etc. It can also carry a payload of up to 500 kg on its back. In this way, it can transport materials to where they are needed. Baubot integrated cameras allow surveillance of the site. The robot has displays to indicate status notifications and advisory messages to fellow human beings and built-in lighting and surveillance. The goal of creating this type of models is to reduce labor costs in construction and robotics.

Construction drones (remote-controlled aircraft) are also participating in the new era of construction. For example they are used for mapping. Drones are quickly exploring large areas of land in a very short time, reducing mapping costs by as much as 95% [8]. Construction drones at particular settings can automatically monitor all site equipment, and can act as security guards when there is no other site supervision.

Modular constructions are also a new method of construction in which the structures are built off-site, delivered as elements and then assembled with cranes. In the construction of houses or low-rise buildings, where all processes occur almost simultaneously, modular construction, as part of new technologies, can be up to twice as fast and correspondingly cheaper than traditionally implemented projects. Among the advantages of modular constructions is the reduction of construction waste. The surplus materials from one project can easily be used in another, as many buildings are built simultaneously in one factory or plant. In this regard, they also help reduce carbon emissions. During the construction and repair works machines for laying screed, machines for spray painting, etc. are being used. In recent years, activities related to green building have a different presence on the market, for some they are innovative, and other companies in the construction industry are gradually beginning to

perceive it as a necessity [10]. Such surveys are “green” activities in construction – a possibility of renovating the building stock. They are aimed at implementing green building policy in construction companies.

Innovations in building materials in recent years in a pandemic situation are aimed at helping to combat the Covid 19 pandemic. These are materials and technologies for indoor air purification. New photocatalytic materials are becoming more and more widely used. Photo catalysis is one of the effective methods for air purification. Such material is the so-called active ceramics that destroys bacteria that come into contact with its surface due to the oxidation process with reactive oxygen. Other practices used by Bulgarian companies are the installation of elevators with voice command, which does not require touching buttons according to the pandemic situation. Such as the use of smart house technology, in which the home is controlled by an application with artificial intelligence, which can turn on and off appliances, lighting and search for information in a database, make phone calls and etc.

3. INNOVATIONS RELATED TO THE REALIZATION OF CONSTRUCTION PRODUCTS

The construction output is final and represents the stages (subprojects), sites and complex sites built in accordance with the investment projects and put into operation, after issuing a permit for use by the competent authorities. In the stage of realization of the construction products innovations are represented by the possibility of using payment schemes with the assignor (client), third parties mediation (real estate agencies) and facilities management following site commissioning.

In recent years, deferred payments for the purchase of real estate (final construction product) have been frequently used in business practice. An example of Bulgarian construction companies is to pay an initial installment and then up to three months deferred payment for the remaining amount. Another option for deferred payment is partial payment upon delivery of each construction and installation activity and gaining completion deed to the last installment after commissioning. Also, more and more buyers are taking the opportunity to finance the real estate purchase via bank lending, a type of mortgage loan. Mortgage interest rates have been significantly lower in the last five years, which has encouraged construction companies to produce more and more construction products.

Intermediaries represented by real estate agencies are also an integral and essential part of the construction products sale. Many construction companies

authorize time-proven real estate agencies for the sale of finished and semi-finished construction production. In recent years, the latter have applied new methods of selling and marketing real estate. Global digitalization is intensively penetrating into the field of real estate sales. Services are being offered such as an open day – a specific day on which many buyers can sign up and view a particular real estate. Some agencies are also offering the possibility to visualize the property or online views. During the last year, online surveys in particular have been applied as an innovative approach to conducting surveys due to pandemic situation in the country, reducing meetings with customers to the minimum. Many online tools are already involved in real estate marketing, such as social networks – Facebook and Instagram, banner advertising, landing page and etc. All innovations in the field of real estate sales are directly related to the successful realization of construction products. From facility management point of view, a lot of innovations are also being introduced in regard to finished construction products. Online house managers – companies that offer services as a house manager entirely online, fees are paid online too via a mobile application and general meetings of owners are being organized online via platforms such as Zoom and Skype.

Innovations in housing construction have a direct correlation to its development and analysis. Data on population number in the 10 largest cities in Bulgaria is presented in order to limit the research and be able to make further analyses, Fig. 1. According to the latest data of the National Statistical Institute (NSI) as of 31.12.2020, the 10 largest cities by terms of population in Bulgaria are: Sofia, Plovdiv, Varna, Burgas, Russe, Stara Zagora, Pleven, Sliven, Dobrich and Shumen [11].

In recent years, housing construction has undergone a number of changes, which implies a study on the development. These changes are triggered by various economic factors and innovations in the sector. For the purposes of the present study we shall compare data on commissioned residential buildings and new housing buildings and their division by number of rooms, prices and number of real estate sales in the 10 largest cities in Bulgaria for 2015 and 2020. Newly built residential buildings demonstrate a significant increase during 2020. We distinguish by type of construction panel, reinforced concrete, brick and other types (from other materials) given in Table 1. The highest growth has been reported in Sofia – by 350 more buildings as compared to 2015, according to NSI data [12]. From 2016 until 2020 the average annual increase was 59%, and in 2017 there was a decrease by 4.8%. Sofia is followed by the city of Pleven with an increase of 132%. In the city of Plovdiv we also report an increase in the number of commissioned residential buildings for

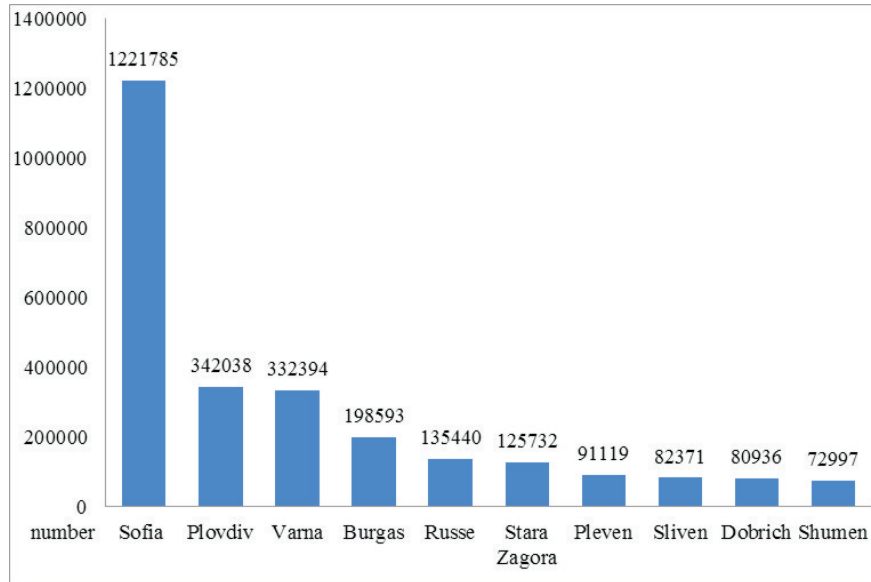


Fig. 1. Number of inhabitants in the 10 largest cities in Bulgaria for 2020,
Source: NSI, Population by cities and sex, <https://nsi.bg/bg/content>

2020 by 60%. In Varna the growth rate is 33%, in Burgas it is 34%. In Russe we report the lowest growth rate by 10%. In Dobrich we observe a decrease by 13%. For the rest of the cities we have the following growth rate: Stara Zagora – 12%, Sliven – 26% and Shumen 92%. The growth in the number of newly built residential buildings is due to the high demand, which is related to the low yields on savings accounts and low interest rates on mortgage loans, which makes residential properties most profitable for investors.

The newly built homes in the 10 largest cities of Bulgaria show the realization options of construction products. In Table 2, the changes in the composition of newly built homes (number of rooms) can be seen. Due to the high growth rate of residential buildings put into operation, we are observing an increase in housing as well. The composition change trend is represented by the two times increase of one-bedroom apartments compared to 2015. According to NSI data the highest number of homes has been built during 2020 in Sofia [13]. The comparison between the city of Plovdiv and the city of Varna is the most interesting one for 2020 with 432 and 421 newly built residential buildings, respectively. The dwellings in the city of Varna are 3088, exceeding Plovdiv by 1067 (having 2021 dwellings in number), which is due to the larger built-up area of the buildings in Varna.

Table 1. Newly built residential buildings by construction type in the 10 largest cities in Bulgaria for 2015 and 2020

Town	2015					2020					number
	Total	Panel	Reinforced concrete	Brick	Others	Total	Panel	Reinforced concrete	Brick	Others	
Sofia	94	1	70	20	3	444	2	425	14	3	
Plovdiv	269	3	232	24	10	432	1	328	98	5	
Varna	316	2	212	93	9	421	–	351	51	19	
Burgas	281	2	263	16	–	376	1	350	17	8	
Russe	52	–	3	48	1	57	–	41	13	3	
Stara Zagora	93	1	50	38	4	104	–	85	19	–	
Pleven	28	–	6	21	1	65	–	44	21	–	
Sliven	57	1	17	39	–	72	–	21	50	1	
Dobrich	105	3	50	50	2	91	1	64	25	1	
Shumen	26	–	18	7	1	50	–	42	7	1	

Source: NSI, Newly built residential buildings put into operation, Dynamic line,
<https://www.nsi.bg/bg/content/3135/>

Table 2. Newly built dwellings by number of rooms in the 10 largest cities in Bulgaria for 2015 and 2020

Town	2015						2020						number
	Total	One	Two	Three	Four	Five	Total	One	Two	Three	Four	Five	
Sofia	336	25	109	142	34	26	4 018	249	1 827	1 393	389	160	
Plovdiv	969	174	289	302	103	101	2 021	160	917	597	168	179	
Varna	1 391	194	602	345	132	118	3 088	259	1 402	1 017	243	167	
Burgas	2 002	392	920	474	124	92	1 581	217	664	414	142	144	
Russe	134	23	33	43	20	15	420	55	162	145	33	25	
Stara Zagora	265	19	73	102	39	32	389	2	175	161	42	9	
Pleven	52	1	23	14	8	6	146	18	37	50	25	16	
Sliven	122	21	33	35	15	18	165	6	30	75	27	17	
Dobrich	295	42	59	138	34	22	117	2	14	60	19	22	
Shumen	69	–	33	25	6	5	232	3	71	126	10	22	

Source: NSI, Newly built residential buildings put into operation, Dynamic line, <https://nsi.bg/bg/content/3137>

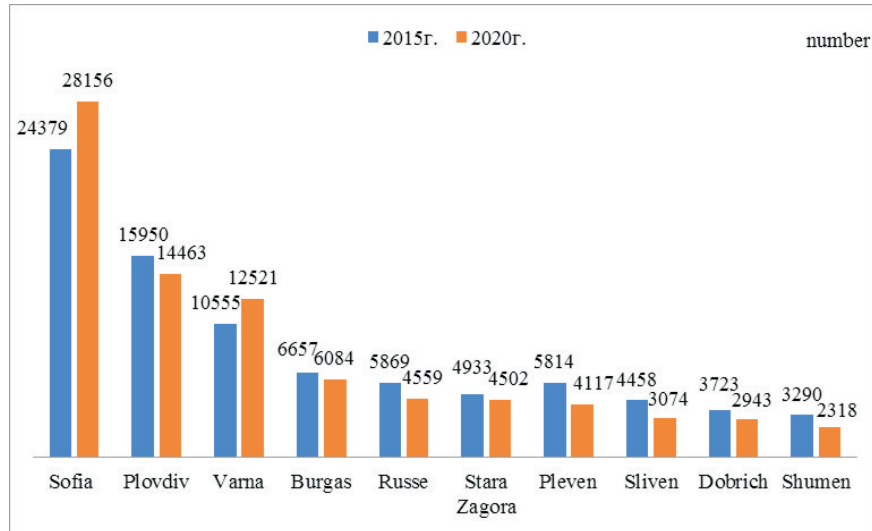


Fig. 2. Number of real estate sales in the 10 largest cities of Bulgaria for 2015 and 2020, Source: Bulgarian Registry Agency, Property Registry, Statistics – data and calculations of the author, <https://www.registryagency.bg/bg/registri/imoten-registar/statistika>

The number of signed real estate contracts demonstrates the purchasing power for finished construction products. In this regard Fig. 2 shows the number of real estate sales in the 10 largest cities of Bulgaria for 2020 and 2015. The highest growth rate of real estate sales for 2020 as compared to 2015 has been reported in the city of Varna – 19% and 15% in the city of Sofia, as per data from the Bulgarian Property Register [14]. In all other cities we report a decrease in the real estate sales number. The highest decline is observed in the cities of Sliven – 31%, Shumen – 30%, for Russe, Pleven, Dobrich it is over than 20%. The lowest decline is in Burgas – 8.6%, Stara Zagora – 8.7% and Plovdiv – 9.3 %. Based on the data presented we may conclude that in the cities of Varna and Sofia most of the investments are being made in real estate. This is due to a number of factors, such as migration from smaller cities to larger ones and greater demand in the real estate market in them. Another factor is the city attractiveness. The main part of the business is concentrated in the Bulgarian capital – Sofia. Regarding Varna it is influenced by the geographical factor, as the city is located at the Black Sea coast combined with the proximity to Russia.

Data presented in Fig. 3 shows that the average market price rates per sq. m. in EUR of dwellings have increased significantly in the period from 2015

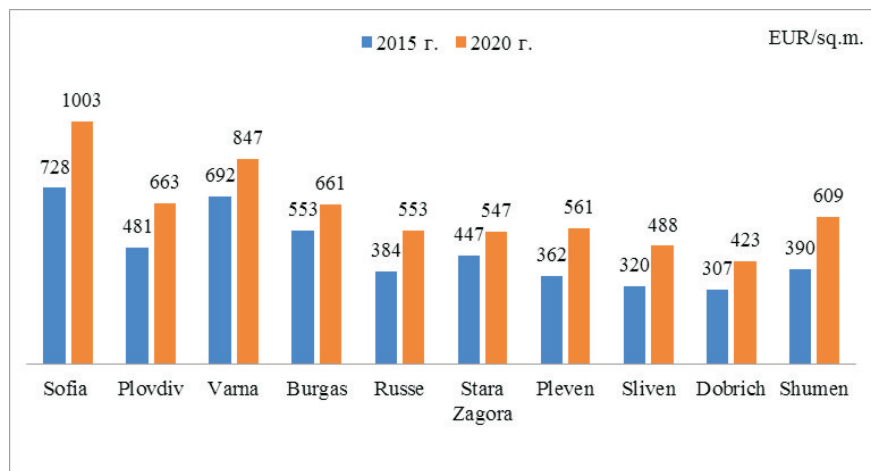


Fig. 3. Average prices per sq. m. of dwellings in the 10 largest cities of Bulgaria for 2015 and 2020, Source: Property, Average prices of residential properties as of 29.12.2020 and 29.12.2015, data and calculations of the author, <https://www.imot.bg/pcgi/imot.cgi?act=14>

to 2020 as per the offers in the internet database of Properties BG [15]. The highest increase rate is in the cities of Shumen – 56%, Pleven – 55% and Sliven 53%. The lowest increase rate is in Burgas – 19.5%, Varna and Stara Zagora by 22% each. In Sofia and Plovdiv it is 39%, Dobrich – 38% and Ruse 44% compared to 2015, and the highest average house prices are registered in the cities of Sofia and Varna. Other studies in the field of housing development reaffirm the positive trend of increasing prices in housing construction. For the city of Varna the average prices per sq. m. of the residential properties are increased by 10 per cent in the period from 2015 to 2017 according to the study conducted at offer prices “Residential real estate market in the city of Varna” [16].

In evidence of the positive development of a construction sector is the change in the country’s GDP. According to data from the Bulgarian National Bank (BNB), the annual real growth rate in GDP in 2017 was 2.8%, in 2018 – 2.7%, in 2019 it was 4%, and in 2020 there was a decline by 4.4% [17]. The decline reported in 2020 is due to the pandemic situation that occurred in 2019 and continues at present. The state economy is recovering at a slow pace. A positive growth rate of 0.2% in the first quarter of 2021 has been reported compared to the first quarter of 2020 according to BNB prediction data. For the second quarter the highest growth rate since 2008 is being observed – 6.5%. The change in the real rate of GDP growth is an indicator for the development

of the country and in particular the Construction sector, having an increasing share in it.

3. CONCLUSION

In a conclusion, we can present several statements about the impact of innovations on the development of housing construction. First of all, innovations in the investment stage of housing construction reduce the risk of discrepancies in the investment project due to the opportunity of communication via internet platforms between participants, such as architect, designer, investor and others. Secondly, innovations in the construction prior to its commissioning lead to a reduction in financial, time and human resources costs due to application of machines and robots in the construction process. Thirdly, innovations in the realization of construction lead to a faster return on investment due to marketing strategies, such as the participation of real estate agencies. All these innovative practices lead to a reduction of production and sales costs in housing construction, enhancing the growth and developing on the economic market of the country. The analysis of the volume and prices of housing construction in the 10 largest cities in Bulgaria gives grounds for the following conclusions, thus outlining expectations and trends in the sector:

1. Housing is one of the fastest growing sectors. It supports the development of the country and increases the GDP due to its large scale.
2. Residential buildings are increasing in number and together with dwellings. The highest growth rate is reported in one-bedroom homes, i.e. more one-bedroom apartments are being built. It is due to the smaller square surface and the more affordable price.
3. Investments in housing construction in the cities of Sofia and Varna are increasing due to the higher attractiveness of the capital and the seaside city. In other cities they are declining.
4. Housing prices are rising at high rates due to migration and high demand, lack of income in savings accounts and the low profitability of keeping money in banks, free of charge. In recent years, there has been a large increase in house prices in smaller cities, and in larger ones the increase has been gradual.
5. Higher housing prices are being triggered also by the low interest rates on mortgage loans provided by banks. More and more citizens are taking advantage of the possibility to buy a home on credit.
6. The study of the development of housing construction is of great importance for the country's economy, as well as for the cultural and living standard

of society. The construction sector is leading in relation to other sectors. Its growth leads to the growth of the whole economy.

REFERENCES

- [1] J. SCHUMPETER, *Theory of Economic Development*, Progress, Moscow (1982) 159 (in Russian).
- [2] B. CHAPAROV, *Status and Trends in the Development of Construction in the Republic of Bulgaria*, Science and Economics, Varna (2012) 38–62 (in Bulgarian).
- [3] S. STOYANOV, *et al. Real Estate Economics*, Science and Economics, Varna (2013) 12 (in Bulgarian).
- [4] Oslo Manual 2018, *Guidelines for Collecting, Reporting and Using Data on Innovation*, 4th Edition, The Measurement of Scientific, Technological and Innovation Activities, OECD, Publishing, Paris/Eurostat, Luxembourg (2018), <https://doi.org/10.1787/9789264304604-en>
- [5] T. RAYCHEV, *Innovations in Construction*, Science and Economics, Varna (2014) 14 (in Bulgarian).
- [6] M. IVANOVA, *State of the Implementation of Innovations in Construction Enterprises in the Republic of Bulgaria*, in: Proceedings of the University of Economics – Varna (2012) **3** 103 (in Bulgarian).
- [7] I. ZHELEV, *Investment Process Management*, Science and Economics, Varna (2009) 57 (in Bulgarian).
- [8] BAIS, *New Technologies and Innovations in Construction in 2021*, <https://bais.bg/> (in Bulgarian).
- [9] Builders–BG, *They Created a Multifunctional Construction Robot* (2021), <https://www.stroiteli-bg.com/novini/sazdadoha-multifunktsionalen-stroitelen-robot-video/> (in Bulgarian).
- [10] K. ANTONOVA, Green Activities in Construction – a Possibility to Renovate the Building Stock, Construction Entrepreneurship and Real Estate, in: Proceedings of the 36th International Scientific and Practical Conference, November 26, 2021, Varna, Science and Economics, 2021, 32–3, ISSN 2683-0280 (in Bulgarian).
- [11] NSI, *Population by Cities and Gender* (2020), <https://nsi.bg/bg/content/> (in Bulgarian).
- [12] NSI, *Newly Built Residential Buildings Put into Operation, Dynamic Order* (2021), <https://www.nsi.bg/bg/content/3135/> (in Bulgarian).
- [13] NSI, *Newly Built Dwellings Put into Operation, Dynamic Order* (2021), <https://nsi.bg/bg/content/3137/> (in Bulgarian).
- [14] Registry Agency, Property Registry, *Statistics – Data and Calculations of the Author* (2021), <https://www.registryagency.bg/bg/registri/imoten-registar/statistika/> (in Bulgarian).

- [15] Property, *Average Prices of Residential Properties as of 29.12.2020 and 29.12.2015 for the Cities: Sofia, Plovdiv, Varna, Burgas, Ruse, Stara Zagora, Pleven, Sliven, Dobrich and Shumen* – data (2021), <https://www.imot.bg/pcgi/imot.cgi?act=14> (in Bulgarian).
- [16] I. KOSTOV, The Residential Real Estate Market in the City of Varna, Construction Entrepreneurship and Real Estate, in: Proceedings of the 32nd International Scientific-Practical Conference, Varna, Science and Economics, 2017, p. 195 (in Bulgarian).
- [17] BNV, *Macroeconomic Indicators* (2021), <https://bnb.bg/Statistics/StMacroeconomic-Indicators/index.htm> (in Bulgarian).

Received December 14, 2021