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***Research paper***

# The Development of Housing Market in Ukraine: Modelling and Prospects

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**Abstract**

Trends in the development of the housing market in Ukraine, dynamics of its fluctuations, the identification of key factors that may lead to changes and shifts in the Ukrainian housing market, the impact of the respective primary housing sectors, factors shaping the consumer preferences of households in connection with demand for housing, modeling the housing market and the prospects for the development of the housing market in Ukraine, are considered in this article. The authors pay attention to certain methodological features and factors that shape the specific functioning of the housing market in Ukraine and create the appropriate preconditions for determining the prospects for its further development. Taking into account the technical, operational, consumer and cost characteristics of such a product as housing, and the specifics of the organization and implementation of the production process in construction, the implementation of a cobweb model is proposed to determine the nature of functioning and prospects for further development of the Ukrainian housing market.

***Keywords***: *cobweb model, construction cost, housing market, market fluctuations, price per square meter.*

## 1. Introduction

The housing market development is an inalienable effective functioning economy component and social sphere of any state. The dynamic of housing market illustrates general and/or particular shifts and changes, which takes place in different categories of economical interactions: industrial and technological development, welfare of the population, investment attractiveness, economic legislative transparency, long-term consumer confidences and expectations, etc. Therefore, the fluctuation of housing market couldn`t be entirely considered only with the classical market`s statements – as case of equilibrium between demand and supply. Besides, the modeling complexity for revealing the patterns of housing market is that, it cannot be rendered without the impacts of related sectors, as the construction industry and the real estate market as a whole, because housing market adsorbs and integrates the results of their processes and phenomena.

It should be noted, that in many domestic and foreign surveys, devoted to the issue, authors point out similar factors of influence to demand and supply on different housing markets. Kosuke Aoki and et al. in survey [2] specifies the influence of monetary policy on households' behavior in making decisions on housing market. Established on UK's market research, authors concluded that important feature on housing market is the regulation point of accessibility of financial sources for households, because it may incline them to short-term consuming or long-term consuming, like investments in residential real estate. Ligita Gaspareniene and et al. [10] considered that the factors of influence on housing market prices set out a level-structured system: on the highest level are the peculiarities of the country (specified for transition economy), then macroeconomic environment, microeconomic environment and market environment. It may clearly explain the mechanisms of interaction between different categories of economical and governmental agents, which can give appropriate approaches for market regulation. According to the Dean Corbae and Erwan Quintin survey [8], their model gives us an explanation of how housing market's boom influence consumer's behavior. The survey [4] shows a point that globalization has a far strongly influence on the world economic environment, not only on the most developed countries, but beyond their measures. As authors highlight the links with the US and G-7 area, as the same impacts could be assessed with Ukrainian housing market, where the construction costs, volume of bargains and housing prices strongly depend on the currency exchange rate.

The importance of influence on housing pricing implements the local features of housing emplacement and affluence of habitants, as it is shown in Antonio Nestico and Massimiliano Bencardino survey [16]. It also greatly depends on evaluation approaches, which can be used by both sides of housing market: residential construction investors and buyers or tenants. This fact could be fundamental for revealing distinguishes in fluctuations between primary and secondary housing markets. Furthermore, for determining the prospective of housing market functioning the peculiarities, which perform a mechanism of market development, designate a particularity of housing supply and set up properties of demand. Should be considered in conditions of Ukrainian housing market such peculiarities could be housing investments methodology [14], housing maintenance costs, especially in energy consumption [18], and presence of supporting sources for standards of living [19]. In general, these factors are also integrated within the framework of the governmental social and housing policy, which is an important component of the Ukrainian housing market functioning [21]. Of cause, housing market trends to illustrate a level

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of society welfare, but from the other point of view, housing market can be considered as a driver of development for national economy as a whole [11]. Thus, the objectives of the research are to detect the main trends in Ukrainian housing market, to find rationale of modeling housing market fluctuations and to reveal the main peculiarities that could perform further prospective of housing market changes.

## 2. Ukrainian Housing Market: Main Trends

When investigating the housing market, we need to weigh the fluctuations of the primary and secondary markets in a balanced manner. Many researchers consider the volume of accomplished residential construction as the leading indicator of the housing market in general. Put into operation housing, this is mainly a proposal of a new housing, which moderates and transforms the general housing market. Such a proposal defines new preferences for the demand for housing in terms of quality, comfort, usefulness and aesthetics. This leads to a change in the consumer value of a particular housing, in line with market influences and expectations, as well as increasing the competitiveness of the local area by: creating a location with more affluent habitants; development of the potential of local business (retail trade, commercial services, housing and communal services, etc.); modernization of social infrastructure [16]. As a result, there may be a shift in prices in the local secondary housing market, primarily linked to the relayed areas. In turn, the secondary market is an area, which is already ready for direct use of housing and related services (rent), and therefore more quickly and dynamically reacts to the change in the structure and volume of solvent demand. If the demand of the primary market is legitimately considered from the standpoint of a fundamental investment commodity, then the demand for the secondary market is formed by market factors largely, that can adequately reflect short-term consumer mood.

The offer on the primary housing market is determined in dependence on the productivity and volume of production in the construction industry. After the collapse of the USSR and Ukraine's independence, the formation and development of the national housing sector independently began to take place. However, during the period of independence, the volumes of accomplished residential construction did not reach the level of 1990, which amounted to 17447 thousand sq. m. Since then, the maximal output did not exceed 65% of 1990 (table 1).

**Table 1:** Volume of accomplished residential construction in Ukraine in 2005-2017*

| Year | Residential total, thousand sq. m. | Including | | In percentage | |
|---|---|---|---|---|---|
| | | in urban settlements | in the countryside | in urban settlements | in the countryside |
| 2005 | 7816 | 6088 | 1728 | 77,89 | 22,11 |
| 2006 | 8628 | 6709 | 1919 | 77,76 | 22,24 |
| 2007 | 10244 | 7737 | 2507 | 75,53 | 24,47 |
| 2008 | 10496 | 7640 | 2856 | 72,79 | 27,21 |
| 2009 | 6400 | 5163 | 1237 | 80,67 | 19,33 |
| 2010 | 9339 | 6304 | 3035 | 67,50 | 32,50 |
| 2011 | 9410 | 6965 | 2445 | 74,02 | 25,98 |
| 2012 | 10750 | 7539 | 3211 | 70,13 | 29,87 |
| 2013 | 11217 | 7672 | 3545 | 68,40 | 31,60 |
| 2014 | 9741 | 6645 | 3096 | 68,22 | 31,78 |
| 2015 | 11044 | 7465 | 3579 | 67,59 | 32,41 |
| 2016 | 9367 | 6503 | 2864 | 69,42 | 30,58 |
| 2017 | 10206 | 7274 | 2932 | 71,27 | 28,73 |

**Source: State statistical data, http://www.ukrstat.gov.ua*

As shown in table 1, a larger share of the primary housing market is formed in cities, which is a rather characteristic phenomenon virtually for all European countries. In the context of the regions of Ukraine, the largest shares of commissioning of housing were located in Kyiv, L'viv, Dnipropetrovsk, Kharkiv and Odessa regions. The housing market situation is conditioned by the part of the population with high economic and social mobility, and the spot concentration of the housing market is concentrated in the largest and most economically developed cities.

In the macroeconomic dimension, the offer of the primary market is a reflection of the economic capacity of the state as an institutional unit. As shown by the example of the relationship between real estate market cycles and GDP in Latvia [11], a change in market volatility can be an indicator for predicting future economic growth. Nevertheless, it should be noted, that housing is a category of public goods, which can have a steady demand only under conditions of steady positive trends in the development of the national economy [4]. Changes in Ukraine's GDP, volumes of investment in residential construction and volumes of accomplished residential construction (adjusted to the base level of 2005) give grounds for identifying the objective dynamics of this sector of the economy. Fluctuations indicate that the development of housing construction is derived from the economic and social situation in Ukraine. The growth of real GDP contributes to the investment attractiveness of housing construction; it stimulates supply and provides solvent demand (fig. 1).

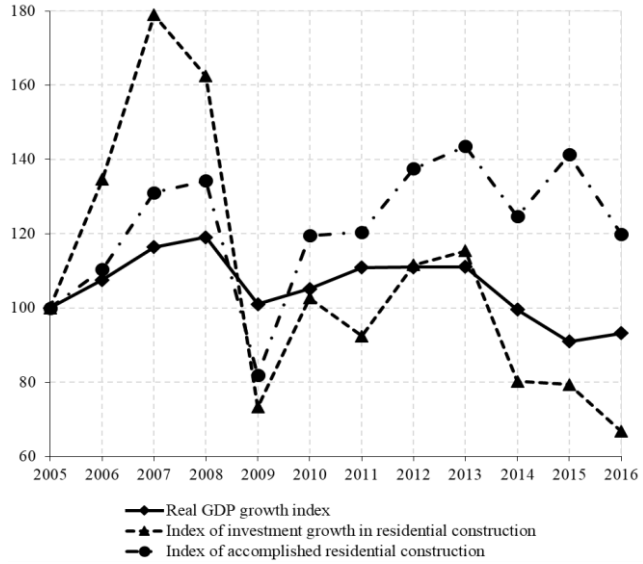



**Fig. 1:** Primary market fluctuations compared to GDP, 2005=100*

**Source: calculated and designed by authors on the State statistical data, http://www.ukrstat.gov.ua*

Significant fluctuations in volumes of investments (rapid growth of 2007-2008, falling in 2009 and 2014) in comparison with the dynamics of GDP indicate that there are no effective mechanisms for the development of the housing market in Ukraine, and, accordingly, the inherent nature for speculative influences and dependence on political factors. Many researchers point out the dependence of mechanisms on coordinated functioning and development of the housing market in Ukraine. In particular, the main problem lies in the inconsistency and inappropriateness of direct and indirect state regulation of this sphere. It even gives researchers the opportunity to determine for the period of 1991-2017, as many as 10 stages of the evolution of investment attractiveness in the housing market [5]. From the standpoint of demand, the dynamics of the primary market is the result of the state economic and social policy, which is an indicator of the ability of the authorities to raise the welfare of the citizens. From the supply side, or housing as a business, the dynamics of the market also reflects the economic efficiency of this sector of the national economy (table 2). According to official statistics, the construction industry is not characterized with a high level of profitability of operating activities, while employment in the industry in the last 10 years has decreased by 2.73 times.

**Table 2:** Employment and profitability of construction industry in Ukraine in 2006-2016*

| Year | 2006 | 2008 | 2010 | 2012 | 2014 | 2016 |
|---|---|---|---|---|---|---|
| Number of employed in the construction industry, thousand people | 675.2 | 662.6 | 472.1 | 411.1 | 286.1 | 247.0 |
| Profitability of enterprises operating in construction enterprises operating, % | 3.1 | 0.5 | 3.7 | 3 | 7.6 | 6.8 |

**Source: State statistical data, http://www.ukrstat.gov.ua*

Of course, the change in the scale of the construction industry was affected by the loss of economic interaction with uncontrolled territories (because of hostilities in eastern Ukraine and the annexation of the Crimea). However, reducing the potential of construction can lead to a shortening of the future offer on the primary market, which will contribute to uncompetitive growth in prices. In this aspect, for a full presentation of the economic situation of the market, it will be useful to consider the dynamics of structural changes in the construction industry (table 3).

**Table 3:** Changes in business entities in construction industry in Ukraine in 2010-2016*

| Year | Number of enterprises in construction | Including | | | The average size of enterprises by number of employees, people | | |
|---|---|---|---|---|---|---|---|
| | | Big | Medium | Small | Big | Medium | Small |
| 2010 | 38215 | 10 | 1499 | 36706 | 1300.0 | 139.4 | 6.8 |
| 2011 | 37544 | 10 | 1453 | 36081 | 1130.0 | 135.4 | 6.2 |
| 2012 | 34077 | 12 | 1389 | 32676 | 875.0 | 135.3 | 6.5 |
| 2013 | 36185 | 13 | 1214 | 34958 | 792.3 | 136.2 | 5.6 |
| 2014 | 29785 | 4 | 930 | 28851 | 575.0 | 141.4 | 5.3 |
| 2015 | 29165 | 5 | 789 | 28371 | 660.0 | 137.5 | 4.8 |
| 2016 | 24333 | 2 | 766 | 23565 | 700.0 | 137.2 | 6.0 |

**Source: calculated by authors on the State statistical data, http://www.ukrstat.gov.ua*

During 2010-2016 the total number of construction companies decreased by 1.57 times. The main productive power of construction is big and medium-sized enterprises with sufficient resources to carry out complex and large-scale housing projects, with the participation of a significant number of subcontractors. The number of big enterprises has decreased by more than 2 times, and the medium – by 1.96 times. Small and medium-sized enterprises are more flexible, so they quickly adapt to the impact of market factors or goes to bankruptcy. Big companies are structurally more sensitive to them, which entails the need to optimize the scale and size of the enterprise to ensure its sustainability. Identifying the factors for creating the economic environment of the primary housing market is quite possible using the PESTEL analysis [15], which allows making effective investment decisions, taking into account all possible risks of changing the market environment.

The dynamics of prices on the housing market depends on changes of the cost of construction and installation work. The recommended cost is determined in accordance with the "Procedure for the determination and application of indices of average housing costs for regions of Ukraine", which is approved by the Order of the State Construction Committee of Ukraine No 174, September 27, 2005. As of November 1, 2017, the recommended construction's cost (average for Ukraine) for 1 sq. m. of the total area of housing is 10745 UAH. At the currency exchange rate of the National Bank of Ukraine, it is 409.65 USD. Comparison of the construction's cost indices (adjusted to the base level of 2005) reflects its steady growth (fig. 2).

Over the past 10 years, the cost of housing construction (in UAH equivalent) has increased by more than six times, with the up-and-down inflation rate, which inevitably led to an increase in the cost of finished housing. The cost of construction and market conditions make up the final value of price dispositions. However, the specifics of price interaction between the primary and secondary market in the readiness of the residential goods [12]. The offer of the primary market is often a residence without finishing work and

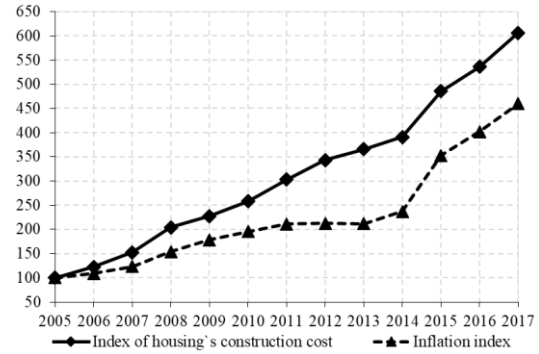



**Fig. 2:** Increasing of housing`s construction cost in Ukraine, 2005=100*
**Source: calculated and designed by authors on the State statistical data, http://www.ukrstat.gov.ua*

interior decoration, cost of which can reach up to 50% of the cost of housing. At the same time, it is almost impossible to adjust existing price ranges to a certain methodical basis. First, there is a difference in the market segment of the offer of new housing. Proposals for housing classes are divided (as a rule) into four classes, based on the level of comfort, location and specificity of architectural and constructive solutions. According to the monitoring of the Kyiv (https://novostroyki.lun.ua) price for 1 sq. m. housing in new buildings (2017) was: economy – 16900 UAH / 610 USD; comfort – 18900 UAH / 680 USD; business – 34000 UAH / 1250 USD; elites – 54300 UAH / 1990 USD. At the same time, the average price for new housing was at 26300 UAH / 992 USD. Secondly, the difference in the cost of the same types of housing in the regions, which is caused by spatial disproportions in the housing market, differences in economic development and demographic situation (fig. 3).

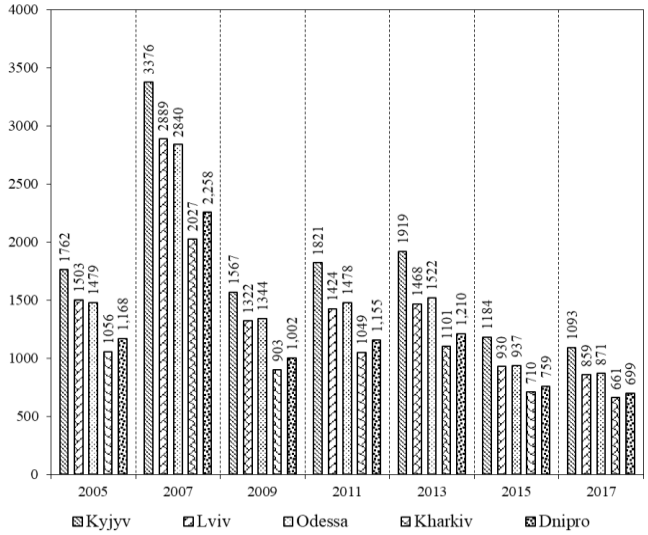



**Fig. 3:** Secondary market's prices in Ukraine, USD per 1 sq. m.*
**Source: designed by authors on SV Developement data, http://www.svdevelopment.com*

Of course, housing in the capital and the largest cities is more expensive than in smaller and provincial cities. Due to the location, difference in the cost of the same type of housing can reach a gap of 1.5 times. Thirdly, in Ukraine there is no comprehensive state statistics on the volume of transactions on the secondary market (in quantitative and cost meters). The Ministry of Regional Development, Construction, Housing and Communal Services of Ukraine has repeatedly emphasized the need for such statistical observations, for a view to qualitative analysis of market transformations and market dynamics. The dynamics of rental prices can be an additional indicator of the development of the secondary market, on the example of Kyiv (table 4).

**Table 4:** Changes in rental prices in Kyiv in 2005-2017, USD*

| Year | 2005 | 2007 | 2009 | 2011 | 2013 | 2015 | 2017 |
|---|---|---|---|---|---|---|---|
| one-room apartment | 333 | 613 | 298 | 379 | 495 | 305 | 284 |
| two-room apartment | 550 | 937 | 426 | 529 | 671 | 414 | 386 |
| three-room apartment | 758 | 1192 | 517 | 648 | 805 | 495 | 459 |

**Source: SV Development data, http://www.svdevelopment.com*

The display of price indices in USD reflects an objective tendency to cheapen housing and services related to the use of housing. Thus, in comparison with the peak years of the rapid growth of the housing market (2007-2008), the market value has decreased by more than 2 times, and by separate positions - more than 3 times. In 2008, the NBU exchange rate was 5.05 UAH for 1 USD. At the expense of more than a fivefold increase of the USD, the price of housing as a whole grew in UAH, which negatively affected on the shift of supply and solvent demand. In particular, the orientation of the Ukrainian housing market on USD as a currency for valuation and payments, introduces into the development of the market a destabilizing factor. Because of this, there is a low elasticity of adjusting the dollar valuation to changes in real incomes; the availability of financial resources and, ultimately, the cessation of mortgage lending [21].

## 3. Housing Market's Impact Factors

The issues of sustainable functioning and development of the housing market in Ukraine depend on the integrated impact of a number of factors that determine demand and supply. When determining the key influences of the most effective factors, there is a certain affinity between the opinions of many researchers regarding the mechanism of such an effect on fluctuations in the housing market. Thus, as the main general factors shaping the negative dynamics of the market, include the following [5; 11; 12; 14; 19; 21]: instability of the economic and political situation in the country; reduction of investment attractiveness; excessive dollarization of the economy; the decrease of the real income of the population; a rise in the cost of borrowed financial sources. However, existing estimates are mostly market-oriented or current. It is necessary to consider in more detail certain factors for finding out the latent potential of future market fluctuations.

It should be noted, that despite the negative trends that have taken place in the market in recent times, the demand for housing remains unsaturated. According to experts, the normal market situation is an excess of supply over demand by 8-10%. The period of rapid market growth in 2007-2008 was characterized by a significant excess of demand for supply, which led to the formation of a "price bubble", that was confirmed with the trends of 2009-2011 [14; 21]. Nevertheless, at the time the level of housing security remains insufficient. According to Shishkin V.S. [19], in Ukraine 20.0% of households with children living in cities lived in high-quality housing with sufficient living space and a basic set of amenities. Among households with children in two or more, households with three or more children were the poorest in cities and rural areas - 32.7 and - 26.5%. The poverty rate for housing without a children's household was much lower than for households with children. In particular, according to the State Statistics Service, in Ukraine only 60.4% of apartments are provided with water supply, 46.8% - hot water supply, 58.4% - with sewage system, 47.2% - by central drainage. In addition, in 2017 in Ukraine (in cities) there were 9533 dilapidated dwelling houses with an area of 1661.1 thousand sq. m. Despite estimates of the natural decrease in the number of population, the level of housing security remains virtually unchanged (table 5).

**Table 5:** Housing stock in Ukraine, 2006-2016*

| Year | 2006 | 2008 | 2010 | 2012 | 2014 | 2016 |
|---|---|---|---|---|---|---|
| Housing stock in total, million sq. m | 1049.2 | 1066.6 | 1079.5 | 1094.2 | 966.1 | 977.9 |
| Housing stock per inhabitant on average, sq. m | 22.2 | 22.8 | 23.3 | 23.7 | 22.6 | 23.1 |

**Source: State statistical data, http://www.ukrstat.gov.ua*

Thus, the demand for housing is potentially dissatisfied with both quantitative and qualitative characteristics. With favorable economic conditions, reducing the comparative cost of housing, public financial support or reducing the cost of borrowed resources, the housing market should be expected with a new stage of steady growth.

Of course, a significant factor in the development of the housing market in Ukraine is the level of income of the population and the structure of expenditures of households. The level of real income, in particular, is the assessment of the stability of its receipt in the future, which allows consumers of the "construction product" to make an appropriate decision on long-term ownership [2]. At the same time, the level and structure of household's expenditures tend to both targets: to the choice of housing; to specify the preferences in housing. Households operate on the analogy of fundamental and technical investors - they assess the attractiveness of long-term permanent possession (acquisition), or temporary possession with the possibility of a quick change of the object, depending on changes in economic or market conditions (rent). The analysis of household expenditures in Ukraine shows that an average 90-92% of total expenditures is spent on current consumption. Exchange rate fluctuations and changes in the dynamics of economic development also led to a decrease in real household incomes, which in turn affected the change in consumer affordability (fig. 4).

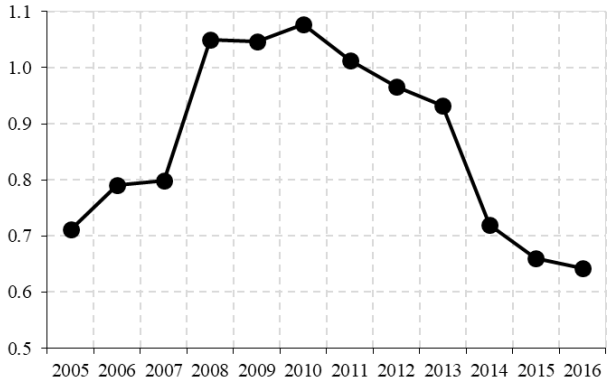



**Fig. 4:** Coefficient of housing affordability in Ukraine*

**Source: calculated and designed by authors*

As noted above, despite the decline in housing costs in USD, the negative effects of dollarization and the growth of the rate do not contribute to the increase in affordable housing, since the income gained in the hryvnia is offset. The combination of factors of dissatisfied demand and limited financial capacity, changes the direction of consumers to improve existing living conditions (table 6).

**Table 6:** Mortgage for households in Ukraine, 2006-2016*

| Year | Mortgage for the purchase, construction and reconstruction of real estate, million UAH | | | | |
|---|---|---|---|---|---|
| | In total | including by currencies | | | |
| | | UAH | USD | Euro | Others |
| 2006 | 20522.7 | 2478.8 | 17136.1 | 477.2 | 430.6 |
| 2007 | 73084.3 | 13729.7 | 55742.3 | 1385.9 | 2226.5 |
| 2008 | 143416.3 | 21346.4 | 116180.3 | 2480.4 | 3409.2 |
| 2009 | 132757.3 | 20541.8 | 106414.6 | 2401.7 | 3399.2 |
| 2010 | 110724.6 | 18103.9 | 87816.7 | 1774.0 | 3030.0 |
| 2011 | 97430.6 | 21938.4 | 72007.5 | 1530.6 | 1954.2 |
| 2012 | 63158.4 | 20669.5 | 40445.3 | 1003.9 | 1039.7 |
| 2013 | 56270.1 | 18640.8 | 35691.3 | 853.8 | 1084.2 |
| 2014 | 72156.0 | 16167.3 | 53311.0 | 1203.6 | 1474.2 |
| 2015 | 60215.3 | 14883.8 | 42796.8 | 968.9 | 1565.8 |
| 2016 | 60265.3 | 13262.7 | 44266.9 | 922.9 | 1812.8 |

**Source: National Bank of Ukraine, https:/www.bank.gov.ua*

Since mortgage lending played a significant role in the development of the housing market, the low share of loans in the national

currency was affected by the housing divergence. Therefore, for all years the volume of mortgage loans in UAH was at the level only 17-30%. The growth of the exchange rate has led to a change in the value of already purchased housing. Therefore, there is currently a tendency for households to invest in renewing and upgrading their existing housing, as this requires less costs than buying a new house. This situation also affected the changes in the structure of the proposal, which is reflected in the changes in the average size of housing, being put into operation. So, if in 2010 the average size of the newly built apartments was 117.9 sq. m, then in 2015 it decreased to 87.2 sq. m. Consumers who seek to satisfy the existing need for housing, are forced to restrict themselves and lean toward housing of lower characteristics.

Nevertheless, along with a group of factors that determine the characteristics of demand in the housing market, it is necessary to pay attention to some aspects that shape the specifics of the proposal. The problem of the efficiency of functioning and development of the housing market in Ukraine is the imperfection of the methodological support for the processes of development, decision-making and implementation of construction projects, including housing construction. Problem issues are in the understanding of the processes of preparation of investment projects and decision-making at an adequate level for a quick and adequate transition to the stage of investing and the immediate start of the construction project. The stage of pre-investment project development and conception formation is not usually considered in the framework of the design and implementation of the project [14].

Also, many construction companies do not have mechanisms that ensure transparent and understandable implementation of project management processes. Thus, this creates the phenomenon of “unconfirmed proposal”, which eventually leads to the appearance of incomplete objects, dissatisfaction with paid demand and the freezing of financial resources. According to a price fluctuation study of 16 housing markets in emerging economies, Alessio Ciarlone concluded [1] that for such markets, the situation of re-estimation / underestimation by entities of the future market environment will always be characteristic. At the same time, the main driver of development is the stability of national economic growth and the increase of real incomes of the population. However, it should be noted, that the housing market in Ukraine has already been “grafted” from cases of excessive expectations and bloated, when the rates of overproduction reached 700%.

## 4. Cobweb Model Implementation

Despite the volatile dynamics of the housing market, it also inherent in the relevant regularities. Design of adequate models of functioning of the housing market allows predicting its further fluctuations, to evaluate possible trends of changes in market development and their consequences. To construct such models a wide range of analytical and mathematical methods and tools are used. According to Gaspareniene L. and et al. econometric models are limited in the analysis of the impact of individual variables on the formation of housing prices, so the structure of the model for formation of the price level of housing should be integrated with a multi-stage set of microeconomic, macroeconomic and other elements [10]. From another point of view, the lack of models adequacy to the real environment involves the applying certain assumptions and idealizing the conditions for market functioning, as illustrated for example in [8]. Williams J. in modeling the behavior of consumers in the housing market notes that each category or group of consumers chooses in the appropriate information and analytical environment. Therefore, the information component of the market becomes a peculiar factor in the formation and decision-making, which is also reflected in the fluctuation of housing prices [22]. In his view, every market agent makes decisions based on the Pareto’s law of effectiveness, that is, the solution that best suits his needs.

As was shown above, the demand for housing is inversely proportional to prices, and is directly proportional to the level of household incomes, as evidenced by the change in the demand elasticity. In the short term, the demand for housing has high elasticity, but in the long term, this elasticity decreases. Reducing elasticity entirely depends on the forecasting time interval. Given the confidence in sustainability and the improvement of economic and social well-being, current consumers of the "home" product (including the same households) tend to benefit from the transition to owner status. On the other hand, the deferred demand is causing speculative expectations, which affects the differences between real value and market price of housing. In this way, the functioning of the market and the establishment of the appropriate balance between supply and demand occur with a certain shift in time. Therefore, in our opinion, an adequate interpretation of market fluctuations can provide a cobweb model. An example of using a cobweb model for displaying the functioning of the housing market is an Israel's housing construction sector, which was mainly due to waves of immigration and is still a major factor in the structure of business cycles. Increasing population, financing methods, higher incomes and investment needs converged and reflected as a result of the rapid growth in demand for housing. On the other hand, technology, the private and public entrepreneur, the housing inventory and the availability of the workforce converge on the supply side [20].

The analysis of the dependence of the market equilibrium on time was based on the method of comparative statics, in which several times-equal equilibrium conditions are compared without considering the process of transition from one equilibrium to another. The description of processes occurring in time is carried out by means of dynamic analysis, in which price and volume are functions of time [6]. In the cobweb model, we take into account that when planning the volumes of a market transaction, consumers and producers often find themselves in a different position. Households or other housing consumers, planning in the period *t* the volume of demand, know the price in this period, and the supplier at the time of implementing measures that determine the scope of his proposal, has no idea what the price will be at the time of the release of the goods on the market. This is typical for construction companies that determine the area of construction of housing, although they are based on current prices, the level of costs and exchange rate factors, but do not know how the price ratios will develop at the time of putting housing into operation. In a similar situation, there are also agents of the secondary housing market. In this calculation, we assume that the price expected by producers in the period *t-1* in the period t is equal to the existing price. In other words, the producer takes today a decision on the volume of the offer for “tomorrow” on the basis of “today's” price. Thus, in the cobweb model, the volume of market demand in the period t depends on the price of this period:

$$Q_t^D = a - b \cdot P_t \quad (1)$$

The volume of the market supply in this period is determined by the price of the preceding period:

$$Q_t^S = m + n \cdot P_{t-1} \quad (2)$$

With this behavior of market agents in any period, the volume of sectoral demand will be equal to the volume of supply, subject to the following condition

$$a - b \cdot P_t = m + n \cdot P_{t-1} \quad (3)$$

Making a substitution for the coefficients $\alpha$ and $\beta$, the condition of market equilibrium can be represented in the following form (6):

$$\alpha = \frac{a - m}{b} \quad (4)$$

$$\beta = - \frac{n}{b} \quad (5)$$

$$P_t = \alpha + \beta \cdot P_{t-1} \quad (6)$$

If $P_t \neq P_{t-1}$, means $Q_t \neq Q_{t-1}$, that is, the market will be in the process of establishing a long-term equilibrium. Accordingly, to predict the possible trends in the development of the market, it is necessary to establish under what conditions a long-term stable equilibrium is achieved in the cobweb-shaped model. Equation (6) proceeds as follows:

$$P_1 = \alpha + \beta \cdot P_0$$

$$P_2 = \alpha + \beta \cdot P_1 = \alpha + \alpha \cdot \beta + \beta^2 \cdot P_0$$

$$P_3 = \alpha + \beta \cdot P_2 = \alpha + \alpha \cdot \beta + \alpha \cdot \beta^2 + \beta^3 \cdot P_0$$

$$P_t = \alpha (1 + \beta + \beta^2 + \ldots + \beta^{t-1}) + \beta^t \cdot P_0 \quad (7)$$

If we convert both sides of the last equation by multiplying by $1 - b$, after transforming the right side, we obtain the following model equation:

$$P_t = \frac{\alpha}{1-\beta} + (P_0 - \frac{\alpha}{1-\beta}) \cdot \beta^t \quad (8)$$

Expression (8) is a differential equation describing the process of adaptation of the market to long-term equilibrium. Thus, the result of solving a dynamic equilibrium model is not a scalar, but a function that describes the change in the market price over time. It follows from (8) that $P_t$ takes a finite value if $|\beta| < 1$, that is, for $|b| > n$. Since the parameters $b$ and $n$ determine the slopes of the supply and demand lines, the long-term equilibrium in the cobweb pricing model is stable only if the direct demand has a smaller slope to the abscissa axis than the direct supply. Thus, the state of the market, depending on the specifics of supply and demand, can be characterized by three types of conjuncture:

1) The market tends to a state of stable equilibrium in the long run, $|\beta| < 1$;

2) The market is in a state of cyclical fluctuations, the volumes of production and the demand that have developed are in constant fluctuations, $|\beta| = 1$;

3) The market is in an unstable state, changes and adjustments in production volumes lead to additional and strong fluctuations, $|\beta| > 1$.

As a result of the calculations carried out using the least squares method, the following most relevant demand and supply functions were obtained:

$$Q_t^D = 7855.774 + 0.1219 \cdot P_t$$

$$Q_t^S = 9289.3234 + 0.0232 \cdot P_{t-1}$$

where $Q$ – the total area of new housing, $P$ – the price of housing for 1 sq. m. in UAH.

$$Q_t^D = 9289{,}0475 + 0.2 \cdot P_t$$

$$Q_t^S = 10499{,}612 + 0.6021 \cdot P_{t-1}$$

where $Q$ – the total area of new housing, $P$ – the price of housing for 1 sq. m. in USD.

$$Q_t^D = 108{,}5623 - 0.0093 \cdot P_t;$$

$$Q_t^S = 114.7904 + 0.0133 \cdot P_{t-1}$$

where $Q$ – the total number of new apartments, $P$ – the price of housing for 1 sq. m. in USD.

The determination of the price function was carried out through conditional equilibrium according to the function of the dependence of the number of new apartments:

$$108{,}5623 + 0.0093 \cdot P_t = 114.7904 + 0.0133 \cdot P_{t-1}$$

$$\alpha = (108.5623 - 114.7904)/0.0093 = -669{,}68$$

$$\beta = 0{,}0133/0{,}0095 = 1{,}43$$

$$P_t = -669.68 + 1.43 \cdot P_{t-1}$$

Thus, in the housing market of Ukraine for a certain time there was an equilibrium with the combination of $P_0$, $Q_0$. Due to the growth in real incomes, demand increased, and the demand curve shifted to the right ($D_0$-$D_3$). As the offer remains at the same level, the price in the period $t$ will rise to $P$. A new equilibrium will be established and will persist until the next shift in the curves of market demand and supply occurs.

Empirical calculations determined that the most adequate dependence is displayed when comparing the dynamics of the number of apartments in accordance with the cost of housing in USD. The obtained functions of the supply and demand of the cobweb model show that, overall, the supply adequately responds to demand, as a result of which stabilization and achievement of conditional equilibrium occurs. The construction of the price function reflects the instability of the functioning of the market, because $|\beta| > 1$ then the market is in an unstable state. Consequently, possible changes in the market situation can be predicted with a high probability, but the change in external factors of influence on demand will lead to a shift in demand and supply curves (as shown in fig. 5).

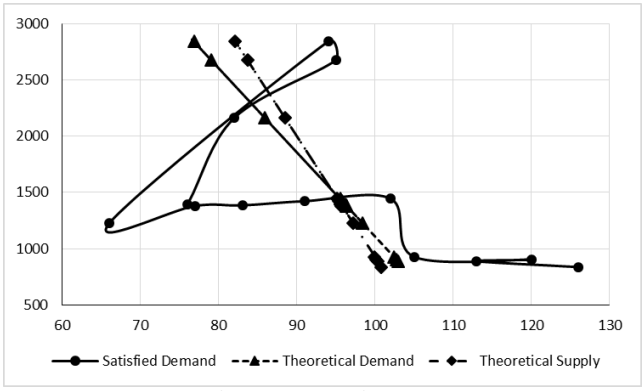



**Fig. 5:** An illustration of cobweb model for Ukrainian housing market*
**Source: calculated and designed by authors*

According to theoretical calculations, on average, the supply does not exceed the demand by 11.7%, while according to experts, the normal market situation is an excess of demand by 8-10%. The function of the price, determined with the help of conditional equilibrium, shows that in the future (in USD equivalent) a price reduction is expected. At the same time, taking into account the previously revealed dependencies, in order to clarify the specific effect of the price on specific demand, an auxiliary model was proposed, calculated for absolute and index values:

1) For absolute values

$$Q_t = a_0 + a_1 \cdot P_t + a_2 \cdot D_t + a_3 \cdot M_t \quad (9)$$

where $Q_t$ – the average area of the new apartment sq. m.; $P_t$ – price per 1 sq. m. in UAH; $D_t$ – coefficient of housing affordability; $M_t$ – coefficient of mortgage affordability of housing.

Equation of specific demand:

$$Q_t = 71.1363 - 0.0012 \cdot P_t + 11.296 \cdot D_t + 1.2124 \cdot M_t$$

2) For the indexes

$$I_{Qt} = a_0 + a_1 \cdot I_{Pt} + a_2 \cdot I_{Dt} + a_3 \cdot I_{Mt} \quad (10)$$

where $I_{Qt}$ – the index of the area of the new apartment; $I_{Pt}$ – the index of the price for 1 sq. m. in UAH; $I_{Dt}$ – the index of housing affordability; $I_{Mt}$ – the index of mortgage affordability of housing.

Equation of specific demand:

$$I_{Qt} = 69.1718 - 0.0788 \cdot I_{Pt} + 0.0783 \cdot I_{Dt} + 0.5568 \cdot I_{Mt}$$

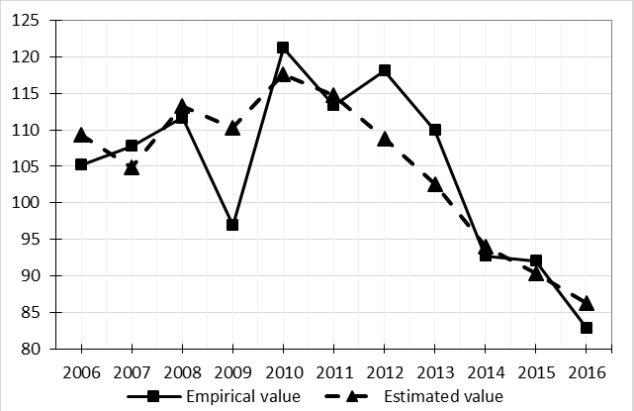



**Fig. 6:** Specific demand for housing on Ukrainian market*
**Source: calculated and designed by authors*

Thus, with a change in the specific demand, there will be a shift in aggregate demand and supply, which will lead to a rearranging of the market situation. Nevertheless, at the same time, it should also be noted the increased influence of a group of factors on the formation of the market situation in the housing market in Ukraine, which is currently characteristic of the housing markets of countries with developed economies:

- centralization of management functions and its implementation for housing projects in the hands of one business unit, which will determines the optimization of construction costs and reduces expenditures by reducing risks [3; 17];

- the implementation of planned governmental programs to increase the availability of housing in Ukraine, which will contribute to the territorial diversification of the housing market [9];

- further integration changes in the construction, which will increase the competitiveness and solidity of housing supply [13]; an increase in the cost of energy, which will shift the demand structure towards housing units with lower operating costs [18];

- strengthening the policy of decentralization in Ukraine, which will reduce disproportions in the socio-economic development of regions and municipalities [7], resulting in an increasing of the effective demand of the population.

At the same time, the index model shows that the elasticity of the specific demand for housing depends not only on price growth, but also on the availability of compensating factors: the growth of real incomes and the availability of mortgage lending.

## 5. Conclusion

Given the replacement of obsolete housing for quality and considering the European construction trends in terms of the number of square meters per person, Ukraine needs to build at least 1 billion square meters of new housing. The construction in Ukraine will continue to actively develop – approximately annually will be introduced 10-12 million square meters of new housing. Demand for renovation of housing will always be, that's performs need to build. At the same time, the main factors for sustainable demand for housing acquisition should be the growth of real incomes of citizens, working mechanisms for mortgage lending and the state's social function to provide the population with affordable housing.

The housing market in Ukraine is unsaturated, but at the same time, there are factors limiting effective demand, which are more influenced not by the aggregate volume of demand, but by its structure. Dollarization of the housing market in Ukraine has a double effect. On the one hand, the depreciation of the national currency leads to an increase in the cost of housing and a decrease in its affordability. On the other hand, the decrease in the price of housing in USD and the possibility of obtaining mortgages in foreign currency allowed to partially holding down the fall in effective demand for housing. Calculations of cobweb model shows that despite the instability of the market, the price in USD equivalent tends to decrease.

The beginning of GDP's growth in Ukraine and the increase in public housing finance should contribute to an increase in residential construction and real estate transactions in general, on condition of the relative stability of the exchange rate. The elasticity of the specific demand for housing shows that even price increases are not a deterrent, provided that it is compensated by real income growth, effective mechanisms of mortgage lending, as well as ensuring transparency of state regulation of the housing market.

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