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THE STUDY OF FACTORS INFLUENCING RESIDENTIAL CONSTRUCTION IN THE POST-WAR PERIOD, CONSIDERING ASPECTS OF SUSTAINABLE DEVELOPMENT

ABSTRACT

The post-war development of Ukraine will be associated with the return of a significant number of people who are currently outside the country. Most of them lived in regions where hostilities are or have been taking place, and whose homes have been destroyed. Ukrainians will seek to return to regions close to the borders with the EU. From the perspective of sustainable development, it is necessary to provide them with adequate living conditions and employment opportunities. In this direction, the construction of new housing will be important. However, there is a certain period between investing in housing and its commissioning. Therefore, using statistical data from the Lviv region, a lag model was built to assess the impact of investments in housing construction on the commissioning of new housing in this region. Additional calculations of the F-criterion and the von Neumann criterion confirmed the model's adequacy to the statistical data of the general population and its suitability for further analysis and forecasting of processes. The proposed model of the impact of investments in housing construction is an important tool for making management decisions at the regional government level. It has been established that when determining the investment attractiveness of construction, it is necessary to consider the need to implement energy-efficient and environmentally friendly solutions using local materials and services, the development of housing infrastructure, and support for inclusive design to ensure proper quality of life.

Keywords: housing construction, investment, post-war period in Ukraine, sustainable development, lag model, regional aspect

JEL Classification: C50, R31

INTRODUCTION

The war has significantly impacted all sectors of the economy and the social sphere in Ukraine. Its negative consequences are associated with the occupation of parts of Ukraine's territory, the destruction of industrial facilities and a substantial amount of housing, and the emigration of many Ukrainians abroad. A portion of the population from the occupied regions and regions where hostilities are taking place has relocated to the western regions of Ukraine, where the demand for housing has increased. Post-war reconstruction in Ukraine will require a significant number of people, including the return of those Ukrainians who currently reside abroad, many of whose homes have been destroyed. It is essential to provide them with attractive conditions for employment, with a proper level of remuneration, and for living. Therefore, from the perspective of sustainable development in a given region, it will be important to meet the growing demand for housing. However, the necessary investments must be secured for housing construction.

As people return to safer regions of Ukraine, the demand for housing will primarily increase in the western regions of Ukraine. It is evident that Ukrainians will not return from other countries simultaneously. The demand for housing will be spread over time. At the national level, it is important to forecast how much new housing will be needed in a particular period in a specific region and to secure the necessary investments for its construction. It is also crucial to consider that there is a time lag between investing

in construction and the commissioning of new housing. Therefore, it is essential to establish a relationship between the required investments in housing construction and the commissioning of new housing in a specific region of Ukraine using an econometric distributed lag model. Given that the Lviv region is close to the EU borders, it can be predicted that a significant number of Ukrainians will return there. Therefore, further research will be conducted using the Lviv region as a case study.

LITERATURE REVIEW

Research on Factors Influencing Housing Construction

Housing construction is one of the key components of the economic development of any country. It not only satisfies the basic need for shelter but also affects employment, financial stability, and the social well-being of the population. In the post-war period, the return of the population to their territories is crucial; however, such stimulation is only possible if housing is available. The development of housing construction is influenced by various factors.

It should be noted that both domestic and foreign authors have already conducted research on the impact of various factors on housing construction. In particular, the study of economic factors, which are among the most important in the context of housing construction, is of great significance. Research on various factors affecting consumers' purchasing power in a particular region, which determines their ability to acquire housing, is presented in the work by Shults S., Popadynets N., Bilyk I., Teslya D., Kosar N., Karpii O. and Kubrak N. (2021). The volume of mortgage loans depends on the actual GDP per capita, actual housing prices, projected inflation, and nominal interest rates. And vice versa, the location of construction is determined by the actual price of housing, the actual interest rate, and the actual cost of construction (Kader S. A., Zayed N. M., Salah Uddin M., Nitsenko V. and Klius Y., 2022). It is also worth noting that the cost of building materials significantly impacts the final cost of housing Tsai I.-C. (2012) argues that the supply of construction is influenced by construction costs, while demand is determined by rental/purchase considerations from the population. The availability of mortgage loans and other forms of financing is also critical for the development of housing construction. According to Kavaarpuo G., Tiwari P. and Martel A. (2024), most households in developing countries rely on informal housing finance and self-help due to issues related to underdeveloped capital markets.

Social factors, such as demographic changes, migration, and urbanization, also significantly influence housing construction volumes. For instance, changes in the age structure of the population, population growth, and changes in household composition affect housing demand. In this context, the research by Gong Y. and Yao Y. (2022) concluded that a 20% increase in the share of young families leads to a 10% increase in housing demand, while d'Albis H., Boubtane E. and Coulibaly D. (2019) argue that migration within the country has a significant impact on the construction industry.

There are also studies that comprehensively analyze the impact of economic and demographic factors on the development of housing construction (Bochko O., Kosar N., Kuzo N., Bilyk I. and Zarichna O., 2022); however, they do not take into account the regional aspects of these factors.

Another important factor influencing housing construction is political decisions and government policies. The research by Schill M. H. (2004) indicates that a wide range of federal, state, and local regulations, including building codes, environmental laws, zoning rules, impact fees, and government procedures for administering these rules, reduce the housing supply and create significant costs. At the same time, Bhanye J., Lehobo M.T., Mocwagae K. and Shayamunda R. (2024) argue for the need to expand and develop sustainable innovative affordable housing.

Environmental aspects, such as environmental conservation, energy efficiency, and the use of eco-friendly materials, are becoming increasingly important in housing construction. The research by Al-Homoud M. S. and Krarti M. (2021) indicates that due to the widespread use of energy-intensive equipment, including air conditioners, nearly half of the electricity is consumed by residential buildings. At the same time, Garg C. and Jain A. (2014) argues that by using green concrete, CO^2 emissions can be reduced in the direction of environmentally friendly construction technology.

Technological innovations and the development of new construction technologies significantly impact the efficiency and cost of housing construction. The use of new construction technologies, such as 3D printing, modular construction, and others, allows for cost reduction and shorter construction timelines. At the same time, Koebel C. T. (2008) emphasizes the need for innovation in the construction industry, particularly the necessity of using 3D technologies. Islam M. M., Prodhan R. K., Shohel M. S. H. and Morshed A. (2025) prove that companies using automation experienced up to 30% faster project completion times, 40% reduction in material waste, and 50% decrease in workplace accidents due to the implementation of AI-based safety analytics and autonomous equipment.

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Digitalization plays an important role in modern housing construction, enabling optimal cost estimation, schedule planning, and efficient tracking and documentation of completed work. This reduces the risk of corruption in the industry and makes processes more transparent and understandable for all market participants. The importance of using digital technologies is emphasized by Mnykh O., Kostiuk O., Dalyk V. and Zaitseva A. (2020), Kuzior A., Kettler K. and Rüb J. (2021), Bochko O., Maletska O. I., Tsitska N. E. and Kapral O. R. (2022).

Thus, housing construction depends on many factors, including economic, social, political, environmental, technological, and digital aspects. It is also important to note the impact of sustainable development principles on the growth of housing construction.

The Role of Sustainable Development Concepts in the Housing Construction Sector

Sustainable development is a crucial topic across many industries, including housing construction. The concepts of sustainable development aim to meet the needs of the present without compromising the ability of future generations to meet their own needs. In the context of housing construction, this means creating housing that is environmentally friendly, economically viable, and socially equitable. The necessity of considering sustainable development concepts is emphasized by Shteingauz, D., Kuznyetsova, A. and Achimovich, D. (2021), Martynovych N., Yemchenko I. and Kulinich T. (2023), Masyk M., Buryk Z., Radchenko O., Saienko V. and Dziurakh Y. (2023), Myskiv G. and Pasinovych I. (2024).

Effective management of construction waste through recycling and reuse is also an important aspect of sustainable development. Ding's (2008) research highlights that recycling construction waste can reduce the overall volume of waste by 30%.

It should also be noted that sustainable housing construction is often associated with higher initial costs, but in the long term, it is economically beneficial due to reduced operating expenses. Research by Roper and Beard (2006) showed that energy-efficient housing can reduce utility costs by 20-30%. In this context, Chiu's (2004) study also demonstrated that residents of energy-efficient homes experience 15% fewer health problems related to indoor air quality.

Modern aspects of sustainable construction also consider social equity dimensions, such as providing affordable housing for all segments of the population. Wardrip K. (2011) research indicates that implementing affordable housing support programs contributes to a 10% reduction in poverty levels.

The use of new construction technologies, such as 3D printing of buildings and modular construction, helps reduce costs and construction timelines.

Thus, the concept of sustainable development plays an important role in housing construction, contributing to the reduction of environmental impact, economic viability, and the improvement of the quality of life for the population. The integration of environmental, economic, social, and technological aspects into the planning and construction processes of housing allows for the creation of more sustainable and comfortable living conditions.

It is also important to note the works of Khmarska I., Kucheryava K. and Klimova I. (2022), Pereira P., Zhao Wenwu, Symochko L., Inacio M., Bogunovic I. and Barcelo D. (2022), Tarasenko I., Olefirenko K., Polozova T. and Murzabulatova O. (2023), which explore the directions for Ukraine's post-war economic recovery, taking into account sustainable development concepts.

Therefore, our research focuses on studying the factors influencing housing construction, considering specific aspects of sustainable development—improving the quality of life in the post-war period, accounting for certain delays in achieving the final result (distributed lag), and the regional aspect.

AIMS AND OBJECTIVES

The aim of the research is to establish the interdependence between the development of the housing construction sector in a specific region and the necessary investment support based on existing statistical data, taking into account the time factor. The research objectives include the development of an econometric distributed lag model to identify the relationship between the required investments in housing construction and the commissioning of new housing in the Lviv region. This model will serve as an important tool for decision-making at the level of regional authorities. Additional objectives include testing the model for adequacy and identifying key factors that may influence adjustments to the developed model within the framework of implementing the concept of sustainable development in a specific region.

METHODS

For economic processes, the effect of a certain factor on the indicator that characterizes it does not manifest immediately but rather after some time, known as the lag. The econometric distributed lag model is expressed as (Nakonechnyi et al., 2004):

$$y_t = a_0 x_t + a_1 x_{t-1} + a_2 x_{t-2} + \ldots + a_\tau x_{t-\tau} + u_t = \sum_{\tau=0}^{\infty} a_\tau x_{t-\tau} + u_t, \quad (1)$$

where a_τ - are the model parameters for the lagged variables; $x_{t-\tau}$ - is the independent lagged variable; τ - is the independent lagged variable; u_t - represents random deviations or residuals.

The challenges of estimating a lag model are primarily related to the large number of parameters and factors involved. However, the practical implementation of such a model is quite complex. Therefore, it is necessary to include in the distributed lag model only those variables $x_{t-\tau}$, for which lags are theoretically justified and empirically verified.

To justify the lags, a cross-correlation function is used, which characterizes the strength of the connection between each element of the indicator vector y_t and the corresponding element of the factor vector x_t, which is shifted relative to each other by a time lag τ (Nakonechnyi et al., 2004):

$$r_{(\tau)} = \frac{(n-\tau)\sum_{t=1}^{n-\tau} y_t x_{t+\tau} - \sum_{t=1}^{n-\tau} y_t \sum_{t=1}^{n-\tau} x_{t+\tau}}{\sqrt{\left((n-\tau)\sum_{t=1}^{n-\tau} y_t^2 - (\sum_{t=1}^{n-\tau} y_t)^2\right)\left((n-\tau)\sum_{t=1}^{n-\tau} x_{t+\tau}^2 - (\sum_{t=1}^{n-\tau} x_{t+\tau})^2\right)}} \quad (2)$$

The largest values $r_{(\tau)}$ by absolute magnitude (closest to one) determine the shift or time lag. By calculating the time lags to determine the relationship between economic indicators and factors, an economic-mathematical model of distributed lag can be constructed.

Applying the method of adaptive expectations (Nakonechnyi et al., 2004) to the econometric model (1), we obtain an econometric model in the form of:

$$y_t = b_0 + b_1 x_t + b_2 y_{t-1} + v_t, \quad (3)$$

To estimate the parameters of this model, we will use the method of instrumental variables, specifically the Wallis algorithm (Nakonechnyi et al., 2004). According to this algorithm, the parameter estimates of the model can be determined by the formula:

$$B = (Z^T X)^{-1} Z^T Y, \quad (4)$$

where:

$$Z = \begin{pmatrix} 1 & x_2 & x_1 \\ 1 & x_3 & x_2 \\ \ldots & \ldots & \ldots \\ 1 & x_n & x_{n-1} \end{pmatrix}, X = \begin{pmatrix} 1 & x_2 & y_1 \\ 1 & x_3 & y_2 \\ \ldots & \ldots & \ldots \\ 1 & x_n & y_{n-1} \end{pmatrix}, Y = \begin{pmatrix} y_2 \\ y_3 \\ \ldots \\ y_n \end{pmatrix}, \quad (5)$$

To assess the adequacy of the constructed model, the coefficient of determination (R^2), the F- (F) and von Neumann's criterion (Q) are used. The coefficient of determination is determined using the formula (Nakonechnyi et al., 2004):

$$R^2 = \frac{\sum(\hat{y}_i - \bar{y})^2}{\sum(y_i - \bar{y})^2}, \quad (6)$$

where $\bar{y}$ - average value; y_i - actual values; $\hat{y}_i$ - theoretical values.

The formula was used to determine the F-criterion:

$$F = \frac{R^2/m}{(1-R^2)/(n-m-1)}, \quad (7)$$

where m – number of factors; n – number of observations.

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The formula was used to determine the von Neumann criterion (Nakonechnyi et al., 2004):

$$Q = \frac{\frac{\sum_{i=2}^{n}(u_i - u_{i-1})^2}{n-1}}{\frac{\sum_{i=1}^{n} u_i^2}{n}}, \quad (8)$$

where u_i *- random deviations (residues).*

The point estimate of the forecast was determined by the formula:

$$\hat{y}_{\text{p}} = b_0 + b_1 y_n + b_2 x_{\text{p}}. \quad (9)$$

The confidence interval for the predicted value, within which the true value of the dependent variable falls with a given probability, is found using the formula (Nakonechnyi et al., 2004):

$$\hat{y}_{\text{p}} - \Delta\hat{y}_p \leq y \leq \hat{y} + \Delta\hat{y}_{\text{p}}, \quad (10)$$

where:

$$\Delta\hat{y}_p = t\sigma_{\text{zal.}}\sqrt{1 + \frac{1}{n} + \frac{(x_p - \bar{x})^2}{\sum(x_i - \bar{x})^2}} \quad (11)$$

To assess the impact of investment in residential construction on the commissioning of new housing in the Lviv region, the elasticity coefficient is used:

$$\text{E} = \frac{dy}{dx} \cdot \frac{x}{y}. \quad (12)$$

RESULTS

Construction of a Model to Assess the Impact of Investments in Residential Construction on the Commissioning of New Housing in the Lviv Region

The full-scale invasion by Russia has caused widespread destruction to Ukraine's economy, particularly affecting the housing sector, business and industrial infrastructure, roads, and agriculture. Rebuilding the country will require significant resources, economic calculations, and financial borrowing. The construction industry will play a crucial role in the state's recovery, with a key development direction being the expansion of residential construction. This will address the socio-economic development needs of the country and increase the pace of providing the population with affordable and quality housing. The Lviv region is considered relatively safe, so it is deemed appropriate to expand residential construction in this area.

We will determine the impact of investments in residential construction on the commissioning of new housing in the Lviv region using the data in Table 1.

Table 1. Data for Assessing the Impact of Investments in Residential Construction on the Commissioning of New Housing in the Lviv Region. *(Source: generated by the authors based on (Main Statistical Office in Lviv Region. State Statistics Service of Ukraine, 2024, Hryhorenko, 2023))*

Years	Investments in residential construction, UAH million		Commissioning of new housing, thousand m2	Consumer price index (inflation index)
	Actual	Adjusted for the inflation index		
2004	451.9	409.70	545.4	110.3
2005	498.4	459.78	499.4	108.4
2006	909.1	849.63	482.9	107.0
2007	1292.5	1106.59	669.5	116.8
2008	1799.3	1438.29	780.4	125.1
2009	808.8	713.23	391.6	113.4

(continued on next page)

Table 1. Continued.

Years	Investments in residential construction, UAH million		Commissioning of new housing, thousand m2	Consumer price index (inflation index)
	Actual	Adjusted for the inflation index		
2010	1581.8	1441.93	642	109.7
2011	1887.9	1799.71	722.7	104.9
2012	2315.9	2332.23	731.4	99.3
2013	2262.4	2257.88	675.1	100.2
2014	3025.8	2388.16	954.4	126.7
2015	4030.2	2775.62	1001.2	145.2
2016	3949.9	3529.85	753.3	111.9
2017	4632.3	4099.38	888.9	113.0
2018	5585.7	5073.30	897.3	110.1
2019	5401.5	5183.78	1292.2	104.2
2020	3177	3017.09	1015.7	105.3
2021	3171.6	2912.40	1211.5	108.9
2022	1259.2	996.2	750.6	126.4

Given the absence of data on investments in residential construction for 2022, the authors have used expert assessments indicating that residential construction in 2022 decreased by 60,3% compared to 2021 (Hryhorenko, 2023).

We will determine the cross-correlation function to establish the relationship between investments in residential construction and the commissioning of new housing in the Lviv region. Figure 1 presents the correlogram of the impact of investments in residential construction on the commissioning of new housing in the Lviv region.

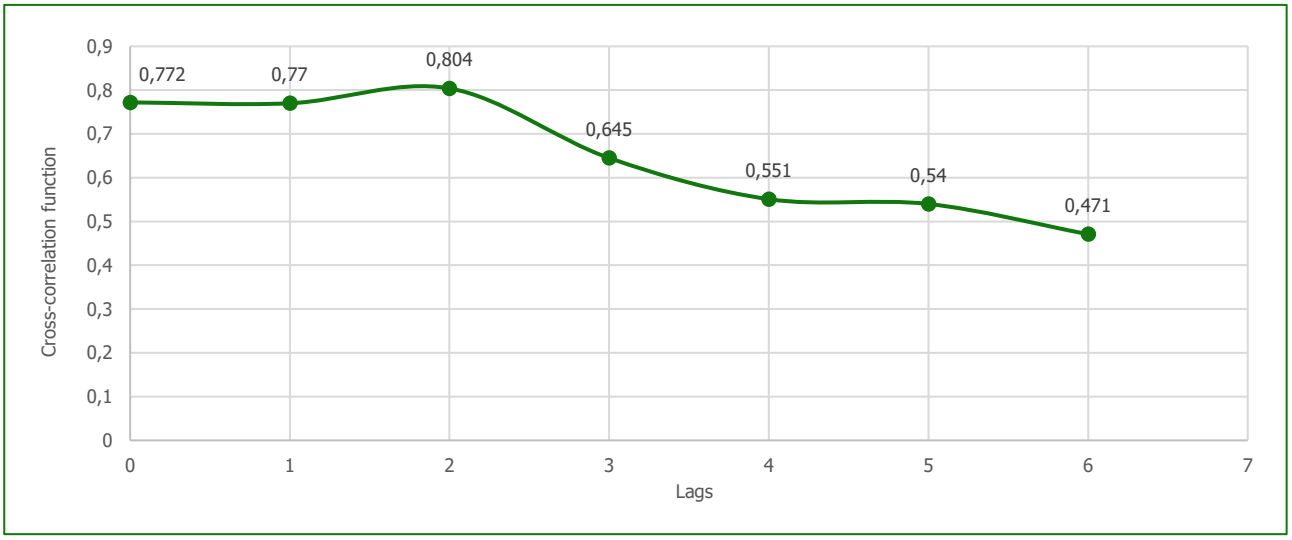

Figure 1. Correlogram of the Impact of Investments in Residential Construction on the Commissioning of New Housing in the Lviv Region.

In this case, the highest values of the cross-correlation function correspond to three values of τ, namely 0, 1, and 2. This indicates that the greatest impact of investments in residential construction on the commissioning of new housing in the Lviv region is expected in the current year and the following two years. In this case, the dynamic model of distributed lag takes the form

$$y_t = a_0 x_t + a_1 x_{t-1} + a_2 x_{t-2} + u_t, \quad (13)$$

where a_j – are the coefficients of the lagged variables, y_t – is the commissioning of new housing in the Lviv region during period t, $x_{t-\tau}$ – represents investments in residential construction during the period (t-τ).

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We will form the matrices Z, X and the vector Y based on the data in Table 1.

$$Z = \begin{pmatrix} 1 & 459.78 & 409.7 \\ 1 & 849.63 & 459.78 \\ 1 & 1106.59 & 849.63 \\ 1 & 1438.29 & 1106.59 \\ 1 & 713.23 & 1438.29 \\ 1 & 1441.93 & 713.23 \\ 1 & 1799.71 & 1441.93 \\ 1 & 2332.23 & 1799.71 \\ 1 & 2257.88 & 2332.23 \\ 1 & 2388.16 & 2257.88 \\ 1 & 2775.62 & 2388.16 \\ 1 & 3529.85 & 2775.62 \\ 1 & 4099.38 & 3529.85 \\ 1 & 5073.3 & 4099.38 \\ 1 & 5183.78 & 5073.3 \\ 1 & 3017.09 & 5183.78 \\ 1 & 2912.4 & 3017.09 \\ 1 & 996.2 & 2912.4 \end{pmatrix} X = \begin{pmatrix} 1 & 459.78 & 545.4 \\ 1 & 849.63 & 499.4 \\ 1 & 1106.59 & 482.9 \\ 1 & 1438.29 & 669.5 \\ 1 & 713.23 & 780.4 \\ 1 & 1441.93 & 391.6 \\ 1 & 1799.71 & 642 \\ 1 & 2332.23 & 722.7 \\ 1 & 2257.88 & 731.4 \\ 1 & 2388.16 & 675.1 \\ 1 & 2775.62 & 954.4 \\ 1 & 3529.85 & 1001.2 \\ 1 & 4099.38 & 753.3 \\ 1 & 5073.3 & 888.9 \\ 1 & 5183.78 & 897.3 \\ 1 & 3017.09 & 1292.2 \\ 1 & 2912.4 & 1015.7 \\ 1 & 996.2 & 1211.5 \end{pmatrix} Y = \begin{pmatrix} 499.4 \\ 482.9 \\ 669.5 \\ 780.4 \\ 391.6 \\ 642 \\ 722.7 \\ 731.4 \\ 675.1 \\ 954.4 \\ 1001.2 \\ 753.3 \\ 888.9 \\ 897.3 \\ 1292.2 \\ 1015.7 \\ 1211.5 \\ 750.6 \end{pmatrix}$$

Therefore, by applying formula (4), we obtain the parameter estimates for model (13).

$$B = \begin{pmatrix} 300.49 \\ 0.10 \\ 0.33 \end{pmatrix}$$

Thus, the econometric lag model to determine the impact of investments in residential construction on the commissioning of new housing in the Lviv region will take the form of:

$$\hat{y}_t = 300.49 + 0.1x_t + 0.33y_{t-1}$$

Assessment of the Adequacy of the Model for the Impact of Investments in Residential Construction on the Commissioning of New Housing in the Lviv Region

For the model assessing the impact of investments in residential construction on the commissioning of new housing in the Lviv region, the coefficient of determination is 0.663. This coefficient indicates that 66.3% of the variation in the commissioning of new housing in the Lviv region is explained by the variation in investments in residential construction in the previous period, suggesting a significant relationship between the factor and the indicator.

The F-statistic for the model is 14.77. According to F-distribution tables with degrees of freedom 2 and 15 at a 0.95 probability level, the critical value is 3.68. Since (F = 14.77 > 3.68), we can conclude that the relationship between investments in residential construction and the commissioning of new housing in the Lviv region is statistically significant.

The von Neumann statistic for the model is 2.56. According to critical values for von Neumann, the threshold value is 1.37. Since (d = 2.56 > 1.37), we can conclude that there is no autocorrelation of the residuals in the model.

Therefore, the constructed lag model for the impact of investments in residential construction on the commissioning of new housing in the Lviv region is adequate for the statistical data of the population and can be used for process analysis and forecasting.

Forecasting the Impact of Investments in Residential Construction on the Commissioning of New Housing in the Lviv Region

To forecast the impact of investments in residential construction on the commissioning of new housing in the Lviv region, we will consider that expert estimates indicate a 4.6% decrease in residential construction in 2023 compared to 2022 (Hryhorenko, 2024). Therefore, investments in residential construction for the commissioning of new housing in the Lviv region are estimated to be at UAH 950.4 million. Based on this, we will determine the possible commissioning of new housing in the Lviv region for 2023.

$\hat{y}_{2023} = 300.49 + 0.1 \cdot 950.4 + 0.33 \cdot 750.6 = 1146.13$ thousand m².

If in 2024, investments in residential construction increase by 20%, reaching UAH 1,140.5 million, then the possible commissioning of new housing in the Lviv region for 2024 would be:

$\hat{y}_{2024} = 300.49 + 0.1 \cdot 1140.5 + 0.33 \cdot 1146.13 = 792.76$ thousand m².

The confidence intervals for the forecasted value in 2024 will be:

$685.15 \leq y \leq 900.37.$

Thus, with investments in residential construction in the Lviv region amounting to UAH 1,140.5 million in 2024, the commissioning of new housing in the Lviv region is expected to range from 685.15 thousand m² under unfavourable market conditions to 900.37 thousand m² under favourable conditions.

To assess the impact of investments in residential construction on the commissioning of new housing in the Lviv region, we will determine the elasticity coefficient for the data in 2024.

$$E = b_1 \cdot \frac{x}{y} = 0.1 \cdot \frac{1140.5}{792.76} = 0.14.$$

Thus, a 1% increase in investments in residential construction in the Lviv region will lead to a 0.14% increase in the commissioning of new housing, assuming existing trends continue.

DISCUSSION

In the post-war period, the importance of the model assessing the impact of investments in residential construction on the commissioning of new housing in the Lviv region lies in its ability to restore Ukraine's housing stock that was destroyed or damaged by the war in safer regions. Investment in residential construction stimulates regional economic development, providing employment for the population and improving infrastructure. Kuzior (2010) emphasizes the need to adhere not only to construction requirements but also to sustainable development principles promoted by contemporary global organizations. This focus on sustainability is also evident in the author's current work, where she highlights the construction of Smart Cities (Kuzior A., 2024). Expanding the housing stock not only improves living conditions in the region but also strengthens social stability by meeting the basic needs of the local population and encouraging the return of individuals temporarily residing abroad.

It is also important to highlight the necessity of building social housing, as the financial resources of newly arrived residents may be limited. The need for social housing is emphasized by Hui-Chun Tsuang and Kuang-Hui Peng (2018). Additionally, considering environmental aspects is crucial, as demonstrated by Shpak N., Maznyk L., Dvulit Z., Mykytiuk O. and Melnyk T. (2021), which are integral to sustainable development concepts.

Investments in residential construction have a multiplicative effect on the regional economy. They stimulate the development of related industries, such as the production of building materials, transportation and logistics, as well as financial and insurance services. Furthermore, creating new jobs in the construction sector increases employment levels, positively affecting consumer demand and overall economic activity. A model tracking this impact allows for forecasting resource needs and planning the further development of the construction sector, considering both economic and social aspects.

The lag model for assessing the impact of investments in residential construction on the commissioning of new housing in the Lviv region can be further adjusted to account for the influence of various marketing environment factors on the actual capacity for commissioning new housing, including new state-level requirements for environmental sustainability and safety. These factors may lead to increased investment needs in residential construction. Conversely, escalated hostilities, inflation, and other factors could affect investment in new housing construction, leading to increased loan costs.

CONCLUSIONS

The research conducted using statistical data from the Lviv region allowed for the development of a lag model assessing the impact of investments in residential construction on the commissioning of new housing in this region. Additional calculations of the F-statistic and the Durbin-Watson statistic confirmed the model's adequacy to the statistical data of the population and its suitability for further process analysis and forecasting. Specifically, it was found that with the forecasted investment in residential construction in the Lviv region amounting to UAH 1,140.5 million in 2024, the commissioning of new housing in the region is expected to range from 685.15 thousand m² under unfavourable market conditions to 900.37 thousand m² under favourable conditions. The research results also indicated that the greatest impact of investments in residential construction on the commissioning of new housing in the Lviv region should be anticipated in the current year and the following two years.

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It should be noted that for future forecasting, we need to approach the problem from the reverse perspective. Based on the projected housing demand during a certain period of post-war economic recovery and overall state rebuilding, it is necessary to determine the required investments in construction for that period and identify their sources.

The proposed model for assessing the impact of investments in residential construction is an important tool for making management decisions at the regional level. It helps identify priority investment areas and effectively allocate financial resources to achieve maximum impact. Analyzing data on investments and the commissioning of new housing helps to identify the most effective approaches to developing housing infrastructure, contributing to sustainable economic growth and improving the quality of life for the population of the Lviv region in the post-war period.

When assessing the investment attractiveness of construction, it is also essential to consider the fundamental principles of sustainable development, which aim to achieve ecological, economic, and social sustainability in the region. This approach involves implementing practices that balance meeting current needs with preserving opportunities for future generations.

Investments in new residential construction can enhance the region's ecological sustainability by implementing energy-efficient technologies, utilizing renewable energy sources, and using environmentally friendly building materials. This can include the installation of solar panels, rainwater harvesting systems, building insulation to reduce energy consumption, and the use of recyclable materials. Such initiatives not only reduce carbon dioxide emissions and other pollutants but also lower the operating costs of buildings, making them more resilient to economic and environmental changes.

Investments in new construction can increase economic resilience by stimulating local economic development and creating new jobs. The creation of additional jobs in the construction sector, coupled with fair wages, can encourage the return of Ukrainian workers who are currently employed in construction abroad. Using local materials and services supports regional economic growth, while the adoption of new technologies can drive innovation and enhance the competitiveness of housing in the region. Long-term investments in energy-efficient and eco-friendly solutions can also reduce maintenance costs for buildings, making them financially beneficial for investors and owners.

Social sustainability is achieved by creating a comfortable, safe, and healthy living environment. Investments in construction can also focus on infrastructure development that improves residents' quality of life, including the enhancement of public spaces, better accessibility of transportation networks, and support for an inclusive design that considers the needs of various population groups, including people with disabilities. A sustainable approach also involves community participation in planning and implementing projects, which fosters social cohesion and increases resident satisfaction.

The prospects for further research are associated with the collection and analysis of primary marketing data through surveys of Ukrainians living abroad. These surveys aim to assess how important the provision of social housing in various regions of Ukraine is in their decision-making about returning to the country and to evaluate their requirements for such housing.

ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

All Authors have contributed equally.

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CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

REFERENCES

1. Al-Homoud, M. S., & Krarti, M. (2021). Energy efficiency of residential buildings in the kingdom of Saudi Arabia: Review of status and future roadmap. *Journal of Building Engineering, 36*. https://doi.org/10.1016/j.jobe.2020.102143
2. Bhanye, J., Lehobo, M.T., Mocwagae, K., & Shayamunda, R. (2024). Strategies for Sustainable Innovative Affordable Housing (SIAH) for low income families in Africa: A rapid review study. *Discover Sustainability*, *5*, 157. https://doi.org/10.1007/s43621-024-00353-9

3. Bochko, O., Kosar, N., Kuzo, N., Bilyk, I., & Zarichna, O. (2022). Determinants of Housing Construction in Ukraine. *Real Estate Management and Valuation*, *30*(3), 1–11. https://doi.org/10.2478/remav-2022-0017

4. Bochko, O., Maletska, O. I., Tsitska, N. E., & Kapral, O. R. (2022). Paradigm of a country competitiveness under conditions of digital economy. *Review of Economics and Finance*, *20,* 572–580. https://doi.org/10.55365/1923.x2022.20.65

5. Chiu, R. L. H. (2006). Socio-Cultural Sustainability of Housing: A Conceptual Exploration. *Housing, Theory and Society*, *21*(2), 65-76. https://doi.org/10.1080/14036090410014999

6. d'Albis, H., Boubtane, E., & Coulibaly, D. (2019). International migration and regional housing markets: Evidence from France. *International Regional Science Review, 42*(2), 147-180. https://hal.science/hal-04141641/documenton

7. Ding, G. K. (2008). Sustainable Construction—The Role of Environmental Assessment. Tools. *Journal of Environmental Management*, *86*(3), 451-464. https://doi.org/10.1016/j.jenvman.2006.12.025

8. Garg, C., & Jain, A. (2014). Green concrete: Efficient & eco-friendly construction materials. *International Journal of Researchin Engineering & Technology*, *2*(2), 259-264. https://www.researchgate.net/publication/266912818_GREEN_CONCRETE_EFFICIENT_ECO-FRIENDLY_CONSTRUCTION_MATERIALS

9. Gong, Y., & Yao, Y. (2022). Demographic changes and the housing market. *Regional Science and Urban Economics*, *95*. https://doi.org/10.1016/j.regsciurbeco.2021.103734

10. Hryhorenko, Yu. (2023). The volume of construction in Ukraine in 2022 fell by 65%. https://gmk.center/ua/infographic/obsiah-budivnytstva-v-ukraini-v-2022-rotsi-vpav-na-65

11. Hryhorenko, Yu. (2024). The volume of construction in Ukraine in 2023 is half of the pre-war level. Retrieved from https://gmk.center/ua/infographic/obsiah-budivnytstva-v-ukraini-u-2023-r-napolovynu-menshyj-za-dovoiennyj-riven

12. Islam, M. M., Prodhan, R. K., Shohel, M. S. H., & Morshed, A. (2025). Robotics and Automation in Construction Management Review Focus: The application of robotics and automation technologies in construction. *Journal of Next-Gen Engineering Systems, 2*(01), 48–71. https://doi.org/10.70937/jnes.v2i01.63

13. Kader, S. A., Zayed, N. M., Salah Uddin, M., Nitsenko, V., & Klius, Y. (2022). Factors affecting demand and supply in the housing market: A study on three major cities in Turkey. *Computation, 10*(11), 196. https://doi.org/10.3390/computation10110196

14. Kavaarpuo, G., Tiwari, P., & Martel, A. (2024). Transaction costs and innovation outcomes: lessons from early adopters of housebuilding innovations. *Construction Innovation.* https://www.emerald.com/insight/content/doi/10.1108/ci-01-2024-0005/full/html

15. Khmarska, I., Kucheryava, K., & Klimova, I. (2022). Peculiarities of the post-war *economic recovery of Ukraine*. *Economy and society*, *42*. https://doi.org/10.32782/2524-0072/2022-*42-31*

16. Koebel, C. T. (2008). Innovation in Homebuilding and the Future of Housing. *Journal of the American Planning Association, 74*(1), 45-58. https://doi.org/10.1080/01944360701768991

17. Kopytko, M., Myskiv, G., Lykholat, S., Petryshyn, N., Taranskiy, I., & Tiurina, N. (2022). Planning Ofresource Support for the Management System of the Process of Increasing the Level of Competitiveness in the Environment of The Functioning ofthe Socio-Economic System. *International Journal of Sustainable Development and Planning, 17*(8), 2571-2577. https://doi.org/10.18280/ijsdp.170825

18. Kuzior, A. (2010). Polish and German experiences in planning and implementation of sustainable development. *Problemy Ekorozwoju*, *5*(1), 81–89. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1547765

19. Kuzior, A. (2024). Smart City Conceptual Framework in the Context of Achieving Sustainable Development Goals. *Management Systems in Production Engineering*, *32*(2), 156–161. https://doi.org/10.2478/mspe-2024-0015

20. Kuzior, A., Kettler, K., & Rąb, Ł. (2021). Digitalization of Work and Human Resources Processes as a Way to Create a Sustainable and Ethical Organization. *Energies*, *15*(1), 172. https://doi.org/10.3390/en15010172

21. Martynovych, N., Yemchenko, I., & Kulinich, T. (2023). From the Territory of Recovery to Sustainable Development: a Methodological Concept of Effective Socio-economic Development of Ukraine after the War Development. *Problemy Ekorozwoju*, *18*(2), 13–25. https://doi.org/10.35784/preko.3923

22. Masyk, M., Buryk, Z., Radchenko, O. Saienko, V., & Dziurakh, Y. (2023). Criteria for governance' institutional effectiveness and quality in the context of sustainable development tasks. *International Journal for Quality Research*, *17*(2), 501–514. http://dx.doi.org/10.24874/IJQR17.02-13

23. Mnykh, O., Kostiuk, O., Dalyk, V., & Zaitseva, A. (2020). Digitalization of economy and assessment of opportunities and implementation. *International Journal of Advanced Science and Technology*, *29*(8s), 2470–2476. http://sersc.org/journals/index.php/IJAST/article/view/14747

24. Myskiv, G., & Pasinovych, I. (2024). Sustainable Development of European Countries: The Climate Component. *Studies in European Affairs, 2*, 173-193. http://dx.doi.org/10.33067/SE.2.2024.9

25. Nakonechnyi, S., Tereshchenko, T., & Romaniuk, T. (2004). Econometrics. Kyiv: KNEU.

26. Pereira, P., Zhao Wenwu, Symochko, L., Inacio, M., Bogunovic, I., & Barcelo, D. (2022). The Russian - Ukrainian armed conflict will push back the sustainable

DOI: 10.55643/fcaptp.2.61.2025.4691

development goals. *Geography and Sustainability*, *3*(3), 277-287. https://doi.org/10.1016/j.geosus.2022.09.003

27. Roper, K. O., & Beard, J. L. (2006). Justifying Sustainable Buildings—Championing Green Operations. *Journal of Corporate Real Estate*, *8*(2), 91-103. https://doi.org/10.1108/14630010610679899
28. Schill, M. H. (2004). Regulations and Housing Development: What We Know and What We Need to Know. https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=974f2223e5d47ac3f37bd1f2b279657f85b31fc2
29. Shpak, N., Matviyishyn, Y., Dziurakh, Y., & Gvozd, M. (2024). Simulation of the impact of changes in the volume of production and export of products on the food security of the country: on the example of Ukraine. *Frontiers in Sustainable Food Systems*, *8*. https://doi.org/10.3389/fsufs.2024.1361625
30. Shults, S., Popadynets, N., Bilyk, I., Teslya, D., Kosar, N., Karpii, O., & Kubrak, N. (2021). Factor determinants of the consumer market development. *Accounting, 7*(3), 563-572. https://doi.org/10.5267/ j.ac.2021.1.002
31. Shteingauz, D., Kuznyetsova, A., & Achimovich, D. (2021). Financial Support and Efficiency of Implementation of Government Housing Accessibility Programs in Ukraine. *Financial and Credit Activity Problems of Theory and Practice,* 5(40), 178–183. https://doi.org/10.18371/fcaptp.v5i40.244967
32. State Statistics Service of Ukraine. Main Statistical Office in Lviv Region (2024). https://www.lv.ukrstat.gov.ua
33. Tarasenko, I., Olefirenko, K., Polozova, T., & Murzabulatova, O. (2023). Strategic management of sustainable development of industrial enterprises in the conditions of the post-war reconstruction of Ukraine. *Economics Finances Law, 7,* 73-77. https://doi.org/10.37634/efp.2023.7.15
34. Tsai, I.-C. (2012). Housing Supply, Demand and Price: Construction Cost, Rental Price and House Price Indices. *Asian Economic Journal, 26* (4), 381-396. https://doi.org/10.1111/j.1467-8381.2012.02088.x
35. Tsuang, H.-C., & Peng K.-H. (2018). The Livability of Social Housing Communities in Taiwan: A Case Study of Taipei City. *International Review for Spatial Planning and Sustainable Development, 6*(3), 4-21. https://doi.org/10.14246/irspsd.6.3_4
36. Wardrip, K. (2011). The Role of Affordable Housing in Creating Jobs and Stimulating Local Economic Development: A Review of the Literature. https://www.opportunityhome.org/wp-content/uploads/2018/02/Housing-and-Economic-Development-Report-2011.pdf

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ДОСЛІДЖЕННЯ ФАКТОРІВ ВПЛИВУ НА ЖИТЛОВЕ БУДІВНИЦТВО В ПІСЛЯВОЄННИЙ ПЕРІОД З УРАХУВАННЯМ АСПЕКТІВ СТАЛОГО РОЗВИТКУ

Післявоєнний розвиток України буде пов'язаний із поверненням значної кількості людей, які сьогодні перебувають за межами країни. Більшість із них проживала в тих регіонах, де сьогодні ведуть чи вели бойові дії, і їхнє житло знищене. Українці будуть прагнути повернутися до тих регіонів, які розташовані близько до кордонів з ЄС. З точки зору концепції сталого розвитку їм необхідно забезпечити належні умови проживання та працевлаштування. У цьому напрямі важливим буде будівництво нового житла. Проте між укладенням коштів у нього та його введенням в експлуатацію минає певний період. Тому на прикладі статистичних даних Львівської області було побудовано лагову модель впливу інвестицій у житлове будівництво на введення в експлуатацію нового житла в цьому регіоні. Додаткові розрахунки F-критерію та критерію фон Неймана засвідчили її адекватність статистичним даним генеральної сукупності та придатність для подальшого аналізу процесів і прогнозування. Запропонована модель впливу інвестицій у житлове будівництво є важливим інструментом для ухвалення управлінських рішень на рівні регіональної влади. Установлено, що при визначенні інвестиційної привабливості будівництва слід ураховувати необхідність реалізації енергоефективних та екологічно чистих рішень із використанням місцевих матеріалів і послуг, розвиток житлової інфраструктури, підтримку інклюзивного дизайну для забезпечення належної якості життя.

Ключові слова: житлове будівництво, інвестиції, післявоєнний період в Україні, сталий розвиток, лагова модель, регіональний аспект

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