ECONOMETRIC ASSESSMENT OF THE INFLUENCE OF FINANCIAL AND ECONOMIC FACTORS ON THE PRICES OF NEW HOMES IN BULGARIA (2015-2025)

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Abstract: *This report presents an econometric model of type ARIMAX (0,2,1), developed to forecast and explain the dynamics of the House Price Index for New Dwellings in Bulgaria for the period 2015Q4–2025Q3 on a quarterly basis (40 observations in total). The model is based on a preliminary screening of 16 potential factors across four thematic groups: macroeconomic indicators, income and labour market, credit indicators, and investment and wealth. The objective is to identify statistically significant determinants of housing prices, assess the quality of the model, and formulate conclusions regarding its practical applicability for analysis and short-term forecasting of the new residential property market in Bulgaria.*

Keywords: *House price index, financial factor, economic factors, new dwellings, ARIMAX.*

Classification JEL: *R31, C22, E44.*

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1. Introduction

This report focuses on the forecasting and explanation of the dynamics of the new housing price index in Bulgaria (HPIND) as of the date of the country's accession to the Eurozone (1.1.2026). The model is based on a preliminary screening of 16 potential factors distributed in four groups: macroeconomic indicators, income and labor market, credit indicators and investment and wealth. The collected database covers a period of 10 years and 40 quarters (2015Q4 – 2025Q3). The aim of the study is to identify statistically significant determinants of housing prices that have the best explanatory power at the time of Bulgaria's accession to the Eurozone. On this basis, ARIMAX (0,2,1) is built, whose focus is to analyze in an operational plan the market of new residential properties in Bulgaria by providing predictors for short-term price forecasting. The structure of the study includes data collection and their analysis through descriptive statistics; testing the 16 factors for stationarity, using ADF and KPSS tests; justification of the ARIMAX model (0,2,1); estimation of the ARIMAX model parameters and coefficients; estimation of the predictive qualities of the model (RMSE, MAPE, MAE, BIC, Ljung-Box & VIF); economic interpretations, structural conclusions and limiting characteristics of the model. The conclusion summarizes the model's key findings and strengths.

2. Literature Review

Household housing is a fundamental factor in economic theory. The study of the dynamics of these homes in terms of quantity and price provides an estimate of the growth of wealth and the tax base of municipal taxes and fees. For the purposes of the study, a focus was placed on four groups of predictors: macroeconomic indicators, income and labor market, credit indicators, investment and welfare, although there are also studies that cover an even larger number of influencing factors (Zahariev, Zaharieva, Shaulska, Larysa, & Oryekhov, 2026).

In the first group, the focus on GDP and/or its components finds a number of confirmations of its influence on housing prices (Algieri, 2013). In these studies, GDP is identified as the main factor influencing housing prices (Li & Zeng, 2010), (Cohen & Karpavičiūtė, 2017), (Ubarevičienė & Aidukaitė, 2026), (Mazáček & Panoš, 2025). Housing prices are also influenced by regional factors (Prodanov & Naydenov, 2020), (Sabitova, Shavaleyeva, Lizunova, Khairullova, & Zahariev, 2020), but also by supply and demand factors (Stroebel & Vavra, 2019). However, the influence of inflation is assessed at two levels - when examining final housing prices, but also when assessing the factors forming the cost of housing (Kuang & Liu, 2015). The latter stands out with particular force in the new era (Anari & Kolari, 2002), (Cohen & Karpavičiūtė, 2017). Other studies focus on factors influencing the effective demand for new housing. Workers' incomes (McQuinn & O'Reilly, 2008) and employment indicators in the labor market (Irandoust, 2019) are included in a number of studies on house prices (Girouard, Kennedy, Noord, & André, 2006). Credit conditions for purchasing houses naturally complement the income and savings capacity of households. Important factors here are mortgage interest rates (McQuinn & O'Reilly, 2008), (Lin, Lee, & Newell, 2022) and housing credit dynamics. In the final fourth place is the attraction of foreign investors in housing (Ouhinou, et al., 2025) and the attractiveness of alternative investments through the stock exchange (Zaharieva, Tarakchiyan, & Zahariev, 2022) and the currency market volatility (Jacque, L., 2025).

3. Methodology, Data and Descriptive Statistics

3.1 Description of Dependent and Independent Variables

The dependent variable HPIND (House Price Index for New Dwellings, 2015=100) is published by the National Statistical Institute (NSI) and reflects changes in the price level of newly built residential properties. Over the study period, the index increased 2.32 times (from a basic value 100 to approximately the value of 232), with a mean of 147.52 points, a standard deviation of 37.00 points, and a coefficient of variation of 25.08%, indicating moderate dispersion around the mean. During model construction, 17 indicators (including the dependent variable) were examined, systematised into four groups: (a). Macroeconomic Factors (5 variables): GDP, Exports, Imports, HICP (Harmonised Index of Consumer Prices) and GDP per capita; (b) Income & Labour Market (3 variables): Average Gross Quarterly Wages and Salaries, Unemployment coefficient and Labour Force; (c) Credit Indicators (6 variables): Dwelling Credits (DwCr), Interest Rate, Bank Loans Secured by Residential Property, Household Interest Costs on Mortgage Loans, Bad and Restructured Housing Loans (BLRSP), and Mortgage Interest Rate in BGN; (d) Investment & Wealth (3 variables): Net Foreign Investment in Dwellings (NFID), EUR/USD exchange rate, and BSE index SOFIX.

3.2 Key Features from Descriptive Statistics

The analysis of descriptive statistics reveals considerable heterogeneity in indicator dynamics. The highest coefficient of variation belongs to bad and restructured housing loans (BRHL – 57.36%), reflecting credit portfolio quality volatility. Bank loans secured by residential property (BLSRP – 43.82%) and dwelling credits (DwCr – 34.65%) also show high variability. The lowest variability is found in labour force (LF – 4.47%), net foreign investment (NFIP – 4.80%) and EUR/USD (ExR - 4.84%). Over the full period (2015Q4 –

2025Q3), bank loans secured by residential property recorded the most substantial growth, expanding 3.83 times relative to the base period (t40/t1). Dwelling credits followed with a 2.89-fold increase, while average gross wages grew 2.83 times and GDP expanded 2.75 times compared to the starting point. These dynamics confirm that the Bulgarian housing market operated in an environment of sustained economic expansion.

3.3. Stationarity Testing (ADF and KPSS)

A prerequisite for the correct application of an ARIMA/ARIMAX model is establishing the order of integration of each series. Two complementary tests are applied: ADF (Augmented Dickey-Fuller) – null hypothesis of unit root (non-stationarity) - and KPSS (Kwiatkowski–Phillips–Schmidt–Shin) - null hypothesis of stationarity. The results show that almost all series are integrated of order I(2), becoming stationary only after second-order differencing. Exception factors are HICML and NFID: I(1) with stationary after first differencing, and HICP and BLSRP: with unclear integration order (contradictory ADF and KPSS results), and they are excluded from further analysis. The basic rule of the research is that if including series with indeterminate integration structure that would yield incorrect estimates. At that stage the key finding is since the dependent variable HPIND is I(2), second-order differencing is required, reflected in the model structure - ARIMA(0,2,1). The best fitting statistical significance independent variables retained in the model are EXP, IMP, and DwCr which are also I(2). On that base we are ensuring integration order homogeneity - a mandatory condition for an ARIMAX specification.

4. Results and Discussion

4.1. Structure and Specification of the ARIMAX (0,2,1) Model

The estimated model is ARIMAX(0,2,1) - an ARIMA model augmented with exogenous regressors. Written in analytical form, after second-order differencing of all series the model formula is expressed with following variables and coefficients:

$$\Delta^2 HPINH\_t = \beta_1 \text{ x } \Delta^2 EXP\_t + \beta_2 \text{ x } \Delta^2 IMP\_t + \beta_3 \text{ x } \Delta^2 DwCr\_t + \theta_1 \cdot \varepsilon\_\{t\text{-}1\} + \varepsilon\_t \quad (1)$$

where Δ^2 denotes the second-order differencing operator, θ_1 is the moving average coefficient MA(1), and εt is the error term. The absence of an autoregressive component (AR=0) means that past values of the index are not included directly; inertia is captured solely through the MA(1) term. From the initial 16 indicators, following stationarity tests and regression screening, three exogenous factors are retained in the final model (See Table 1).

Table 1. Exogenous factors of ARIMAX(0,2,1) model

Factor	Description	Direction	Interpretation
EXP_D2	Exports (2nd difference)	(+) Positive	Rising exports signal economic expansion and increased residential demand
IMP_D2	Imports (2nd difference)	(−) Negative	Accelerating imports reflect consumer demand for goods rather than housing
DwCr_D2	Dwelling Credits (2nd difference)	(+) Positive	Expansion of mortgage lending directly stimulates demand and drives housing prices upward

Source*: Author calculations with IBM SPSS*

4.2. Assessment of Model Parameters

The MA(1) coefficient is estimated at $\theta_1 = 0.980$ (SE = 0.430; t = 2.282; p = 0.029). The value is positive, close to unity, and statistically significant at $\alpha = 0.05$. The high value of θ_1 indicates that the current change in the index is strongly conditioned by the error of the preceding period, reflecting a substantial inertial component in housing price dynamics. In case that value near 1.0 lies at the practical boundary of MA invertibility ($|\theta| < 1$) it should be monitored carefully when the model is updated with new observations.

Table 2. Significance assessment of ARIMAX(0,2,1) parameters

Predictor	B	SE	Beta	t-stat	p-value	95% CI Lower	95% CI Upper	VIF
EXP_D2	0.002	0.001	0.396	2.357	0.024 *	0.000	0.003	1.316
IMP_D2	-0.003	0.001	-0.534	-2.724	0.010 **	-0.005	-0.001	1.793
DwCr_D2	0.011	0.006	0.338	1.756	0.088 (“)	-0.002	0.023	1.730
* p < 0.05; ** p < 0.01; “ marginally significant (p < 0.10)								

***Source**: Author calculations with IBM SPSS*

Regarding the interpretation of the obtained model coefficients we can share following arguments: (a) The Exports (EXP_D2) has B = 0.002, positive and statistically significant (p = 0.024). The Standardised Beta = 0.396 ranks it as the second most important predictor. Economically, accelerating exports drive as a proxy for economic growth and rising incomes, and are associated with upward pressure on housing prices. The partial correlation (r = 0.370) is moderate; (b) The Imports (IMP_D2) has B = -0.003, negative and highly significant (p = 0.010). The Standardised Beta = -0.534 makes it the most influential predictor in absolute terms. Economically, accelerating imports reflecting domestic demand for foreign goods, and it is are inversely related to housing price dynamics. When imports surge, disposable resources for residential investment likely diminish, or import growth signals consumer spending that competes with housing investment; (c) The Dwelling Credits (DwCr_D2) has B = 0.011, positive and marginally significant (p = 0.088), at the 10% threshold, not passing the conventional 5% level. Standardised Beta = 0.338 places it third in importance. The 95% confidence interval spans zero (-0.002; 0.023), meaning the effect may vanish under structural change or smaller samples. Nevertheless, the economic rationale is strong – mortgage lending is the primary financing mechanism for housing purchases.

4.3. Assessment of the Model Quality

Table 3 represent forecast accuracy measures. The combination of MAPE = 1.68% and R^2 = 0.993 positions the model as exceptionally accurate for practical purposes. Important caveat: R^2 = 0.993 must be interpreted cautiously in I(2) models, since second-order integration inherently generates smooth, highly correlated series. The stationary R^2 of 0.666 is the more informative measure of in-sample fit. The Ljung-Box Q(18) test yields Q = 23.465 with 17 degrees of freedom and p = 0.135 > 0.05. The null hypothesis of no autocorrelation in residuals is not rejected. This is a key diagnostic result: residuals behave as white noise, confirming that the model has captured the systematic structure in the data and that the ARIMA specification is adequate.

Table 3. Forecast accuracy of ARIMAX(0,2,1) model

Factor	Description	Econometric Interpretation
Stationary R^2	0.666	Model explains ~67% of variation in differenced series
R^2 (overall)	0.993	Exceptionally good coverage of original series levels (I(2) models naturally yield high R^2 by construction)
RMSE	3.195	Root mean square error of ~3.2 index points – acceptable given a mean value of 147.52
MAPE	1.683%	Mean absolute percentage error below 2% - excellent forecast precision
MAE	2.511	Mean absolute error of ~2.5 index points
MaxAPE	3.707%	Maximum percentage error below 4% - no forecast anomalies
MaxAE	7.066	Maximum absolute error of ~7 points (~4.8% of mean level)
Normalised BIC	2.706	Information criterion for model selection – lower is better; useful for comparing alternative specifications
Stationary R^2	0.666	Model explains ~67% of variation in differenced series - good fit

***Source**: Author calculations with IBM SPSS*

VIF values for the three predictors are: EXP_D2 = 1.316, IMP_D2 = 1.793 and DwCr_D2 = 1.730. All values are below the threshold of 5, indicating an absence of problematic multicollinearity. Tolerance values (0.760, 0.558 and 0.578 respectively) are all above 0.2, confirming that multicollinearity does not undermine the reliability of the parameter estimates. The model registers no outliers (Outliers = 0). This is a positive indicator of data robustness and internal consistency – no corrections for extreme values are required.

5. Conclusions

The final ARIMAX specification retains three explanatory variables (Exports, Imports, and Dwelling Credits). Each of them is based on well-established economic logic and reflects different mechanisms through which macroeconomic conditions affect the dynamics of residential property prices and especially new dwelling. Of particular theoretical significance is the role of the trade balance. The combination of a statistically significant positive export effect and a negative import effect jointly captures the influence of the net export position on housing prices: a favourable trade balance is associated with upward price pressure, insofar as export-oriented activity generates income and employment that strengthen effective housing demand, while accelerating import growth may signal a reorientation of household expenditure away from real estate toward consumer goods and services. The credit channel, although marginally significant (p = 0.088), remains a substantively important dimension of the model. Dwelling credits reflect the central role of financial intermediation in housing price formation, as expansion in mortgage lending directly amplifies effective demand for new dwellings – a relationship consistent with the classical credit accelerator mechanism. The attenuated significance level may be attributable to lag structure effects or partial collinearity with the trade-side predictors rather than to an absence of genuine economic relevance. Despite the model's satisfactory econometric performance, the analysis reveals the absence of several indicators that carry considerable theoretical weight in housing price determination. Variables such as wages, unemployment, mortgage interest rates, and the stock exchange index were not retained in the final specification despite their conceptual relevance to residential property markets. This outcome may reflect that their influence is captured implicitly through the included predictors, or alternatively, it may indicate genuinely weak linear associations with the second-differenced dependent series over the sample period under examination.

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