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HOW MACROECONOMIC FACTORS IMPACT RESIDENTIAL REAL ESTATE PRICES IN EASTERN EUROPE

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Abstract. *Purpose* – This study examines how GDP growth, interest rates, and unemployment rates influence residential real estate prices in politically and economically stable Eastern European countries, aiming to identify key drivers of property value changes in the region.

Research methodology – The study uses multiple linear regression and Pearson correlation (r) to assess the relationship between variables and housing prices, with ARIMA (3,1,0) applied for short-term price forecasts based on cyclical time series trends.

Findings – The findings show a strong correlation between macroeconomic indicators and residential real estate prices, with the key influencing factor varying by country, reflecting diverse market sensitivities and regional economic contexts.

Research limitations – The research is limited to Eastern European countries with stable political and economic conditions, excluding those facing instability. Future studies could expand the analysis to include such regions to provide a more comprehensive view.

Practical implications – The results provide valuable guidance for policymakers and investors in crafting strategies tailored to specific macroeconomic conditions, enhancing market predictions and stability.

Originality/Value – By focusing on the underexplored residential real estate market in Eastern Europe, this study contributes novel insights into regional housing price determinants and offers a foundation for further research on macroeconomic impacts in real estate markets.

Keywords: real estate, macroeconomic, prices, interest rates, unemployment rate, GDP growth, Europe.

JEL Classification: C53, E37, F62, R15.

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1. Introduction

In recent years, especially in Europe, the global landscape has been marked by significant events, including the war in Ukraine, pandemic, oil and gas shortage touched the world's economy in every aspect. The outlook for Europe's economy appeared bleak, inflation rates were rising rapidly, central banks were increasing interest rates strongly, the world expected to experience a recession (European Commission, 2023). Even though the recession seems to be avoided, Europe's economy grappled with many challenges. Sanctions for Russia caused swift prices' growth and volatility, mainly the food and energy sectors (Gaur et al., 2023). Moreover, the huge inflation rates lowered the purchasing power of people and hampered the competitiveness of exporting companies. It has a comparatively large impact on people's and business's decisions and expectations, which were shaped by European Central Bank's monetary policy (European Central Bank, 2023). The interest rates were raised for the 1st time

in 11 years by the European Central Bank as a response to speedily rising inflation in July 2022. That affected the whole real estate sector in Europe. This rate hike led individuals and businesses to make more conservative choices in the real estate market, given the rising interest rates (Anderson et al., 2023). The developers scaled back on developing new projects while the demand has fallen. The existing projects became less profitable, which was caused by lower demand and higher prices for resources. It led to price growth (Graham & Read, 2023). Investments dwindled due to the people's and businesses' cautious decisions that were being taken. The economies were landscaped by varying GDP growth rates and unemployment challenges. While some countries in Eastern Europe appeared as dynamic and adaptive nations, others faced serious obstacles (Kitsos et al., 2023).

To create the analysis of real estate market in selected Easter European countries, it is vital to acknowledge its fundamental concepts and relationship with respective national economies, while also taking into consideration the significance of recognizing macroeconomic factors. The purpose of this study is to extend current understanding by examining how these macroeconomic factors interact with regional dynamics and geopolitical influences unique to Eastern Europe. Taking into account the socio-economic context of the region, the study provides a more comprehensive understanding of residential real estate price developments.

2. Literature review

2.1. The interdependence between the real estate market and economic growth

Real estate (RE) is regarded as fundamental asset class, that is indispensable for both developed and developing nations. The real estate market (REM) itself is a relevant part of the economy, which changes reveal how successful the economy of a specific country is. It encompasses physical structures and objects crucial for life and work. Furthermore, its development defines the whole country's economy (Golob et al., 2012).

RE is composed not only of economic and legal aspects, but it also consists of physical and social elements. When RE is analyzed from a physical standpoint, objects' size, shape, location, and environment are distinguished (Kowalczyk et al., 2019). If it is studied from an economic aspect, then RE can be characterized as commodity, property, investment that can be used through ownership, property, or usage (Li et al., 2022). Moreover, ownership or RE evokes feelings such as well-being, independence, self-esteem or even security. The analysis of real estate can consider all these aspects, depending on the desired outcome (Ersoz et al., 2018).

Household and loans' capacity are increasing when the REM is growing. This process braces expenditure and investment (Grum & Govekar, 2016). As it is widely known, investments and expenditure help the economy to circulate and develop further (Yakub et al., 2022). On the contrary, shortage in REM usually signifies economic recession. The biggest financial crises in the world were exacerbated by downturns of REM. Conducted studies show that mostly less developed countries' economies are more reliant on real estate market's fluctuations.

Even though many studies have shown moderate to strong correlation between REM and economic growth, some researchers argue that there exists a negative impact between REM and economic growth (Thi Nguyen & Ngoc Bui, 2019). Several studies have provided

evidence that real estate rapid surges can contribute to financial crisis (Jang et al., 2018). REM bubble, when the market reaches unprecedented heights, can decelerate the economy, or even trigger the stock market (Lim, 2018). There are substantial evidence illustrating how bubble worsens the Global financial crisis in 2007–2009 (Aziz, 2012).

Despite many assumptions on the relation between REM and economic growth have been made, the main concept remains consistent – there is a positive relation between REM and economic growth. The key distinction lies in determining the direction of influence – whether economic growth affects REM or vice versa – with debates centered on which side primarily influences the other (Wilhelmsson, 2020).

2.2. The recognition of macroeconomic factors

GDP growth

"Neo-classical" model of economic growth was created in 1978 by Robert Solow (Philippe & Patrick, 2020). This model posits, that growing capital investments drive growth rates due to soared capital-to-labor ratio (Sung et al., 2021). All the investments, that comes through RE exert a long-term influence on economic growth and Gross Domestic Product (GDP) changes (Shen, 2021). Additionally, the ability to purchase real estate is closely linked to income, which, in fact, appears to be directly associated with the GDP (Dey, 2019). Empirical studies have consistently demonstrated positive correlations between GDP growth and income ratio in many cases, although some uncertainties may arise when the correlation cannot be identified (Oishi & Kesebir, 2015). RE market's dynamics can be affected not only by countries economy, but by various other factors such as global trends, constructions sector, demographic changes, all which impact supply demand.

Unemployment rate

Unemployment exerts a direct and substantial impact on the real estate market (REM). When the unemployment rates rise, the income levels decline, mortgages appear to be more difficult to pay, ultimately leading to loan defaults (Dogan & Topuz, 2020). This, in turn, results in falling property prices and reduced demand (Usta, 2021). Despite the close relationship between unemployment and the economy, unemployment can be analyzed independently. A low unemployment rate encourages investment in the real estate market and the economy. Real estate, being a relatively stable form of investment that evokes positive sentiments, attracts individuals to invest in it, even when they may not have absolute confidence in their financial stability. However, many real estate investments involve mortgages, and since banks have stringent regulations regarding new mortgages approvals, unemployment is one of a pivotal aspect in receiving a mortgage (Reed & Ume, 2016). To sum up, the unemployment rate's effect to REM can be likened as an investment which necessitates financial stability that comes with a job.

Long-term interest rate

Monetary policy plays a pivotal role in the real estate market (REM). The long-term interest rates (IR) determine the value of money, which are reflected in discount rates used for setting real estate prices, especially for income properties (Vonlanthen, 2023). Moreover, real estate

(RE) prices are directly impacted by interest rates, particularly in the context of mortgages. The interest rate policy is an instrument to stabilize prices of Real estate while decreasing demand through higher current prices (Baek et al., 2021). It is usually the case due to the higher risk of recession because of rising inflation. The prices of RE can be influenced by the investors as well, which touches commercial real estate, where investors assess the riskless yields on government bonds against their projected returns in the REM. The difference is affected by IR and reflects investment perspectives, and, as a result, has an impact on real estate prices (Freybote & Seagraves, 2018).

3. Methodology

The data used for this analysis was sourced from OECD and ECB databases for selected eastern Europe countries (Bulgaria, Czechia, Hungary, Poland, Romania, Slovakia) (OECD, 2023; European Central Bank, n.d.). The data sets the time from 2009 to 2022 on an annual basis.

The primary dependent variable under analysis is the price per square meter of residential real estate for selected countries in Euros (HP). Others independent variables are unemployment rate (UR), long-term interest rates (IR), GDP growth rate (GDP). All these independent variables will be employed to elucidate the variations in housing prices.

Through a linear collinearity test, we assessed the connection between our independent values – unemployment rate, long-term interest rates, GDP growth rate and dependent value, housing prices per square meter in selected countries. This assessment was conducted using a mathematical model of multiple regression. Those kinds of models are commonly employed to make predictions for the future on how some factors could affect dependent variables (Uyanık & Güler, 2013).

Research data analysis was performed with Microsoft Excel 365 and Statistical Package for Social Sciences (SPSS) programs after systematizing the data. The normality of the data was checked with the Shapiro-Wilk test, and if it was statistically insignificant ($p > 0.05$) and if the data were normal, one-way analysis of variance of independent samples (one-way ANOVA) was used to check the price averages between countries. The formula for calculating ANOVA is given in Equation (1):

$$W = \frac{\left(\sum_{i=1}^{n} a_i x_{(i)}\right)^2}{\sum_{i=1}^{n} \left(x_i - \overline{x}\right)^2}, \tag{1}$$

where n is the number of observations, x_i is the sampling values arranged, and ai are the coefficients.

The null hypothesis of the ANOVA method states that the means of the compared groups are not statistically significantly different. Its justification is given in Equation (2):

$$H_0: \mu_1 = \mu_2 = \mu_3 = \ldots = \mu_k, \tag{2}$$

where H_0 is the null hypothesis, μ – mean, k – sample size.

Pearson's r test was used to find the statistical dependence of the relationship between the nominal criteria. Statistical significance (by default) is selected when $p < 0.05$. The correlation

was considered strong when p exceeded 0.7, and very weak when it did not reach 0.3. The formula for calculating the Pearson correlation coefficient is given in Equation (3):

$$r = \frac{\sum\left(x_i - \bar{x}\right)\left(y_i - \bar{y}\right)}{\sqrt{\sum\left(x_i - \bar{x}\right)^2 \sum\left(y_i - \bar{y}\right)^2}}, \tag{3}$$

where r is the Pearson correlation coefficient, x_i is the sample x variables, y_i is the sample y variables, $\bar{x}$ is the mean in the x value of the variables, $\bar{y}$ is the mean in the y value of the variables.

Afterwards, there will be employed linear regression models to calculate the correlations between selected macroeconomic factors (unemployment rate, long-term interest rate, GDP growth) and residential real estate prices fluctuations. The multicollinearity problem was avoided choosing only relevant independent variables based on previous research. The further relation between real estate prices and macroeconomic factors will be determined using multiple regression models. This model will be used to find if the independent variables correlate with the real estate prices, whether changes in these variables can impact future housing prices (Kang & Zhao, 2020) (see Equation (4)).

$$Y = a + (\sum b_i X_i) + \varepsilon, \tag{4}$$

where Y is the dependent variable, X is the independent variable, a and b are the coefficients of the Equation, and ε is the error of the Equation.

Finally, a short-term forecasting test – ARIMA – was performed to predict price movements. The ARIMA model consists of three components: the autoregressive process – AR(p), the moving average process – MA(q) and the integrating part I, which indicates the data differentiation order d, which is required to ensure data stationarity. The formula for the AR(p) process is given in Equation (12) (see Equation (5)):

$$\text{AR(p) process: } y_t = \phi_1 y_{t-1} + .. + \phi_p y_{t-p} + e_t, \tag{5}$$

where y_t is the value at time t, p is the lag order of the autoregressive process, ϕ_p is the lag regression coefficient of order p, and e_t is the random error.

$$\text{MA(q) process: } y_t = \theta_1 e_{t-1} + .. + \theta_q e_{t-q} + e. \tag{6}$$

When differentiating the data, the ARMA model might be supplemented with an integrating part I. In this case, integration part will not be used due to wide gaps of periods between our housing prices values.

4. Results

4.1. The analysis of the impact of economic factors on the real estate market

One-way ANOVA was employed to examine the uniformity of price averages across countries, yielding a statistically insignificant result after checking the data for normality. This suggests that the averages of house prices across Eastern European countries are statistically close.

To assess the relationship between independent variables and housing prices in the Baltic countries, a correlation analysis was performed according to the Pearson r criterion (see Table 1).

Table 1. Pearson r correlations' coefficients between variables

Bulgaria	Housing Prices	GDP growth	Interest rates	Unemployment
Housing Prices	1	–0.017 (*p = 0.954*)	**–0.837 *(p = 0.000)***	–0474 (*p = 0.087*)
GDP growth	–0.017 (*p = 0.954*)	1	–0.248 (*p = 0.392*)	–0.447 (*p = 0.109*)
Interest rates	**–0.837 *(p = 0.000)***	–0.248 (*p = 0.392*)	1	**–0.618 *(p = 0.018)***
Unemployment	–0474 (*p = 0.087*)	–0.447 (*p = 0.109*)	**–0.618 *(p = 0.018)***	1
Czechia	Housing Prices	GDP growth	Interest rates	Unemployment
Housing Prices	1	0.083 (*p = 0.777*)	–0.091 (*p = 0.757*)	**–0.821 *(p = 0.000)***
GDP growth	0.083 (*p = 0.777*)	1	–0.355 (*p = 0.213*)	–0.279 (*p = 0.335*)
Interest rates	–0.091 (*p = 0.757*)	–0.355 (*p = 0.213*)	1	0.432 (*p = 0.123*)
Unemployment	**–0.821 *(p = 0.000)***	–0.279 (*p = 0.335*)	0.432 (*p = 0.123*)	1
Hungary	Housing Prices	GDP growth	Interest rates	Unemployment
Housing Prices	1	0.337 (*p = 0.238*)	–0.461 (*p = 0.097*)	**–0.826 *(p = 0.000)***
GDP growth	0.337 (*p = 0.238*)	1	–0.448 (*p = 0.108*)	–0.488 (*p = 0.077*)
Interest rates	–0.461 (*p = 0.097*)	–0.448 (*p = 0.108*)	1	**–0.779 *(p = 0.001)***
Unemployment	**–0.826 *(p = 0.000)***	–0.488 (*p = 0.077*)	**–0.779 *(p = 0.001)***	1
Poland	Housing Prices	GDP growth	Interest rates	Unemployment
Housing Prices	1	0.135 (*p = 0.646*)	–0.218 (*p = 0.453*)	**–0.757 *(p = 0.002)***
GDP growth	0.135 (*p = 0.646*)	1	0.078 (*p = 0.792*)	–0.265 (*p = 0.360*)
Interest rates	–0.218 (*p = 0.453*)	0.078 (*p = 0.792*)	1	0.532 (*p = 0.050*)
Unemployment	**–0.757 *(p = 0.002)***	–0.265 (*p = 0.360*)	0.532 (*p = 0.050*)	1
Romania	Housing Prices	GDP growth	Interest rates	Unemployment
Housing Prices	1	**–0.619 *(p = 0.018)***	**0.645 *(p = 0.013)***	0.132 (*p = 0.652*)
GDP growth	**–0.619 *(p = 0.018)***	1	–0.494 (*p = 0.072*)	–0.393 (*p = 0.165*)
Interest rates	**0.645 *(p = 0.013)***	–0.494 (*p = 0.072*)	1	0.451 (*p = 0.106*)
Unemployment	0.132 (*p = 0.652*)	–0.393 (*p = 0.165*)	0.451 (*p = 0.106*)	1
Slovakia	Housing Prices	GDP growth	Interest rates	Unemployment
Housing Prices	1	–0.066 (*p = 0.822*)	**–0.681 *(p = 0.007)***	**–0.917 *(p = 0.000)***
GDP growth	–0.066 (*p = 0.822*)	1	–0.209 (*p = 0.474*)	0.039 (*p = 0.895*)
Interest rates	**–0.681 *(p = 0.007)***	–0.209 (*p = 0.474*)	1	**0.791 *(p = 0.001)***
Unemployment	**–0.917 *(p = 0.000)***	0.039 (*p = 0.895*)	**0.791 *(p = 0.001)***	1

In the case of Bulgaria, similar results are observed as in Romania. The primary variable with the greatest impact on housing prices is interest rates. Interestingly, Bulgaria's situation is negatively influenced by interest rates, whereas Romania's is positively affected. This implies that when interest rates rise, housing prices decrease in Bulgaria and increase in Romania. Conversely, other countries exhibit different outcomes, where the main statistically significant variable with the greatest negative impact on housing prices is the unemployment rate. Higher unemployment rates correspond to lower housing prices in these countries.

To forecast the variation in house prices across the selected countries, a linear regression analysis was conducted using GDP growth, interest rate, and unemployment rate as predictor variables. The coefficient of determination obtained was substantial, exceeding 0.2 in all

6 countries, indicating a strong relationship between the predictors and house prices. Furthermore, the ANOVA value was found to be less than 0.05, indicating statistical significance. Cook's measures obtained < 1, so there are no outliers, the regression model fits the data. T-test values in all cases were less than 0,05, which means that all our tested variables are significant.

The B coefficients form the housing price model equation for Bulgaria (see Equation (7)):

$$HP = 140.8 - 1.028\left(GDP\right) - 0.277\left(IR\right) - 3.004\left(UR\right). \quad (7)$$

In Equation (5), it becomes evident that the unemployment rate exerts the most substantial influence on the variation in house prices, followed by GDP growth with slightly less impact, while the interest rate has the least effect. Consequently, in the scenario concerning Bulgaria, a rise in the unemployment rate per unit will lead to the most significant decline in real estate prices, estimated at over 3,004 units, as indicated by Equation (7).

The B coefficients form the housing price model equation for Czechia (see Equation (8)):

$$HP = 159.399 - 0.64\left(GDP\right) + 5.392\left(IR\right) - 13.359\left(UR\right). \quad (8)$$

In Equation (6), we can see that the unemployment rate has the greatest influence on the change in housing prices, the interest rate, to a lesser extent, and the GDP growth the least. This means that in the case of the Czechia, real estate prices will fall the most (by 13,359 units) with an increase in the unemployment rate per unit (see Equation (8)).

The B coefficients form the housing price model equation for Hungary (see Equation (9)):

$$HP = 170.628 - 0.37\left(GDP\right) + 5.825\left(IR\right) - 11.152\left(UR\right). \quad (9)$$

In Equation (7), it's evident that the unemployment rate holds the most significant sway over the fluctuation in housing prices, followed by the interest rate to a lesser degree, and GDP growth with the least impact. Consequently, for Hungary, a rise in the unemployment rate per unit would lead to the most substantial decline in real estate prices, estimated at 11,152 units, as illustrated in Equation (9).

The B coefficients form the housing price model equation for Poland (see Equation (10)):

$$HP = 129.165 - 0.665\left(GDP\right) + 2.038\left(IR\right) - 3.816\left(UR\right). \quad (10)$$

Equation (8) reveals that the unemployment rate exerts the greatest influence on housing price fluctuations, followed by the interest rate to a lesser extent, and GDP growth having the smallest impact. Consequently, in the context of Poland, a rise in the unemployment rate per unit would precipitate the most significant decline in real estate prices, amounting to a decrease of 3,816 units, as outlined in Equation (10).

The B coefficients form the housing price model equation for Romania (see Equation (11)):

$$HP = 115.713 - 1.761\left(GDP\right) + 4.378\left(IR\right) - 4.125\left(UR\right). \quad (11)$$

Within Equation (9), it's apparent that the interest rate indicator holds the most substantial sway in affecting shifts in house prices, with the unemployment rate following suit but to a lesser extent, and GDP growth exerting the least impact. Consequently, in the context of Romania, a unit increase in the unemployment rate would yield the most considerable escalation in real estate prices, totaling over 4,378 units, as elucidated in Equation (11).

The B coefficients form the housing price model equation for Slovakia (see Equation (12):

$$HP = 160.329 - 0.018\left(GDP\right) + 1.048\left(IR\right) - 4.904\left(UL\right). \quad (12)$$

In Equation (10), we can see that the unemployment rate has the greatest influence on the change in house prices, the interest rate, to a lesser extent, and the GDP growth the least. This means that in the case of Slovakia, real estate prices will fall the most (by 4,904 units) with an increase in the unemployment rate per unit (see Equation (12)).

4.2. Short-term price forecast for Eastern Europe

This study used the same values of prices from 2009 to 2022. The countries were analyzed separately to indicate the possible price movement in the coming years.

The ARIMA model was chosen, which consists of three components: an autoregressive process (AR(p)), a moving average process (MA(q)) and an integrable part (I). This model is based on the idea that in this case the change in house prices depends on time.

When testing the statistical stability of the time series and the goodness of fit of the data, no statistical significance was observed ($p > 0.05$) in all countries. Therefore, the unadjusted time series is unstable, and the data is not completely suitable for forecasting. After differentiating these data, statistical significance was confirmed ($p < 0.05$), which proves the stability of our data.

Differentiation was followed by a white noise test, which was confirmed for statistical significance ($p < 0.05$), meaning that it was possible to move to the next step in the ARIMA model run. By observing the autocorrelation and partial autocorrelation tests, we can see that we have obtained the optimal model results in ARIMA (3, 1, 0) for all countries separately.

Next, a quantile comparison plot (QQ) was drawn, along with the added line, to check that the residual followed a normal distribution. After checking the correlations between the results, no statistical significance was obtained ($p > 0.05$), which means that the results are not related. After performing the white noise test, the final price forecast model for all countries was created. The model is used to predict the price change in the coming years in Eastern Europe (see Figures 1–6).

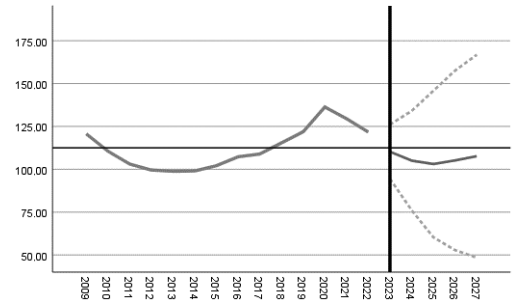

Figure 1. Graph of the direction of price change in Bulgaria

The average price change of houses in Bulgaria in near future should continue falling and again starting to grow in a few years since now. Though some experts may say, that Bulgaria's

housing prices reached its peak since 2008 and would disagree that it may fall or have fallen in the past. But it is the case only in bigger cities such as Varna, Sofia and etc.

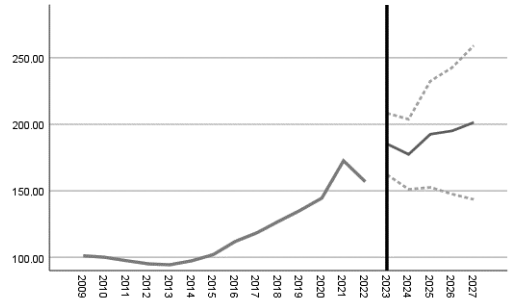

Figure 2. Graph of the direction of price change in Czechia

Housing prices in Czechia regarding our ARIMA model should start growing in the near future. It means that now it is the perfect time to invest into real estate in Czechia. Even though investors should have in mind, that Czechia is the second-most expensive country in Europe to buy property regarding Deloitte Property Index. Results have shown that it should not be any better in near future.

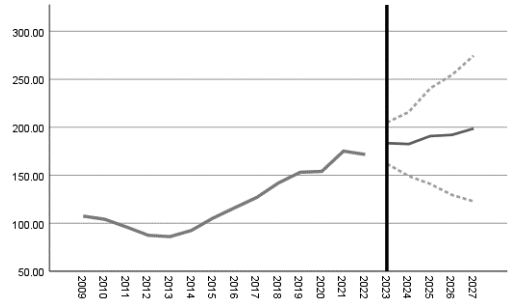

Figure 3. Graph of the direction of price change in Hungary

Housing prices in Hungary should also be rising in a few years. Not as much as it should be rising in Czechia, but the perfect time to buy some property would be now. Even though, Hungary's housing market situation is not any better than Czechia's. The demand is plunging, residential construction's activity declined, and the overall economy is ailing.

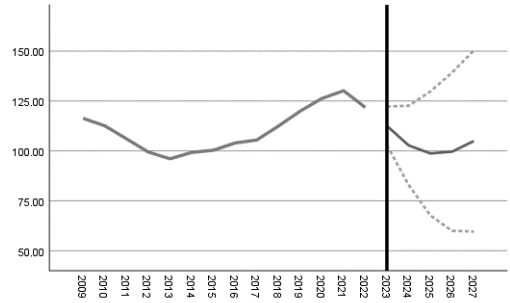

Figure 4. Graph of the direction of price change in Poland

Housing prices in Poland will continue decreasing and, in a few years, may start growing again. Experts, again, would disagree that prices will go down. In the bigger cities prices have risen for about 5.5% in the near past and it should continue going like that they might say. But the increase have fallen down more than twice in the bigger cities, while the smaller cities already had low housing prices.

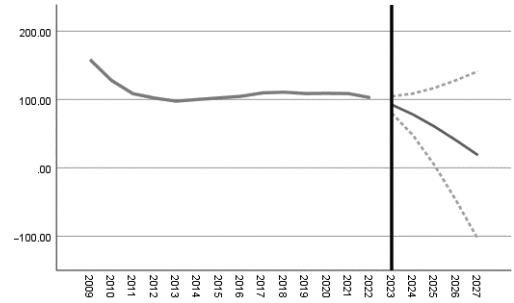

Figure 5. Graph of the direction of price change in Romania

Romania's housing prices should decrease in the future and should not start growing at all. In 2022 the researches have shown that the property deals slightly grew, even though the demand of housing market has fallen rapidly in Romania in the past few years.

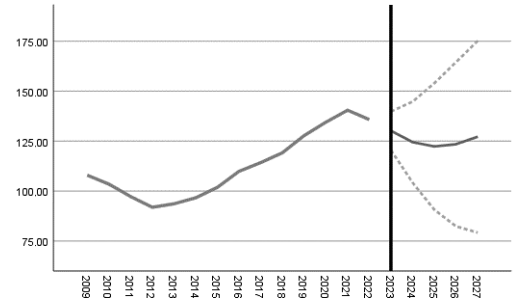

Figure 6. Graph of the direction of price change in Slovakia

Slovakia's case is similar to Poland, it should decrease in near future, and probably will start growing afterwards. Experts says that Slovakia's housing market is struggling at the moment, due to the falling demand, prices, and property deals in the recent past.

In conclusion, the short-term price forecast for residential real estate in Eastern Europe reveals diverse trends across the analyzed countries. While housing prices in Bulgaria, Poland, and Slovakia are expected to decline in the near term before rebounding, markets in Czechia and Hungary show potential for growth, making this a favorable time for investment despite current economic challenges. Conversely, Romania's housing market is projected to face sustained price declines due to falling demand. These findings emphasize the varying dynamics of real estate markets within the region, shaped by local economic conditions, demand patterns, and historical trends. Policymakers and investors should consider these differences to make informed decisions tailored to each country's market realities.

5. Conclusions and discussion

The article conducts an in-depth analysis about macroeconomic factors effect on real estate market and its prices in selected countries. It employs various statistical techniques, including linear collinearity test, comparative analysis, and multiple regression to find out whether chosen independent variables influence housing prices. The independent variables under scrutiny are unemployment rate, gross domestic product growth and interest rates.

Given previous research highlighting multicollinearity issues arising from numerous independent variables (Gecevičius, 2020), this analysis concentrated on three primary independent variables. Findings revealed that, across all countries except Romania, the unemployment rate had the most significant statistical impact on housing prices, exhibiting a statistically significant negative effect. Interestingly, previous researches already discovered that unemployment will be the most significant macroeconomic factor among others (Grum & Govekar, 2016). Conversely, Romania displayed a different trend, where interest rates emerged as the most influential variable on housing prices, demonstrating the largest statistically significant positive effect. Although, previous researchers have found, that unemployment rate, as it was in all other countries, should be the most important independent variable affecting housing prices in Romania (Chirilus, 2023). These three variables, selected for their prevalence in various studies and proven impact, formed the focus of this research (Laurinavičius et al., 2021). Although, analysis on such perspective in Eastern Europe region is missed.

When discussing forecasting, intriguing results emerged across all six countries. In each case, the near-term outlook suggests a trend of declining prices, with some countries expected to sustain this decrease (such as Romania), while others are anticipated to transition into an upward trajectory thereafter. Forecasts are indeed lacking in this region as well, even though some countries have forecasting's researches. For example, Poland, which results are the same as in this analysis, prices should decrease in near future (Bełej, 2023). In this research, ARIMA was selected due to the cyclical nature of real estate trends, which tend to repeat themselves over time. ARIMA is widely recognized as an effective method for forecasting based on time series data, making it an appropriate choice for this study (Kontopoulou et al., 2023). It is worth mentioning that some previous analyses have focused more on socioeconomic factors, such as income levels, population growth, social preferences, and demographic trends, rather than purely economic indicators like GDP or interest rates. This perspective helps researchers understand the market beyond traditional economic models, highlighting the role of people's decisions, habits, and needs in shaping real estate dynamics (Hromada, 2019). Worth mentioning that some experts may say that the results are inexact, and that they see it differently. This research analyzed housing prices across the entire country, not just in the major cities, which could explain the divergent results observed in different studies.

Future research should further explore environmental and sustainability factors. Over the past decade, policies in the European Union and other developed regions have prioritized creating sustainable and safe environments, with attention also directed towards the real estate market sector (Strauss, 2019). However, there is a notable scarcity of research examining how these policies specifically influence the real estate market, including its supply and prices (Katafygiotou et al., 2023).

Moreover, prognostic analyses should incorporate exogenous variables to enhance the accuracy of the model by capturing external effects. Additionally, employing larger sample sets for time series analysis would be beneficial (Dagan & Wilkins, 2023). The benefits of "big data" were studied in many other researches and were always confirmed (Zhang et al., 2023). These improvements could be easily achieved through the use of Artificial Intelligence, which could help capture all these small variables that may go unnoticed by the naked eye (Kang et al., 2020). Moreover, Artificial Intelligence could predict the future housing and renting prices by itself using data-based analysis, timeline in the past and human experience. Especially having in mind, that real estate market depends on cycles, Artificial Intelligence could help to minimize the risk and increase Return on Investments (Pandey et al., 2021).

Disclosure statement

All authors declare no conflicts of interest in this paper.

References

Anderson, I., Thoma, V., & Krawczyk, D. C. (2023). Editorial: Improving financial decisions. *Frontiers in Psychology*, *14*, Article 1171950. https://doi.org/10.3389/fpsyg.2023.1171950

Aziz, B. (2012). Financial crisis 2007–2009. How real estate bubble and transparency and accountability issues generated and worsen the crisis. *Estudios Fronterizos*, *Nueva Época*, *13*(6), 201–221. https://doi.org/10.21670/ref.2012.26.a08

Baek, I., Lee, S., Lee, J., & Kim, J. (2021). Analysis of housing market dynamics considering the structural characteristics of mortgage interest. *Sustainability*, *13*(19), Article 10523. https://doi.org/10.3390/su131910523

Bełej, M. (2023). Predicting housing price trends in Poland: Online social engagement – Google trends. *Real Estate Management and Valuation*, *31*(4), 73–87. https://doi.org/10.2478/remav-2023-0032

Chirilus, A. I. (2023). Forecasting real estate prices in Romania: A lag optimized linear approach. *Baltic Journal of Real Estate Economics and Construction Management*, *11*(1), 120–132. https://doi.org/10.2478/bjreecm-2023-0008

Dagan, D. T., & Wilkins, E. J. (2023). What is "big data" and how should we use it? The role of large datasets, secondary data, and associated analysis techniques in outdoor recreation research. *Journal of Outdoor Recreation and Tourism*, *44*, Article 100668. https://doi.org/10.1016/j.jort.2023.100668

Dey, S. R. (2019). The relationship between income, consumption and GDP of Asian countries: A panel analysis. *Managing Global Transitions*, *17*(2), 113–127. https://doi.org/10.26493/1854-6935.17.113-127

Dogan, C., & Topuz, J. C. (2020). Real effects of real estate: Evidence from unemployment rates. *Studies in Economics and Finance*, *37*(4), 605–623. https://doi.org/10.1108/SEF-03-2019-0124

Ersoz, F., Ersoz, T., & Soydan, M. (2018). Research on factors affecting real estate values by data mining. *Baltic Journal of Real Estate Economics and Construction Management*, *6*(1), 220–239. https://doi.org/10.2478/bjreecm-2018-0017

European Central Bank. (2023a). *Monetary policy decisions*. https://www.ecb.europa.eu/press/govcdec/mopo/html/index.en.html

European Central Bank. (n.d.). *ECB data portal*. https://data.ecb.europa.eu/

European Commission. (2023). *Spring 2023 economic forecast: An improved outlook amid persistent challenges*. https://economy-finance.ec.europa.eu/economic-forecast-and-surveys/economic-forecasts/spring-2023-economic-forecast-improved-outlook-amid-persistent-challenges_en

Freybote, J., & Seagraves, P. (2018). The impact of investor sentiment on commercial real estate market liquidity. *Journal of Real Estate Research*, *40*(4), 597–628. https://doi.org/10.1080/10835547.2018.12091513

Gaur, A., Settles, A., & Väätänen, J. (2023). Do economic sanctions work? Evidence from the Russia-Ukraine conflict. *Journal of Management Studies*, *60*(6), 1391–1414. https://doi.org/10.1111/joms.12933

Gecevičius, V. (2020). *Nekilnojamojo turto rinkos signalų apie ekonominius ciklus vertinimas* [Magistro darbas, Šiaulių universitetas].

Golob, K., Bastic, M., & Psunder, I. (2012). Analysis of impact factors on the real estate market: Case Slovenia. *Engineering Economics*, *23*(4), 357–367. https://doi.org/10.5755/j01.ee.23.4.2566

Graham, J., & Read, A. (2023). House prices, monetary policy and commodities: Evidence from Australia. *Economic Record*, *99*(324), 1–31. https://doi.org/10.1111/1475-4932.12705

Grum, B., & Govekar, D. K. (2016). Influence of macroeconomic factors on prices of real estate in various cultural environments: Case of Slovenia, Greece, France, Poland and Norway. *Procedia Economics and Finance*, *39*, 597–604. https://doi.org/10.1016/S2212-5671(16)30304-5

Hromada, E. (2019, May 22–24). Real estate prices in the Czech Republic: Behavioral approach. In *Proceedings of the 18th International Scientific Conference Engineering for Rural Development* (pp. 1795–1800). Jelgava, Latvia. https://doi.org/10.22616/ERDev2019.18.N087

Jang, H., Song, Y., Sohn, S., & Ahn, K. (2018). Real estate soars and financial crises: Recent stories. *Sustainability*, *10*(12), Article 4559. https://doi.org/10.3390/su10124559

Kang, H., & Zhao, H. (2020). Description and application research of multiple regression model optimization algorithm based on data set denoising. *Journal of Physics: Conference Series*, *1631*(1), Article 012063. https://doi.org/10.1088/1742-6596/1631/1/012063

Kang, J., Lee, H. J., Jeong, S. H., Lee, H. S., & Oh, K. J. (2020). Developing a forecasting model for real estate auction prices using artificial intelligence. *Sustainability*, *12*(7), Article 2899. https://doi.org/10.3390/su12072899

Katafygiotou, M., Protopapas, P., & Dimopoulos, T. (2023). How sustainable design and awareness may affect the real estate market. *Sustainability*, *15*(23), Article 16425. https://doi.org/10.3390/su152316425

Kitsos, T., Grabner, S. M., & Carrascal-Incera, A. (2023). Industrial embeddedness and regional economic resistance in Europe. *Economic Geography*, *99*(3), 227–252. https://doi.org/10.1080/00130095.2023.2174514

Kontopoulou, V. I., Panagopoulos, A. D., Kakkos, I., & Matsopoulos, G. K. (2023). A review of ARIMA vs. machine learning approaches for time series forecasting in data driven networks. *Future Internet*, *15*(8), Article 255. https://doi.org/10.3390/fi15080255

Kowalczyk, C., Nowak, M., & Źróbek, S. (2019). The concept of studying the impact of legal changes on the agricultural real estate market. *Land Use Policy*, *86*, 229–237. https://doi.org/10.1016/j.landusepol.2019.05.012

Laurinavičius, A., Laurinavičius, A., & Laurinavičius, A. (2021). Macroeconomic variables influencing housing prices in Vilnius. *International Journal of Strategic Property Management*, *26*(1), 24–34. https://doi.org/10.3846/ijspm.2021.15961

Li, J., Fang, W., Shi, Y., & Ren, C. (2022). Assessing economic, social and environmental impacts on housing prices in Hong Kong: A time-series study of 2006, 2011 and 2016. *Journal of Housing and the Built Environment*, *37*, 1433–1457. https://doi.org/10.1007/s10901-021-09898-x

Lim, T. (2018). Growth, financial development, and housing booms. *Economic Modelling*, *69*, 91–102. https://doi.org/10.1016/j.econmod.2017.09.008

OECD. (n.d.). *Housing prices* [Data]. https://data.oecd.org/price/housing-prices.htm

Oishi, S., & Kesebir, S. (2015). Income inequality explains why economic growth does not always translate to an increase in happiness. *Psychological Science*, *26*(10), 1630–1638. https://doi.org/10.1177/0956797615596713

Pandey, S., Gupta, S., & Chhajed, S. (2021). ROI of AI: Effectiveness and measurement. *International Journal of Engineering Research & Technology*, *10*(5), 749–761. https://doi.org/10.2139/ssrn.3858398

Philippe, H., & Patrick, M. (2020). Influence of gross domestic product (GDP) on real estate prices in Rwanda. *International Journal of Innovative Research and Development*, *9*(4), 77–82. https://doi.org/10.24940/ijird/2020/v9/i4/APR20041

Reed, R. R., & Ume, E. S. (2016). Housing and unemployment: The search for the "American Dream." *Journal of Macroeconomics*, *48*, 72–86. https://doi.org/10.1016/j.jmacro.2016.01.001

Shen, S. (2021). Empirical research on the impact of real estate on economic development. *Journal of Mathematical Finance*, *11*(2), 246–254. https://doi.org/10.4236/jmf.2021.112014

Strauss, D. (2019). *A policy framework for sustainable real estate in the European Union*. In T. Walker, C. Krosinsky, L. N. Hasan, & Kibsey, S. D. (Eds.), *Sustainable real estate. Palgrave studies in sustainable business in association with future earth* (pp. 77–111). Palgrave Macmillan. https://doi.org/10.1007/978-3-319-94565-1_5

Sung, R., Owen, E., & Li, Q. (2021). How do capital and labor split economic gains in an age of globalization? *Review of International Political Economy*, *28*(1), 232–257. https://doi.org/10.1080/09692290.2019.1677744

Thi Nguyen, M.-L., & Ngoc Bui, T. (2019). Stock market, real estate market, and economic growth: An ARDL approach. *Investment Management and Financial Innovations*, *16*(4), 290–302. https://doi.org/10.21511/imfi.16(4).2019.25

Usta, A. (2021). İktisadi aktivite ve işsizlik oraninin konut talebi üzerine etkileri: Türkiye için vektör hata düzeltme modeli tahmini [The impact of economic activity and unemployment rate on housing demand: Estimating a vector error correction model for Turkey]. *Gümüşhane Üniversitesi Sosyal Bilimler Enstitüsü Elektronik Dergisi*, *12*(3), 1157–1168.

Uyanık, G. K., & Güler, N. (2013). A study on multiple linear regression analysis. *Procedia – Social and Behavioral Sciences*, *106*, 234–240. https://doi.org/10.1016/j.sbspro.2013.12.027

Vonlanthen, J. (2023). Interest rates and real estate prices: A panel study. *Swiss Journal of Economics and Statistics*, *159*, Article 6. https://doi.org/10.1186/s41937-023-00111-0

Wilhelmsson, M. (2020). What role does the housing market play for the macroeconomic transmission mechanism? *Journal of Risk and Financial Management*, *13*(6), Article 112. https://doi.org/10.3390/jrfm13060112

Yakub, A. A., Achu, K., Ali, H. M., & Abdul Jalil, R. (2022). An analysis of the determinants of office real estate price modelling in Nigeria: Using a Delphi approach. *Property Management*, *40*(5), 758–779. https://doi.org/10.1108/PM-08-2021-0060

Zhang, J., Wolfram, D., & Ma, F. (2023). The impact of big data on research methods in information science. *Data and Information Management*, *7*(2), Article 100038. https://doi.org/10.1016/j.dim.2023.100038