

DETERMINANTS OF REAL ESTATE PRICES IN SLOVAKIA AT THE NATIONAL AND REGIONAL LEVEL

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Abstract: The real estate market in Slovakia has seen significant changes since 2022, caused primarily by the consequences of inflation, which pushed up the growth of interest rates, prices of building materials, and construction works and caused a decrease in the real net income of the population. The aim of the contribution was to identify the influence of economic and sociological variables on the price of real estate at the national and regional level and to point out the differences at the NUTS 3 level. Quarterly data for the period 2006-2022 were monitored, while the multiple linear regression method was used. The results of the study thus confirm the assumption about the different effect of determinants on the price of real estate at the regional level, which gives specific regions room to adapt their own measures in this area.

Keywords: real estate market, real estate prices, interest rate, mortgages, linear regression.

1 Introduction

Real estate prices in Slovakia have undergone turbulent development over the past decades. The relative boom of the Slovak real estate market in the second half of the last decade was mainly driven by the favourable development of the Slovak economy, which represented the basis for positive expectations of the population and a growing willingness to purchase housing. An important role was also played by relatively easily available credit sources intended for housing, which, together with other factors, led to a sharp increase in real estate prices and the emergence of a real estate bubble (Sinicakova et al. 2017). The situation changed in 2008 due to the financial and economic depression, when the real estate market gradually stagnated and real estate prices fell due to external and internal influences. Brzezicka et al. (2019) and Strobel et al. (2018) confirm that the development of the real estate market is closely linked to the development of the business cycle and confirmed by the existence of economic crises. The start-up of the economy after the end of the financial crisis resulted in the stabilization of prices on the Slovak real estate market. The long period of low interest rates resulted in growth in demand for real estate, accompanied by growth in development activity on the supply side (Soltes & Gavurova, 2014, 2015). This has caused property prices to approach their pre-financial crisis highs. However, the pre-crisis boom was much more dynamic, while the pre-coronavirus price growth was caused by price cumulation over a longer period. Before the corona crisis, indicators did not indicate the presence of a real estate bubble in Slovakia, but regional differences were significant and, in some regions, real estate prices were overvalued (Cesnak & Klacso, 2021; Gavurova et al. 2016). As a result of significant shocks such as the coronavirus, inflation growth, the war in Ukraine and price growth energy, there were significant changes in the real estate market after 2020. It faced challenges such as a lack of workers, an increase in the prices of materials and labour costs, as well as anti-inflationary monetary policy measures in the form of an increase in interest rates on the mortgage loan market (Gavurova et al., 2022). These factors also had an impact on changes in the development of real estate prices in Slovakia. Siemińska (2021) confirmed that the period of the Covid 19 pandemic also had an impact on the change of preferences on the real estate market, where, for example, in Poland there was a significantly higher

demand for apartments and houses with their own gardens and for recreational properties.

Existing studies describe a range of economic and social determinants of property prices (Cunha & Lobão 2021; Votava et al. 2021; Zakaria & Fatine, 2021; Pažický, 2020; Belke & Klein 2018; Glaeser et al., 2017; Kokot, 2018, 2020 and others) while these are determinants on the supply and demand side. Chau et al (2001) and Xiao et al. (2019) define tree groups from determinants: permanent (territory, type of building, ecology of the territory, availability of developed infrastructure), conditionally permanent (total area, floor level, construction material, layout, presence of balconies (loggias), availability of an elevator) and conditional variables (engineering communications).

Significant changes in the impact of selected determinants depending on the region of the country were also demonstrated in studies such as Wu and Lux (2018), Dluhoš, (2017), Golej et al. (2016), Zimmer (2015) and others. It can therefore be assumed that the development of real estate prices on the Slovak real estate market will be the result of determinants that act both nationwide and regionally. We will consider the real estate price determinant as a variable that can cause a price reaction at the national or regional level. Uncovering regional determinants can help to explain price differences by place and region in the past and can also help to define measures that can effectively influence the price trend.

The aim of the presented study is to identify the determinants of real estate prices on the Slovak real estate market at the national level and at the same time to identify these determinants at the regional level, which should contribute to explaining the different development of real estate prices at the SK-NUTS 3 level.

1.1 Literature review

The real estate market can be divided into the commercial real estate market, the development of which is primarily influenced by the economic cycle (Kalabiska & Hlaváček, 2022; Pagliari, 2017), and the residential real estate market (Bianchi et al., 2018). Studies by Schindler et al. (2009) and Sunjo and Yilmaz (2017) show that due to the specific position of this commodity, this market cannot be considered efficient. The reason is the impossibility of applying price arbitrage in case of price differences, inelastic supply in the short term and the existence of price bubbles (Schindler et al., 2009; Lyons, 2015; Sunjo & Yilmaz, 2017; Votava et al., 2021.)

The price of real estate is formed by supply and demand on the real estate market, which affect several factors. According to Car (2009), the prices of residential real estate in Slovakia the following factors are the most determined by GDP (economic factor), average number of populations aged from 25 to 44 years (demographic factor), the total volume of household loans (credit-financial factors), the volume of household loans for housing purchase (credit-financial factors), the volume of construction production of residential buildings (economic-technological factor). The intensity of the dependence on the above factors and residential real estate prices is very high. Identifying determinants is an important step towards completion of regression analysis, model construction and subsequent prognosis of the future, he says.

According to analysis Golej et al. (2016), based on the results of correlation and regression analysis, they mentioned as a key determinant of development of Slovak real estate prices as population aged from 25 to 44 years, GDP and interest rates on loans granted to households. According to their study, the state of real estate prices is mainly influenced by regional differences. High real estate prices in Bratislava encourage entrepreneurs to invest heavily in building new real estate and infrastructure.

Dluhoš (2017) analysed a database of 959 building plots in Slovakia using an econometric model based on the OLS, the goal of this paper is to quantify the relationship between selected characteristics and average real estate prices in municipalities in Slovakia. The results indicate that real estate prices in the Bratislava region are statistically significantly higher than in other regions of Slovakia, there is a statistically significant negative relationship between distance from the municipality and the nearest big regional city and the average real estate price of the municipality, and there is a statistically significant negative relationship between the average real estate price of a municipality and the rate of unemployment in this municipality.

Horváthová (2020) investigated the Slovak mortgage sector using methods such as VAR, DEA, panel, and linear regression. The study confirmed that the availability of real estate loans in Slovakia had a significant impact on the growth of real estate prices. From a national point of view, real estate prices in Bratislava have different development factors than real estate prices. Low interest rates play an important role in housing finance.

Poliaková and Kameniková (2023) analysed the Slovak and Czech housing market in 2020-2022. For the evaluation, they used many indicators for comparisons such as housing price indices, average wages, indebtedness, unemployment, and interest rates of the central banks of both countries and hypo index indicators DTI, DSTI, and LTV. The authors find a similar development of the indicators in both countries, the differences were found in the amount of interest rates, due to the different policies of the central banks.

Table 1 presents an overview of world studies focused on real estate market determinants.

Table 1 Overview of determinants used in world studies

| Authors | Country | Used models | Determinants |
|-----------------------------|--|---|---|
| Cunha, Lobão (2021) | EU, Portugal, 25 MSA Portugal | panel regression, regression model, method of least squares | house price index, GDP, average interest rate, construction costs, tourism, house price index for the previous period |
| Votava et al. (2021) | Czech regions | multiple panel regression, OLS | disposable income, number of inhabitants in an apartment, change of inhabitants, status of inhabitants, marriages, divorces, number of job applicants, number of crimes per 1000 inhabitants |
| Zakaria, Fatine (2021) | Morocco | Hedonic regression, autocorrelation tests, Geary's test, log-log model | area (m ²), number of floors, property type, address, number of bedrooms, garage, additional services |
| Pažický (2020) | Slovakia | Method of principal components, Cointegration model, Three-stage panel model | Expectations in the construction industry (ESI)? Interest rates on new loans granted to households, net monetary income, number of inhabitants, unemployment rate, supply of new apartments, interest rates on new loans granted to companies, costs in the construction industry |
| Belke, Keil (2018) | Germany | panel regression, pooled least squares (POLS) regression, fixed effects model | house prices, apartment prices, rents, transactions, construction, stock of existing apartments, age structure, number of households, unemployment rate, economic structure, average annual disposable income, purchasing power index, number of hospitals, interest |
| Wang et al. (2017) | China | OLS, regression analysis, spatial lag model, Moran index, geographic detector technique | share of tenants, living space per inhabitant, share of urban population, average wage in cities, price of land, share of population working in the real estate industry, share of employment in the tertiary sector |
| Grum, Govekar (2016) | Slovenia, Greece, France, Poland, Norway | multiple linear regression | price m ² of residential real estate, unemployment, stock index, current account of the country, industrial production, gross domestic product |
| Hlaváček et al. (2016) | Slovakia, Poland, Czech Republic, Hungary, Romania | error-correction model | office real estate stock GDP, loans/GDP, HCPI |
| Panagiotid, Printzis (2016) | Greece | vector error correction model (VECM), cointegration tests, Granger causality | HPI, CPI, IP, retail trade volume, interest rate, annual mortgage growth rate, M ₁ money supply growth rate, unemployment rate |

Source: Own processing by the authors.

Cunha and Lobão (2021) highlighted the fact that tourism is one of the determinant factors of real estate prices in Portugal. This is because tourists can rent cottages, villas, and houses (Patwal et

al., 2023) that accommodation enterprises provide for them (Čelik and Čevirgen, 2021). These enterprises also create value addition for economies (Ključnikov et al., 2022a), and provide many job opportunities for unemployed people (Ključnikov et al., 2022b; Civelek and Krajčík, 2022; Civelek et al., 2023), thus, many migrant employees work for tourism and hospitality sectors (Přivarová et al., 2022). For this reason, the increase that these sectors cause in the demand of real estate also increases prices. This fact can also be a good example to explain how tourism sector can make changes in economy of a country (Shpak et al., 2022).

The different dynamics of price development from the point of view of location are documented by Glaeser et al. (2012) when they compare poorer areas versus richer ones using the example of large American cities. In this case, the level of employment in individual locations also plays a role. Zimmer (2015) subsequently confirms the importance of location for price formation in the USA and compares this result with the unproven dependence of prices between individual OECD countries. On the other hand, the analysis of individual regions of the German market shows a strong connection of real estate prices to demographic data, infrastructure, and basic economic variables (Belke & Keil, 2018). Wu and Lux (2018) analysed U.K. regional real estate prices from 2005 to 2017 to identify factors influencing house prices (regional versus national) and potential price bubbles. They used the Gordon dividend discount model, and they considered house prices as the present value of imputed rents. They differentiated between long-term and short-term effects using pooled mean group (PMG) and mean group estimation (MG) to determine variations in regional house prices. Regional trend analysis shows that house price growth in the regions has been affected differently in the short run and each region has varying long-run fundamentals. Other studies (Androniceanu, 2023; Androniceanu et al., 2022a; Androniceanu et al., 2022b) analysed the relationships between economic growth, digitalization, and political stability which influenced the real estate market in different European states.

Votava et al. (2021) confirmed that there are determinants that are linked to the Czech real estate market at the regional level. For five of the eight determinants such as net disposable income, number of inhabitants, number of inhabitants per completed apartment, average population status, number of applicants for one job and number of divorces, it was proven based on regional data that these determinants act differently in selected regions and have thus the importance for explaining the different prices of apartments in the Czech Republic.

Based on the results of studies such as Glaeser et al. (2012), Zimmer (2015), Golej et al. (2016), Dluhoš, (2017), Belke and Keil (2018), Wu and Lux (2018), Votava et al. (2021) or Cunha Lobão (2021) we can assume that at the regional level the selected determinants have a different impact on the real estate price.

2 Data and Methodology

The presented study is based on the analysis of data for the period 2006-2022 at the quarterly level. Data sources are publicly available databases such as National Bank of Slovakia (NBS), Statistical office of Slovak Republic (SOSR) and Eurostat. For the purposes of the study, variables are monitored at the level of Slovakia as well as at the regional level, while the legislative division into eight regions (Bratislava Region (SK-BL), Trnava Region (SK-TA), Nitra Region (SK-NI), Trenčín Region (SK-TC), Zilina Region (ZA), Banská Bystrica Region (SK-BC), Prešov Region (SK-PV) and Košice Region (SK-KI)). Region abbreviations correspond to ISO 3166-2 codes for Slovakia. The influence of twelve selected determinants on the price of real estate in selected regions is investigated using linear regression models.

The models include as explained variables real estate prices (P) for Slovakia as a whole and for individual regions, which represent the average nominal offer prices of real estate in

Euro/m² published quarterly by the NBS adjusted for inflation using the consumer price deflator from Eurostat. When determining the prices of residential real estate, the NBS bases it on the database of the National Association of Real Estate Agencies of Slovakia (NARKS), which contains data obtained from entities involved in the mediation of the purchase and sale of real estate. A description of the construction of the indicator, which represents real estate prices, is available in the methodological instructions on the NBS website. Table 2 lists selected explanatory variables and their predicted impact on real estate prices according to available studies.

Table 2 Overview of monitored determinants in the presented study and their impact in the case of available studies

| Determinant | In short | Database | A scientific study in which the relationship to the price of real estate was analysed | The influence of determinants on real estate prices according to the selected study |
|---|----------|----------|--|---|
| Marriages (number of marriages per thousand inhabitants) | M | SOSR | Votava et al. (2021) | statistically insignificant |
| Divorces (number of divorces per thousand inhabitants) | D | SOSR | Hlaváček, Komárek (2011) | positive |
| GDP per capita (€) | GDP | SOSR | Cunha, Lobão, (2021) Grum, Govekar (2016) Hlaváček et al. (2016) Égert, Mihaljek (2007) | statistically insignificant statistically insignificant positive positive |
| Unemployment rate (%) | UN | SOSR | Belke, Keil (2018) Panagiotidi, Printzis (2016) Grum, Govekar (2016) Égert, Mihaljek (2007) | negative negative negative negative |
| Net cash income of households (€) | NIH | SOSR | Votava et al. (2021) Belke, Keil (2018) Wang et al. (2017) Algieri (2013) Égert, Mihaljek (2007) IFP (2020) | statistically insignificant positive positive positive positive positive |
| Interest rates on housing loans granted to households (%) | IRH | NBS | Cunha, Lobão (2021) Algieri (2013) Égert, Mihaljek, (2007) IFP (2020) | negative negative negative negative |
| Price index of construction works (2015=100) | PIW | SOSR | Cunha, Lobão (2021) Pažický (2020) | statistically insignificant positive |
| Price index of building materials (2015=100) | PIM | SOSR | Cunha, Lobão (2021) Pažický (2020) | statistically insignificant positive |
| Population growth (the difference between the number of live births and the number of deaths) | PG | SOSR | Votava et al. (2021) Algieri (2013) | both positive and negative in different regions positive |
| Total value of housing loans (million €) | TVHL | NBS | Panagiotidi, Printzis (2016) | positive |

Source: Own elaboration.

The present study works with two basic forms of multiple linear regression models, namely a national-level model expressed by relation 1 and eight regional-level models expressed by relation 2.

$$P_SK_t = \beta_0 + \beta_1 M_t + \beta_2 D_t + \beta_3 GDP_t + \beta_4 UN_t + \beta_5 NIH_t + \beta_6 IRH_t + \beta_7 PIW_t + \beta_8 PIW_t + \beta_9 PG_t + \beta_{10} TVHL_t + u_t \quad (1)$$

$$P_NUTS3_{it} = \beta_0 + \beta_1 M_{it} + \beta_2 D_{it} + \beta_3 UN_{it} + \beta_4 NIH_{it} + \beta_5 PG_{it} + \beta_6 IRH_{it} + \beta_7 PIM_{it} + \beta_8 TVHL_{it} + u_{it} \quad (2)$$

Where t represents the time period (time series from Q1 2006-Q4 2021 are available for all variables) and i represents one of the eight regions according to the SK-NUTS 3 classification with designation based on ISO 3166-2 for Slovakia. The only

variable that does not change in the models at the regional level is the IRH, which are determined and reported centrally for the entire territory of Slovakia. Including this significant variable in the model at the regional level made it impossible to build a fixed effects model that works with panel data. For this reason, multiple linear regression models were preferred, which allowed the interpretation of the models for each region individually.

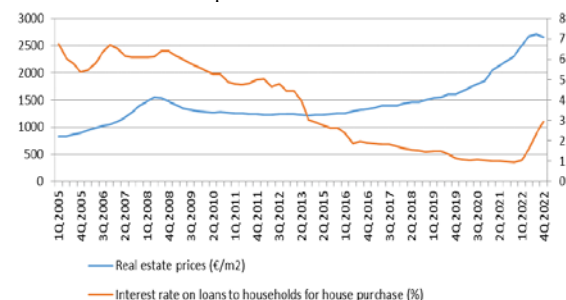
Constructed models for Slovakia and individual regions have a different number of variables, which was determined by the availability of data for the given indicator. At the level of Slovakia, there are ten variables, at the level of the regions eight variables were available. At the regional level, quarterly data were not available for the variables GDP per capita (GDP) and the construction price index (PIW). Data at the regional level are seasonally adjusted using the method of equalization using seasonal indices. Both types of models are tested for the presence of heteroscedasticity (Breusch-Pagan test), order dependence (Breuch-Godfrey test), cross-sectional dependence (Pesaran CD test), multicollinearity (correlation coefficient) and stationarity (Maddala-Wu test). In case of violation of the assumptions of the model, the data are modified in the form of first differences (solving the problem of multicollinearity). The presence of autocorrelation and heteroskedasticity is solved by estimating the standard errors of the regression coefficients using the HAC matrix.

3 Results and discussion

3.1 Determinants of real estate prices at the level of Slovakia

Strong economic factors generally create conditions for a strong growth in real estate prices. Record-low unemployment combined with dynamic wage growth, low interest rates and a longer-lasting economic conjuncture increase asset prices. In the development of the Slovak real estate market since 2005, it is possible to find two significant turning points in time. The first occurred around 2008 when, as mentioned, after a long positive development of the economy, there was an increase in real estate prices. The rate of growth of real estate prices exceeded the rate of growth of other economic fundamentals, which led to a real estate bubble, which was also confirmed by Pažický (2020) based on his analysis in Slovakia. During this period, the increase in real estate prices was also accompanied by a decrease in interest rates on the mortgage market. After the global financial crisis, there were steps in the area of monetary policy that led to extremely low mortgage loan prices and further supported the growth of real estate prices, which can also be seen in Figure 1. The growth of real estate prices in the pre-pandemic period represented a gradual cumulative growth, and thus it no longer showed the characteristics of a real estate bubble as it did in 2008. At the beginning of 2022, there was an increase in interest rates under the influence of high inflation, which could be the most significant determinant of stagnation and a humiliating decline in real estate prices at the end of 2022. Based on Figure 1, it is possible to assume a negative impact of interest rates on the price of real estate in Slovakia, which is in line with studies published so far such as Égert, Mihaljek, (2007), Algieri (2013), Pažický (2020), Cunha, Lobão (2021) and others.

Figure 1 Development of real estate prices and interest rates for household loans for the purchase of real estate



Source: Own processing according to NBS.

For a more in-depth analysis of the determinants of real estate prices in Slovakia, a linear regression model was built, where the explanatory variable is the real estate price in €/m², and the set of explanatory variables consists of ten economic and social determinants for the period Q1 2006-Q4 2021. Testing the assumptions of the original form of the model, which represents the relationship 1 demonstrated problems of heteroskedasticity, autocorrelation and multicollinearity. Table 3 presents the test results of the original model.

Table 3 Results of model testing at the level of Slovakia (quarterly periodicity)

| Subject of testing | Method | Value test. statistics |
|------------------------|-------------------------------|------------------------|
| Normality of residuals | Shapiro-Wilk test | 0,2279 |
| Heteroskedasticity | Breusch-Pagan test | 0,0002 |
| Autocorrelation | Breuch-Godfrey test | <0,001 |
| Multicollinearity | The variance inflation factor | >10 |
| | Farrar-Glauber test | <0,001 |

Source: Own processing of the output from the RStudio program.

The problem of multicollinearity was solved by first differences, but autocorrelation and heteroskedasticity remained present in the model. Subsequently, the estimation of standard errors of regression coefficients using HAC matrices was chosen.

Table 4 Summary of the transformed model at the level of Slovakia (quarterly periodicity)

| Determinant | Regression coefficients | Standard error | t value | Pr(> t) | Signs of statistical significance |
|----------------------------|-------------------------|----------------|---------|----------|-----------------------------------|
| β_0 | -0,2050 | 0,0351 | -5,8345 | 0,0000 | *** |
| M | -0,0968 | 0,0828 | -1,1694 | 0,2479 | |
| D | -0,0547 | 0,0657 | -0,8338 | 0,4084 | |
| UN | 0,1532 | 0,0774 | 1,9810 | 0,0532 | . |
| NIH | 2,1417 | 0,7008 | 3,0563 | 0,0036 | ** |
| IRH | -0,4002 | 0,0912 | -4,3877 | 0,0001 | *** |
| PIW | -0,9548 | 0,9589 | -0,9957 | 0,3243 | |
| PIM | 1,2769 | 0,2908 | 4,3910 | 0,0001 | *** |
| PG | -0,000001 | 0,0014 | -0,0009 | 0,9993 | |
| TVHL | 0,7337 | 0,1730 | 4,2406 | 0,0001 | *** |
| GDP | 0,5012 | 0,4254 | 1,1782 | 0,2444 | |
| R ² | 0,8057 | | | | |
| Modified by R ² | 0,7661 | | | | |
| p value | <0,001 | | | | |

Source: Own processing of the output from the RStudio program.

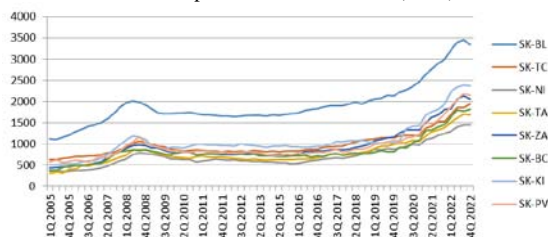
Based on the estimation of regression coefficients using the HAC matrices in Table 4, which take into account the present problem of autocorrelation and heteroskedasticity, a statistically significant positive dependence between real estate prices and the determinants of the average nominal monthly wage, the price index of construction materials and provided housing loans was demonstrated at the 0.05 level. A significant negative dependence was demonstrated with the interest rate determinant.

3.2 Real estate price determinants at SK-NUTS level 3

Available studies have shown that there are regional differences in the development of real estate prices, which may be caused by different determinants. In Slovakia, there are significant differences in real estate prices (see Figure 2), which can also be

caused by the development of economic foundations at the regional level.

Figure 2 Development of real estate prices in the regions of the Slovak Republic from 2005-2021 (€/m²)



Source: Own processing according to NBS.

Figure 2 illustrates significantly higher real estate prices in SK-BL, which can be linked precisely to significantly higher economic indicators such as GDP per capita and higher net cash income of households compared to other regions of Slovakia. The development of real estate prices in 2022 points to a change in the development of real estate prices downwards, which was most pronounced in the given period in SK-BL, SK-ZA and SK-TA, which represent the regions in the west of Slovakia near the capital.

In the models at the level of regions, the represented figure of GDP per capita is missing, but also based on the study of Votava et al. (2021), it is possible to assume a high degree of correlation between GDP per capita and net income of households at the level of regions. At the regional level, only annual GDP per capita data were available, while the average correlation between annual GDP per capita data and household net cash income was 0.89. This implies the assumed equal influence of both variables on the price of real estate at the NUTS 3 level in the case of quarterly data. In terms of GDP per capita and real estate prices on an annual basis, the value of both variables was significantly higher in the case of the Bratislava region (SK-BL).

A separate multiple linear regression model was created for each region of Slovakia according to relation 2. The stationarity of the time series was ensured and the problem of multicollinearity was eliminated with the help of first differences. In the case of the presence of heteroskedasticity and autocorrelation, estimation of standard errors of regression coefficients using HAC matrices was used. Table 5 shows the results of the transformed models at the level of regions.

Table 5 Estimate and significance of regression coefficients in Slovak regions based on the model

| NUTS 3 | Determinants | | | | | | | | | | R ² |
|--------|------------------------------|-----------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|--|--|----------------|
| | M | D | UN | NIH | PG | IRH | TVHL | PIM | | | |
| SK-BL | -0,0246 p=0,7111 | -0,0282 p=0,6165 | 0,0454 p=0,2051 | 1,0743*** p=0,0091 | 0,0028 p=0,3779 | -0,2802 * p=0,0115 | 0,5490** p=0,0031 | 1,2402 *** p<0,001 | | | 65,66 |
| SK-TV | -0,0296 p=0,2921 | 0,0680 p=0,2137 | 0,0320 p=0,1928 | 0,6665 * p=0,0336 | 0,0003 p=0,9055 | -0,1717 . p=0,0824 | 0,5379 * p=0,0119 | 1,3828 *** p<0,001 | | | 71,24 |
| SK-NI | -0,2253 * p=0,0394 | 0,2099 * p=0,0410 | 0,0430 p=0,0231 | 1,8368 *** p<0,001 | -0,0017 p=0,4550 | -0,0963 p=0,5636 | 1,1729 *** p<0,001 | 1,4055 ** p=0,0025 | | | 74,67 |
| SK-TA | -0,0863 p=0,2618 | 0,0187 p=0,8093 | 0,0842 p=0,2347 | 2,5188 *** p<0,001 | - | -0,3233 . p=0,0736 | 1,1932 *** p<0,001 | 1,207 ** p=0,00267 | | | 73,37 |
| SK-ZA | -0,0758 p=0,3580 | 0,0491 p=0,5189 | 0,0788 p=0,2818 | 1,1763 . p=0,0964 | -0,0091 p=0,0779 | -0,3907 . p=0,0507 | 1,3292 *** p=0,0024 | 1,7314 *** p=0,0003 | | | 69,02 |
| SK-BC | -0,0479 p=0,6386 | 0,1661 * p=0,0581 | -0,4662 *** p<0,001 | 2,6313 *** p<0,001 | 0,0012 p=0,2190 | -0,4239 ** p=0,0058 | 1,1755 *** p<0,001 | 1,7630 *** p<0,001 | | | 76,1 |
| SK-PV | -0,1471 p=0,1346 | -0,0161 p=0,9014 | 0,0455 p=0,7053 | 2,6609*** p<0,001 | -0,0643 p=0,3449 | -0,1228 p=0,5095 | 0,7074 ** p=0,0092 | 1,7443 *** p<0,001 | | | 69,56 |
| SK-KI | -0,2248 . p=0,0840 | 0,2907 * p=0,0442 | 0,2886 p=0,3051 | 0,5550 ** p=0,03168 | -0,0261 ** p=0,0045 | -0,5526 . p=0,0619 | 2,0466 *** p<0,001 | 2,0074 *** p<0,001 | | | 65,45 |

Source: Own processing of the output from the RStudio program.

The results in Table 5 show a positive relationship between real estate prices and housing loans in all regions, while the same result is also observed for the variable price index of construction materials. The regression coefficients of the

determinant of net cash income of households reach positive values in all regions of Slovakia. These findings show that there are economic variables on the demand and supply side of real estate that have the same effect on real estate prices regardless of region. In most cases, the monitored determinants have a non-uniform influence on the explained variable. For example, the relationship between interest rates and real estate prices in most regions is negative, while in SK-NI and SK-PV it is statistically insignificant. The relationship between real estate prices and the unemployment rate can be considered statistically insignificant, with the exception of SK-BC, where the model demonstrates a positive relationship. In the case of determinants of a social nature, there are statistically significant links between real estate prices and variables to a lesser extent than in the case of economic determinants, while their links differ in individual regions not only in strength, but also in the direction of dependence. Statistically significant links of real estate prices with marriages and population growth are negative, while the determinant of divorces is a positive link. The importance of social variables was demonstrated only in three regions, at the level of SK-NI, SK-BC and SK-KI. The models compiled at the regional level have shown that there are determinants that have a different impact on the price of real estate in the region and have the potential to explain the different development of prices in the regions of Slovakia.

3.3 Evaluation of results in the context of existing studies

Constructed models for Slovakia and individual regions showed a different type of selected variables at the national and regional level. Table 6 presents a comparison of the results of the present study and the available studies.

Table 6 Comparison of the results of constructed models and existing studies

| Determinant | Influence at the SR level | Influence at the level of regions | The influence of determinants on real estate prices according to the selected study |
|---|-----------------------------|---|--|
| Marriages (M) | statistically insignificant | negative (SK-NI, SK-KI) statistically insignificant in other regions | statistically insignificant (Votava et al., 2021) |
| Divorces (D) | statistically insignificant | positive (SK-NI, SK-KI), statistically insignificant in other regions | positive (Hlaváček, Komárek, 2011) |
| GDP per capita (GDP) | statistically insignificant | - | statistically insignificant (Cunha, Lobão, 2021, Grum, Govekar, 2016) positive (Hlaváček et al., 2016, Égert, Mihaljek, 2007) |
| Unemployment rate (UN) | statistically insignificant | negative (SK-BC), statistically insignificant in other regions | negative (Belke, Keil, 2018, Panagiotidi, Printzis, 2016, Grum, Govekar, 2016, Égert, Mihaljek, 2007) |
| Net cash income of households (NIH) | positive | positive in all regions | statistically insignificant (Votava et al., 2021) positive (Belke, Keil, 2018, Wang et al., 2017, Algieri, 2013) Égert, Mihaljek, 2007, IFP, 2020) |
| Interest rates on housing loans granted to households (IRH) | negative | statistically insignificant in SK-NI and SK-PV, negative in other regions | negative (Cunha, Lobão, 2021, Algieri, 2013, Egert, Mihaljek, 2007, IFP, 2020) |
| Price index of construction works (PIW) | statistically insignificant | - | statistically insignificant (Cunha, Lobão, 2021) positive (IFP, 2020) |
| Price index of building materials (PIM) | positive | positive in all regions | statistically insignificant (Cunha, Lobão, 2021) positive (IFP, 2020) |
| Population growth (PG) | statistically insignificant | negative in SK-KI, statistically insignificant in other regions | both positive and negative in different regions (Votava et al., 2021) positive (Algieri 2013) |
| Total value of housing loans (TVHL) | positive | positive in all regions | positive (Panagiotidi, Printzis, 2016) |

Source: Own elaboration.

Analysis of data from 2006-2021 showed a significant influence of selected determinants of supply and demand. On the demand side, real estate prices were raised by increasing net household incomes, which was demonstrated by the example of all monitored regions, despite the high differences in the amount of net income between CK-BL and other regions. Due to the high rate of inflation in 2022 and 2023, there is a reduction in net cash income, which should lead to stagnation or a decrease in real estate prices in each region. Another important factor that could confirm this downward direction of real estate prices is the impact of interest rates on mortgage loans for households, which have risen significantly in the recent period. The results of the models confirm that the growth of interest rates for households has a negative impact on the price development at the regional level as well. The total value of housing loans at the national and regional level had a positive effect, which was in line with the result of the study Panagiotidi and Printzis (2016). Only in two regions such as SK-NI and SK-PV was this effect statistically insignificant. An important factor on the supply side was the rise in the prices of construction works and materials. At the national and regional level, the positive impact of the growth of these indicators on the price of real estate was demonstrated, despite the fact that the pace of their growth differed between regions.

In the case of basic economic fundamentals such as GDP per capita and the unemployment rate, the statistical impact of these variables has not been proven at the national level. The statistically insignificant effect of GDP on the price of real estate confirmed the results of the study by Cunha and Lobão (2021). In the case of the unemployment rate, it was expected that its decrease would increase the demand for real estate, which would affect the growth of their price. However, this indicator also proved to be statistically insignificant, with the exception of SK-BC.

Population growth was among the group of indicators for which a positive impact was assumed at least at the national level. However, the compiled models showed statistical insignificance for most regions except SK-KI.

The presented study identified the impact of selected sociological variables such as marriages and divorces, which were followed in their study by Votava et al. (2021). The authors found a statistically significant effect only for divorces. The results of the models for the regions of Slovakia showed a consistent effect only in the case of the SK-NI and SK-KI regions, with a negative effect on marriages and a positive effect on divorces. At the national level, the effect was statistically insignificant, which is consistent with the studies analysed.

4 Conclusion

The real estate market has undergone significant changes over the past twenty years, and nowadays it can also be considered a political issue. Since the real estate bubble in 2008, there has been a phase of stabilization in the real estate market, but low interest rates on housing loans as well as the growth of net household income led to renewed pressure on price growth, which was also confirmed by the results of the presented study. Pažický (2020) pointed out that the growth of real estate prices after 2015 did not show signs of a new real estate bubble. At the regional level, there was gradual overheating during this period in the Nitra, Zilina and Trencin Regions, but still not at the level of 2008. In the case of the Bratislava Region, real estate prices moved in line with the development of economic fundamentals. The combination of low interest rates and high net income led many citizens to increase demand for "investment" properties, which again pushed prices up. The relationship between the price of old properties and new buildings, which were at a similar level, was also unnatural. At the same time, there was increasing pressure on the growth of the number of new buildings from the position of the government, which was taking steps towards a significant increase in the number of rental apartments, thereby wanting to increase the availability of housing for the inhabitants of Slovakia. One of the steps was the

submission of changes in the Construction Act, which would make it possible to shorten the length of the construction procedure. This usually takes 300 days in Slovakia and according to Doing Business, is one of the longest in the world. It is the lack of construction that represents another factor in the growth of real estate prices in Slovakia (Halenár, 2021). Under the influence of the current rise in interest rates and the decrease in net income due to high inflation, the availability of housing has become a key issue for many people. Even the growth of wages in the private sector was not sufficient compensation for the changes in the mortgage market. Employees of the public sector, whose salaries have not been valued as much as in the private sector, fall into a vulnerable group in terms of the availability of mortgages. In the case of already existing mortgages, the increase in instalments can also negatively affect the ability of households to repay these obligations. The growth of real estate prices can also lead to problems with interregional migration for work, which reduces the flexibility of the labour market (Sunega et al., 2010; Kubala & Peciar, 2019). However, the present study does not include this view.

The presented study confirmed that there are differences between regions in the determinants that affect real estate prices. These are divorces, marriages, population growth or the unemployment rate. For this reason, it would be appropriate to give municipalities more room to influence the real estate market, for example by adjusting real estate tax rates. These can be increased by local governments in the case of unoccupied real estate or adjusted in the case of residents with permanent residence in the given real estate. The solution is also the regulation of construction by the municipality in case of overheating of the market. The overvaluation of prices in the regions can be mitigated by local governments with appropriate measures to make spatial plans more flexible, speed up the issuance of territorial decisions and building permits.

The presented study also has its limits, which can be seen at the level of the monitored data. The first limitation is the use of a short time period of 2006-2022, which was extended by using quarterly data. However, this caused some variables to drop out, which could not be included in the models. It was primarily data at the regional level, such as quarterly GDP or the quarterly occurrence of crimes, which could represent another sociological indicator. In the future, it would be appropriate to add the number of newly built apartments and the number of applicants for one job to the set of variables. Likewise, psychological-expectational determinants were not the subject of this study. Expectations of future property price developments may influence speculative purchases in the future. This dimension could be supplemented with the help of another monitored indicator such as the Economic sentiment indicator (ESI) and its component focused on expectations in the construction industry. Another dimension that the study does not examine is the influence of determinants on different categories of real estate when divided according to the size and purpose of use of the real estate. It is also possible to assume that differences also enter when monitoring the influence of determinants at the level of regional places and other parts of the region. Especially in the case of social variables, it is possible to assume different intensity of influence on the price of real estate in a given location. In the case of this topic, there is a lot of room for further research, especially at the regional and local level.

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