Determinants of real estate prices in Croatian counties: spatial panel data analysis

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Abstract. This paper examines the determinants of real estate prices across Croatian counties, taking into account not only economic and demographic factors, but also tourism-related variables. The main focus is on spatial spillover effects, which are based on the assumption that real estate prices in one county are influenced by the developments in neighboring counties. The study covers the period from 2011 to 2019 and confirms that real estate prices are influenced by both local and regional factors. The key determinants include the number of tourist accommodation units, population size, and GDP per capita. An important result is the existence of a statistically significant spatial dependence across all specifications. This indicates that changes in real estate prices extend beyond county boundaries, underscoring the interconnectedness of the real estate market. These results underline the need for using spatial econometric models, which provide a more comprehensive understanding of regional price dynamics by capturing spillover effects between counties.

Keywords: counties, real estate prices, spatial panel data, spillovers, tourism

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1. Introduction

The relationship between tourism and real estate prices has become the focus of research interest due to the growing availability of travel, which has led to an increase in tourist numbers and a greater impact of tourism on the economy in many countries. In addition, the advances in empirical methods of analysis, particularly the application of spatial econometrics, have further contributed to the study of these issues [17, 9, 3, 8]. The recent surge in real estate prices in Europe requires a more detailed analysis of the factors influencing the development of real estate prices. This study focuses on the Republic of Croatia, specifically at the county level, where real estate supply and demand largely depend on economic, demographic, and tourism-related factors [13, 12, 2, 8, 17, 9, 7, 18]. Typical economic variables examined in the literature are GDP per capita, average net income (wages), interest rate, unemployment rate, credit supply, and the purchasing power of the population. Demographic indicators typically include the number of new businesses opened, the number of new residents moving into the area and the number of building permits issued. In recent research, tourism variables are increasingly included as they

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have a significant impact on the economy [14, 16, 13, 17, 9]. Among the tourism indicators, the share of rental properties, the share of private accommodation in total tourist capacity, the length of the summer tourist season, the number of overnight stays by tourists, and the length of their stay in the country show the most important effects on real estate prices [17, 9, 3].

This study analyzes all counties of the Republic of Croatia, taking into account their mutual interconnections. The aim of the study is to examine the impact of tourism-related indicators on the real estate prices in each county and to employ spatial panel models to demonstrate how tourism significantly contributes to the transmission of real estate prices across county borders. Due to the county-level focus, variables available only at the national level, such as the purchasing power of the population, interest rates on housing loans and the supply of housing loans, are excluded from the research, as their effects cannot be specifically isolated at the county level. Tourism indicators are widely recognized in the literature as key drivers of real estate price transmission between more and less tourism-developed regions. While the theoretical foundations of spatial price transmission have been established [15], empirical research on this phenomenon in Croatia remains limited. The first empirical analysis confirming this hypothesis for Croatia was conducted in 2023. [17] applied spatial econometrics to show that real estate prices in tourist cities and municipalities in the Republic of Croatia influence prices in less tourist-developed areas. However, with the exception of this paper, most previous studies have relied on traditional econometric methods, which cannot fully capture the spatial interdependencies between regions. These models typically overlook the potential spillover effects, where tourism-induced price increases in one region may affect neighboring areas. However, real estate markets are inherently spatial, as real estate prices depend not only on local supply and demand, but also on factors in neighboring regions. This is particularly true in the context of Croatian counties, which are linked by commuter flows, investments, shared infrastructure, and tourism-driven real estate demand. Ignoring these spatial interdependencies can lead to misleading conclusions about the determinants of real estate prices. Incorporating a spatial dimension into the analysis enables the explicit modeling of spillover effects, i.e. how shocks in one location may spread to other locations, improving the accuracy of the estimates and increasing their policy relevance. By applying spatial panel models, this study, therefore, provides a more sophisticated and robust analysis that allows us to more accurately capture the spatial transmission of real estate prices and provide deeper insights into the way tourism affects the Croatian real estate market.

The paper contributes to the literature by analyzing the impact of tourism on real estate prices in the Republic of Croatia at the county level, which has not been systematically studied before. In contrast to previous studies that have focused on the impact of tourism at the national level or within individual cities, this research examines counties as the primary spatial units of analysis. This approach provides valuable insights into regional macro-trends that remain invisible at narrower geographical levels. In addition, spatial econometric methods are used to investigate potential spatial spillover effects between counties, which have hardly been studied in the Croatian context. To this end, three different spatial econometric models and three different spatial matrices are applied, which underline the importance of spatial dynamics for the understanding of real estate price movements.

2. Determinants of real estate prices in Croatia: a literature review

Since the early 2000s, the development of real estate prices in Croatia has attracted increasing attention. Initially, price changes were well explained by traditional supply and demand indicators identified in the empirical literature. However, as time progressed, these traditional factors began to diverge from actual price movements, prompting researchers to investigate new determinants. Due to their strong and increasing correlation with real estate market dynamics, tourism-related variables gradually became recognized as key drivers of real estate prices —

not only in Croatia, but also in other (Mediterranean) countries. In this context, the literature highlights several important supply-side determinants of real estate prices, including the housing stock, the number of newly established businesses, the number of tourist accommodations, the share of private accommodations in the total supply, and the length of the tourist season. In addition, the number of overnight stays per capita, the number of tourist arrivals and the length of stay are also considered important indicators of the impact of tourism on real estate supply and pricing [16, 17, 9, 13, 2]. These variables reflect the capacity of the market and its ability to respond to increased tourism demand, which can have a significant impact on the availability and price of housing units.

On the other hand, the demand for real estate is determined by the income of the population, the supply of housing loans, the proportion of new immigrants, the purchasing power of the population, unemployment rate, interest rates, and GDP per capita [14, 13, 16, 17, 9, 10] These economic indicators reflect the population's financial ability to purchase or rent existing properties, as well as their ability to access financing sources such as loans.

The influence of these supply and demand factors has been examined by numerous authors, whose empirical results provide a deeper insight into the Croatian real estate market. The following section presents selected studies that have made a significant contribution to our understanding of the relationship between economic, demographic, and tourism-related variables and real estate prices in Croatia.

[16] analyzed the effects of various variables on real estate prices in Croatia from 1965 to 2003. The variables included were housing stock, income, availability of credit (as measured by interest rates), cost of living, and the share of the informal economy. He concluded that real estate investment was often driven by the preservation of wealth in an unstable economy rather than by the actual housing needs. This phenomenon, combined with inefficient housing use and insufficient investment in entrepreneurship, contributed to rising rental prices and declining average household income over the long term. [13] analyzed the period from 2005 to 2018 for 11 Central and Eastern European (CEE) EU Member States. The focusing on the impact of tourism and the number of newly established companies on real estate prices. Their findings indicate that an increase in the number of short-term rental apartments and a decrease in newly established companies correlate with higher property prices. It was also found that, tourism—especially tourism driven by foreign visitors—was a significant driver of demand in the real estate market.

At the local/national level, [9] analyzed the impact of tourism on housing affordability in 242 Croatian cities and municipalities between 2012 and2018. Their variables included seasonality, income, loan repayment capacity, number of tourist accommodations and tourism concentration. Their findings showed that extended summer season and a higher proportion of rental housing significantly reduce housing affordability and encourage population migration from tourist to non-tourist areas.

[10] theoretically considers credit supply and collateral as the most important variables. Croatia's accession to the EU has increased foreign demand for real estate. In 2017–2018, the prices rose by approximately 5 %, but without an increase in the volume of credit, which indicates that tourism was the main driver of price growth.

Finally, [14] used Croatian data from 2002 to 2022 to investigate how household income, interest rates, credit supply, GDP and the number of building permits influence house price risks using quantile regression. Their results underline the importance of macroeconomic and financial factors in shaping house price dynamics and affordability.

While most existing studies focus on local economic, demographic and tourism-related factors, spatial effects remain under-researched. When analyzing real estate prices at the county level, it is crucial to consider spatial interdependence, as price dynamics in one county can be influenced by developments in other counties. [7], one of the seminal studies in this area, examined regional house prices in the UK and identified the so-called "ripple effect", i.e., a phenomenon whereby price changes originate in one region, e.g. the South-East, and spread outwards. This finding suggests that regional real estate markets are interconnected and that price movements can spread spatially over time. According to [7], the most important mechanisms for this effect are migration, capital transfer, spatial arbitrage, and exogenous shocks.

In the real estate literature, there are other price transmission mechanisms between locations. According to [7, 4] the spatial spillover effect is a more comprehensive concept than the ripple effect. Unlike the ripple effect, spatial spillover effects refer more generally to the broader influence of economic or demographic changes in one region on surrounding regions. Spatial spillover effects can emerge through various mechanisms, e.g. spatial autocorrelation, contagion effects, and diffusion processes. In the Croatian context, these spillover effects can be particularly pronounced between counties due to their geographical proximity, migration between counties, similar economic characteristics, and factors such as shared infrastructure.

Despite the recognized importance of spatial effects in real estate literature, this aspect has received limited empirical attention in Croatia. To date, the only comprehensive empirical analysis of spatial spillover effects on Croatian real estate prices is provided by [17], who used a spatial panel model to estimate the impact of tourism, demographic, and economic variables across 556 Croatian cities and municipalities. The variables analyzed included: the share of rental space, the number of overnight stays and tourist arrivals per capita, the share of private accommodation, and demographic indicators (new residents, marriages, vitality index). The increasing share of short-term rentals and private accommodation has the strongest impact on price increases, while the spatial spillover effects are not necessarily limited to immediate neighboring areas, indicating complex interregional dependencies in housing market dynamics.

Although city- and municipality-level analyses provides detailed local insights, a county-level approach can add value by capturing broader regional patterns, increasing the relevance of results for regional policymaking, and providing a more stable and robust statistical framework for analyzing the spatial impact of tourism on real estate prices. For these reasons, the present study focuses on county-level data for Croatia to assess how tourism-related factors contribute to real estate price transmission and spatial spillover effects across regions.

3. Data and methodology

This paper examines the factors influencing real estate prices across the 21 counties of the Republic of Croatia. The analysis covers the period from 2011 to 2019 for each individual county. Although the initial intention was to include data up to 2021, the last two years of the sample (2020 and 2021) were excluded from the sample since they significantly affected the results as they are related to the pandemic period. A spatial panel model is used to assess how selected economic, tourism, and demographic indicators in one county influence real estate prices in neighboring counties, i.e., the counties it borders. The term “spatial” in statistical models refers to spatial econometrics, a method for analyzing interactions between geographical units. In this study, the observed units are the 21 counties of the Republic of Croatia. Spatial dependence poses a methodological challenge for the application of traditional econometric methods, as the assumption of independence and equal distribution of observations is no longer fulfilled. Therefore, it is crucial to use methods that adequately address spatial interactions between geographical units.

Given the structure of the dataset — 21 counties observed over nine years (2011–2019) — a (static) spatial panel model is applied to analyze the relationship between tourism, economic and demographic variables, and residential real estate prices. Table 1 provides a list of variables along with their data sources, while Table 2 presents their descriptive statistics. It should be noted that the selection of variables was guided by the existing literature and the theoretical framework discussed earlier. However, the final selection was largely constrained by the availability of county-level data across the study period.

Variable	Variable description	Source
Real estate price	The median prices of houses and apartments per square meter	MPGI (2024)
Tourist accommodation units	The number of accommodation units in a county	HTZ (2024)
Tourist arrivals (in 000)	The number of tourist arrivals in a county	HTZ (2024)
Share of employees in service activities	Share of employees in service industries within a county compared to the total number of employees in that county (%)	HTZ (2024)
Unemployment rate	Registered unemployment rate (%)	HZZ (2024)
Wages	Net salaries in euros by county	DZS (2024)
Population	Number of inhabitants of the county	DZS (2024)
GDP per capita (EUR)	GDP per capita of a county	DZS (2024)

Table 1: *Definition and source of variables.*

Note: MPGI - Ministry of Physical Planning, Construction and State Assets (Ministarstvo prostornog uređenja, graditeljstva i državne imovine) `https://mpgi.gov.hr/`; HTZ - Croatian National Tourist Board (Hrvatska turistička zajednica) `https://www.htz.hr/hr-HR`; HZZ - Croatian Employment Service (Hrvatski zavod za zapošljavanje) `https://www.hzz.hr/statistika/`; DZS - Croatian Bureau of Statistics (Državni zavod za statistiku) `https://podaci.dzs.hr/hr/` [Accessed 24/6/2025]

Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Variable	Obs	Mean	Std. dev.	Min	Max
Real estate price	189	1006.86	435.36	362	2540
Tourist accommodation units	189	49182.29	80287.15	356	306040
Tourist arrivals (in 000)	189	700.61	1053.23	9	4482
Share of employees in service activities	189	6.16	8.32	0.21	45.32
Unemployment rate	189	18.50	8.60	3.7	38.1
Wages	189	726.15	87.78	581	1100
Population	189	199865.00	164618.70	44625	807254
GDP per capita (EUR)	189	9523.16	2803.13	5285	17959

Table 2: *Descriptive statistics of accepted variables.*

Before applying spatial regression, its application must be justified by establishing the presence of spatial correlation between the geographical units. since the units under investigation are croatian counties, which can be assumed to be interdependent due to shared infrastructure, labor market integration, and regional policy. The expectation of a spatial correlation is further supported by the results of previous studies (see e.g. [17]). To test for cross-sectional dependence, the CD(p) test developed by [11] is employed. This test examines the null hypothesis that assumes the absence of the above dependence. The results of the CD(p) test (Table 3) show that all the analyzed variables are statistically significant, which allows us to reject the null hypothesis and confirm the spatial connectivity between counties. These findings justify the application of spatial econometrics in subsequent analysis.

Variable	CD-test	p-value	corr	abs(corr)
Real estate price	4.96	0.000	0.114	0.387
Tourist accommodation units	26.8	0.000	0.616	0.617
Tourist arrivals (in 000)	33.65	0.000	0.774	0.892
Share of employees in service activities	35.78	0.000	0.823	0.824
Unemployment rate	-1.97	0.048	-0.045	0.322
Wages	-1.98	0.048	-0.045	0.294
Population	24.32	0.000	0.559	0.862
GDP per capita (EUR)	32.12	0.000	0.739	0.847

Table 3: *Test for global dependence of variables.*

Cross-sectional dependence has become a central theme in econometric research, particularly in studies analyzing regional economic dynamics. Traditional panel data models assume independence across cross-sectional units, which is often unrealistic, especially in the case of real estate markets where price transmission frequently occurs between neighboring regions. As a result, the econometric literature increasingly relies on "cross-sectional interaction effects", which indicate that economic behavior in one unit is influenced by behavior in other units. Spatial econometrics extends this approach by explicitly modeling these interactions, especially those driven by geographic proximity. Admittedly, there are alternative approaches for addressing cross-sectional dependence, such as Common Correlated Effects (CCE) estimators. These estimators account for general cross-sectional dependence by modeling correlations arising from unobserved common factors; however, they do not incorporate specific spatial structures. In contrast, spatial panel data models explicitly account for both distance decay and spillover effects across neighboring regions via the spatial weight matrix. This is particularly important in the context of real estate prices, where proximity and regional interdependencies play a crucial role [5].

To further support the use of spatial models, the global Moran's I test is conducted to formally assess the presence of spatial autocorrelation in the data. The test is applied separately for each year, which is appropriate for panel data as it assesses spatial autocorrelation within each cross-section separately. The results (Table 4) indicate that the spatial distribution of the data is not random in most years, with certain periods exhibiting particularly strong spatial clustering. These findings support the use of spatial econometric models for our analysis, as failing to account for spatial dependence could lead to biased results.

Year	Moran's I	Z-score	p-value
2011	0.52457	2.24	0.025
2012	0.14034	0.71	0.48
2013	0.22868	1.02	0.308
2014	0.52678	2.18	0.029
2015	0.62043	2.47	0.014
2016	0.52783	2.22	0.026
2017	0.44717	1.94	0.052
2018	0.44585	1.83	0.068
2019	0.51758	2.07	0.038

Table 4: *Global Moran's I.*

In real estate markets, spatial interactions occur when real estate prices in one county are co-determined by (i) real estate prices in neighboring counties, (ii) explanatory variables such as tourism activity in other counties, and (iii) spatially correlated error terms. These effects, known as "spatial lags", capture the mechanisms through which regional housing markets are interconnected. In contrast to standard panel methods, which do not take such dependencies into account, spatial econometric models — such as the Spatial Autoregressive Model (SAR), the Spatial Durbin Model (SDM) or the Spatial Error Model (SEM) — allow for a more accurate estimation of the impact of tourism on real estate prices in different counties. An important first step in the application of spatial econometrics is the definition and creation of a spatial matrix. A spatial weights matrix is a non-negative N×N matrix where each row represents an observation, while the columns correspond to the locations of neighboring spatial units. Since geographic measures are considered most effective for estimating interactions between spatial units, this study employs a spatial weights matrix based on the connectivity of neighboring counties. We begin by using a row standardized spatial matrix that includes one nearest neighbor (wknn1). To assess the robustness of the results, the same models will be additionally tested using a row-standardized spatial weights matrix based on two nearest neighbors (wknn2), as well as a rook contiguity matrix (wcon), which defines neighbors as counties that share a common border.

To analyze the influence of the independent variables on the dependent variable, three different spatial models—SAR, SDM, and SEM—will be used.

The SAR model focuses on the spatial dependence of the dependent variable. This means it accounts for how the values of the dependent variable in one unit (in this case, a county) depend on the values of the dependent variable in neighboring counties. The SAR model is given as follows:

$$y_t = \rho W y_t + X_t \beta + \mu + \epsilon_t, \quad t = 1, \ldots, T \tag{1}$$

where y_t is a vector of real estate prices for the observed county (i) at year t, while Wy_t represents the spatial lag of the dependent variable, reflecting the influence of real estate prices in neighboring counties. The parameter ρ defines the intensity of the influence of real estate prices in neighboring counties on the prices in the observed county. Additionally, real estate prices in the observed county depend on the county's own vector of variables (X_t) that influence real estate prices, with β indicating the strength of these variables' influence.

The SDM model extends the SAR model by incorporating spatial lags of the independent variables. This model accounts for both the influence of the dependent variable in neighboring counties and the impact of independent variables from neighboring counties on the dependent variable in a given county. It is more flexible because it captures spatial effects on both sides of the equation. The SDM model is described by:

$$y_t = \rho W y_t + X_t \beta + W X_t \theta + \mu + \epsilon_t \tag{2}$$

Compared to the SAR model, this model is extended by $WX_t\theta$. The parameter θ shows the strength of the correlation between the independent variables in neighboring counties and the real estate prices of the observed county.

The SEM model focuses on the spatial dependence of the model errors. It assumes that errors are not independent but have a spatial structure, suggesting that spatial dependence stems from unobserved factors not included in the model. This model is useful when spatial effects influence the data but are not directly measurable. In this analysis, SEM uses a Kapoor-type spatial error structure, which assumes time-varying spatial autocorrelation in the idiosyncratic errors. The SEM model is expressed as:

$$\begin{aligned} y_t &= X_t \beta + \mu + \nu_t \,, \\ \nu_t &= \lambda W \nu_t + \epsilon_t \,. \end{aligned} \tag{3}$$

Here, λ indicates the degree to which errors in one county are related to errors in neighboring counties.

To determine which model best fits the data, a series of diagnostic tests will be conducted. The likelihood ratio (LR) test will evaluate the hypothesis $\theta = -\rho\beta$ to compare SEM and SDM. Rejection of the null hypothesis ($p < 0.05$) favors SEM; otherwise, SDM is preferred. Similarly, SAR and SDM will be compared by testing $\theta = 0$. Rejection of this hypothesis ($p < 0.05$) supports SDM; otherwise, SAR is sufficient.

Additionally, Akaike's Information Criterion (AIC) and Bayesian Information Criterion (BIC) will be used. According to [1], these criteria help analysts select the optimal spatial econometric model and correctly identify spatial dependence. Lower AIC and BIC values indicate better model performance. The results of these diagnostic tests will be reported at the bottom of each results table..

4. Empirical anaylsis

Based on the list of potential determinants (Section 2) and the applied methodology (Section 3), the empirical analysis focuses on examining the impact of tourism and demographic and economic factors on real estate prices in 21 counties of the Republic of Croatia in the period from 2011 to 2019. The analysis is conducted on an annual basis.

First, all variables listed in table 1 are tested, each of which is hypothesized to have a significant impact on real estate prices. For this purpose, the spatial matrix wknn1is used, which considers only one nearest neighbor, i.e., the nearest neighboring county. The full regression results are available in the online appendix at: https://zenodo.org/records/15773699. Diagnostic tests suggest that SAR is the preferred model. Among the tested variables, only three variables are found to be statistically significant in their effects on real estate prices: the number of tourist accommodation units, population, and GDP per capita. The remaining variables are not statistically significant, either when they are all included in the model or when tested in various combinations. Due to space limitations, these results are not presented here but are available upon request.

Given these findings, the analysis is continued using only the three variables and the results are interpreted in more detail. These results are shown in Table 5.

The key component of all spatial models is the coefficient with the spatial matrix, ρ, whose significance indicates the existence of spatial spillover effects across countries. In both Table A1 and Table 5, the spatial ρ is positive and statistically significant, confirming the importance of spatial effects in real estate prices across Croatian counties. In particular, a positive value of spatial ρ indicates that an increase in real estate prices in one county leads to an increase in real estate prices in other counties, i.e., that there are spatial spillover effects.

The interpretation of the coefficients is not as simple as with linear regressions, as spatial regression models also contain information from neighboring counties/observations. In these models, one should therefore distinguish between "direct" and "indirect" effects, while the "overall" average effect of a change in the independent variable on the dependent variable is the combination of these two effects [6]. In our case, the direct effect measures the impact of changes in the underlying factors within a county on the growth of real estate prices in that county when the spatial multiplier is taken into account. The indirect effect measures the impact of changes in the explanatory variables (underlying factors) of other counties on the growth of real estate prices in the county under observation. The main estimation results are shown in the first part of Table 5, while the direct and indirect spillover effects are shown in the lower part of the table.

	(1)	(2)	(3)
Model	**SAR**	**SDM**	**SEM**
Spatial weights matrix	**wknn1**	**wknn1**	**wknn1**
	Real estate price	**Real estate price**	**Real estate price**
Tourist accommodation units	0.00245***	0.00253**	0.00264***
	(0.000817)	(0.00100)	(0.000890)
Population	0.00119***	0.000969**	0.00122***
	(0.000429)	(0.000452)	(0.000475)
GDP per capita	–0.0460**	–0.0248	–0.0482**
	(0.0206)	(0.0240)	(0.0237)
_cons	929.6***	999.7***	1091.7***
	(210.6)	(214.0)	(215.9)
$\boldsymbol{\rho}$	0.145***	0.131**	
	(0.0554)	(0.0554)	
$\boldsymbol{\lambda}$			0.113*
			(0.0626)
LR_ Direct			
Tourist accommodation units	0.00252***	0.00265***	
	(0.000856)	(0.000993)	
Population	0.00119***	0.000998**	
	(0.000421)	(0.000435)	
GDP per capita	–0.0447**	–0.0255	
	(0.0201)	(0.0223)	
LR_ Indirect			
Tourist accommodation units	0.000403*	0.000977	
	(0.000218)	(0.000885)	
Population	0.000186*	0.000629*	
	(0.0000984)	(0.000376)	
GDP per capita	–0.00680*	–0.0424**	
	(0.00387)	(0.0199)	
LR_ Total			
Tourist accommodation units	0.00292***	0.00363***	
	(0.00102)	(0.000997)	
Population	0.00138***	0.00163***	
	(0.000489)	(0.000517)	
GDP per capita	–0.0515**	–0.0679***	
	(0.0230)	(0.0224)	
Number of observations	189	189	189
Number of cross-sectional units	21	21	21
$\boldsymbol{\theta = -\rho\beta}$ **(SEM vs SDM)**		p=0.1015	
$\boldsymbol{\theta = 0}$ **(SDM vs SAR)**	p=0.2843		
AIC	2626.529	2626.906	2629.901
BIC	2649.221	2656.082	2652.594

Table 5: *Main results for SAR, SDM and SEM model mentioned.*

Note: Standard errors are reported in parentheses.
Significance levels: * p $<$ 0.10, ** p $<$ 0.05, *** p $<$ 0.01.

• The hypothesis $\theta = -\rho\beta$ is tested to determine whether the Spatial Durbin Model (SDM) can be simplified to the Spatial Error Model (SEM). The p-value from this test is reported under the model selected based on this criterion.

• The hypothesis $\theta = 0$ is tested to determine whether the Spatial Durbin Model (SDM) can be simplified to the Spatial Autoregressive Model (SAR). The p-value from this test is reported under the model selected based on this criterion.

Since the diagnostic tests suggest the use of SAR model, the results are interpreted using only this model. Both the direct and indirect effects of all independent variables are significant (up to the 10% significance level). The findings can be interpreted as follows.

An increase in the number of tourist accommodation units by 100 is associated with an increase in the average real estate price per square meter in that county of €0.29, of which €0.25 can be attributed to direct effects and €0.04 to indirect effects. For an average 60 m^2 apartment, this corresponds to a total increase of approximately €17.40 in its price. More accommodation units can increase the demand for real estate, as it is expected that tourists, investors and perhaps even local residents will be willing to invest in real estate in that area, which will directly result in an increase in real estate prices. In addition, an increase in tourist accommodation capacity in one county can stimulate tourism development in surrounding areas, increasing the demand for real estate in other neighboring counties, even though the accommodation is not located in those specific areas. The €0.04 per square meter indirect effect reflects a minor but meaningful impact on real estate prices in neighboring counties. For an average 60 m^2 apartment, this indirect effect would lead to a €2.40 increase in its market value, showing that even modest changes in neighboring areas can accumulate and influence broader real estate trends.

An increase in the population of a county by 1,000 is associated with an increase in the price of the average real estate in that county of €1.38 per square meter, of which €1.2 can be attributed to direct and €0.18 to indirect effects. Using the example of an average 60 m^2 apartment, this means an increase in the price of the average apartment of around €82.80, whereby the majority of this increase (€72) is due to direct effects within the county, while the remaining €10.80 is due to indirect effects from neighboring counties. Namely, an increase in population directly contributes to rising real estate prices by increasing demand for housing. As the number of residents grows, so does the pool of potential buyers and tenants. Finally, an increase of the GDP per capita by €100 in a county, leads to a decrease in the price of the average real estate by €5.15, of which €4.47 are direct effects and €0.68 are indirect effects. At first glance, this finding may seem counterintuitive, as one would typically expect that an increase in GDP per capita, i.e., an improvement in the standard of living, would lead to higher real estate prices. However, it is possible that in counties with a higher GDP per capita, i.e., more developed counties, there are more opportunities for investment other than real estate. In such cases, reduced demand for residential property, could result in a decline in housing prices.

To assess the robustness of our results, the spatial weights matrix was changed and the lags of the independent variables were included. These results are given in Table 6.

In Column 1 of Table 6, the two-nearest neighbors weight matrix (wknn1) is used, while in Column 2, the contiguity matrix is applied. The results are largely consistent across both specifications, with the only notable difference being that GDP per capita becomes statistically insignificant in one specification. In Column 3, the current values of the dependent variables are replaced with their spatial lags to address potential endogeneity concerns. As in the main specification, the results remain robust, confirming the validity of our findings. Additionally, the spatial coefficient, rho, is statistically significant in all model specifications.

	(1)	(2)	(3)
Model	**SAR**	**SAR**	**SAR**
Spatial weights matrix	**wknn2**	**wcon**	**wknn1**
	Real estate price	**Real estate price**	**Real estate price**
Tourist accommodation units	0.00238***	0.00226***	
	(0.000823)	(0.000699)	
Population	0.00115***	0.00102***	
	(0.000434)	(0.000364)	
GDP per capita	−0.0452**	−0.0253	
	(0.0210)	(0.0193)	
Lag_Tourist accommodation units			0.00219***
			(0.000726)
Lag_Population			0.000966**
			(0.000387)
Lag_GDP per capita			−0.0161
			(0.0240)
_cons	901.5***	508.5**	653.1***
	(221.0)	(221.8)	(210.6)
ρ	0.189**	0.427***	0.180***
	(0.0764)	(0.102)	(0.0549)
LR_Direct			
Tourist accommodation units	0.00246***	0.00250***	
	(0.000862)	(0.000784)	
Population	0.00115***	0.00109***	
	(0.000426)	(0.000381)	
GDP per capita	−0.0438**	−0.0256	
	(0.0205)	(0.0203)	
Lag_Tourist accommodation units			0.00227***
			(0.000767)
Lag_Population			0.000973**
			(0.000383)
Lag_GDP per capita			−0.0142
			(0.0239)
LR_Indirect			
Tourist accommodation units	0.000558*	0.00164*	
	(0.000329)	(0.000845)	
Population	0.000253*	0.000706*	
	(0.000144)	(0.000372)	
GDP per capita	−0.00937	−0.0152	
	(0.00573)	(0.0139)	
Lag_Tourist accommodation units			0.000449**
			(0.000220)
Lag_Population			0.000191*
			(0.000101)
Lag_GDP per capita			−0.00277
			(0.00500)
LR_Total			
Tourist accommodation units	0.00302***	0.00414***	
	(0.00110)	(0.00147)	
Population	0.00140***	0.00180***	
	(0.000523)	(0.000682)	
GDP per capita	−0.0532**	−0.0408	
	(0.0246)	(0.0331)	
Lag_Tourist accommodation units			0.00272***
			(0.000943)
Lag_Population			0.00116**
			(0.000464)
Lag_GDP per capita			−0.0170
			(0.0286)
N	189	189	168
N_g	21	21	21

Table 6: *Robustness checks.*

Note: Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

5. Conclusion

This paper analyzes the impact of tourism, economic and demographic factors on real estate prices across all 21 counties of the Republic of Croatia, with a particular focus on spatial spillover effects between counties. Covering the period from 2011 to 2019, the study offers a novel perspective by using counties as the primary geographical units of analysis — unlike prior research in Croatia, which has predominantly focused on cities, municipalities, or the national level. The aim of this research was to show that changes in real estate prices in a county are not only the result of local factors, but also reflect interdependencies with neighboring counties.

The results confirm the existence of spatial dependence in all 21 counties and show significant spillover effects in real estate prices across them. Key factors influencing real estate prices include the number of accommodation units, population size and GDP per capita. Although additional factors such as tourist arrivals, the share of employees in the service sector and the unemployment rate were tested, their effects were not found to be statistically significant.

Importantly, the results highlight the critical role of spatial panel models in capturing these spillover effects between counties. By accounting for spatial dependence, a better understanding is gained of how changes in one county can trigger chain reactions in neighboring counties, leading to fluctuations in real estate prices. This underscores the need to use econometric models that consider spatial dimensions to fully capture the dynamics of real estate markets. The results confirm the significant influence of neighboring factors, emphasizing that any real estate policy design must take these spatial relationships into consideration.

The contribution of this study lies in the fact that it accounts for spatial interdependencies in real estate markets at the county level offering a better understanding of price dynamics compared to traditional models. By explicitly modeling these spatial effects, this study contributes to filling a gap in the literature and provides valuable insights for the design of county-level policy, particularly in the context of tourism-driven real estate markets.

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