



Housing Prices under Geopolitical Threats: Transmission Channels of Geopolitical Risk along the EU's Eastern Border – The Case of Poland

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Abstract: *The aim of this paper is to assess the impact of different categories of geopolitical risk (GPR) on housing prices and identify its transmission channels in a border country of the European Union. The analysis focuses on Poland, which constitutes the EU's eastern border, has the largest and most dynamic housing market in the region, and is directly adjacent to war-torn Ukraine. The study utilises a vector autoregression (VAR) model for diagnostic purposes and a multiple linear regression (MLR) model for identifying the types of geopolitical risk responsible for observed price responses. The VAR results confirmed the existence of an indirect channel (the immigration channel). In the MLR, the aggregate GPR is statistically insignificant, while selected risk categories have a varied impact on the short-term dynamics of housing prices.*

Keywords: residential property; geopolitical risk; war; threats; Central and Eastern Europe.



Introduction

Growing geopolitical risk (GPR) poses a significant challenge to the stability of financial markets (Hodula et al. 2024). The real estate market, which combines features of real and financial assets, is particularly sensitive to such shocks, especially in the context of migration, military risk, and security threats (Wong 2018). The aim of this paper is to assess the impact of different GPR categories on housing prices (secondary market) and to identify the channels through which this risk is transmitted in a border country of the European Union. Poland was chosen as a case study because it is an example of a strategic emerging economy in the EU with a large and dynamic real estate market directly exposed to the Russian-Ukrainian war.

The paper tests two hypotheses:

- **H1.** Individual GPR categories exert heterogeneous effects on housing prices, varying in both direction and magnitude.
- **H2.** The impact of the aggregate geopolitical risk (GPR Index) on housing prices is transmitted indirectly through the economic and demographic variables included in the model, rather than through a direct price response.

The study relies on the GPR Index and its eight risk categories (Caldara and Iacoviello 2022). The empirical strategy combines VAR (diagnostic stage) and MLR with decomposed GPR categories (explanatory stage) for quarterly data (2007Q1–2025Q2). The study assumes that individual GPR components affect the housing market in different directions, thus offsetting each other's effects. Aggregating diverse geopolitical risk into a single index conceals potential heterogeneous effects, which justifies the analysis of a decomposed index.

The VAR model results confirmed the existence of an indirect channel (the immigration channel). At the same time, they did not confirm a significant impact of the aggregate GPR Index on housing prices. In the MLR specification, the aggregate GPR is statistically insignificant, while selected risk categories affect short-term price dynamics. Price inertia and domestic credit instruments remain dominant determinants.

This paper fills a research gap regarding the functioning of housing markets in countries neighbouring those affected by military conflict, particularly in the CEE region. It expands the literature to include a new geopolitical context and contributes to the literature on frontier economies within the EU. The findings are useful for investors and financial institutions, as well as for policymakers analysing the conditions in which the housing market serves as a protective asset.

The following sections include a literature review, a description of the methodology, and a presentation of the results and conclusions.

Literature review

Increased global instability has driven intensified research into the relationship between GPR and the prices of main asset classes (Snarska et al. 2025; Zaremba et al. 2022). This is considerably less evident in the property market, which has so far remained relatively under-researched in terms of its response to GPR. There are several factors that destabilise the property market. These include financial and macroeconomic uncertainty (Jackson and Orr



2019; Zhao and Liu 2023), geopolitical events, terrorist attacks, and military conflicts (Abakah et al. 2025; Baek, Liu and Noh 2024; Bekiros et al. 2020; Hazam & Felsenstein 2007).

There are numerous studies describing the impact of microeconomic and macroeconomic uncertainty through multi-channel transmission mechanisms. Mikeszová and Lux (2020) identify uncertainty in relation to future pension reforms and psychosocial uncertainty in relation to the loss of ontological security. Lux and Sunega (2025) point to structural factors, such as family transfers and mortgage debt, which shape attitudes towards the role of the state. Garriga et al. (2019) highlight changes in credit conditions. Hromada (2024) confirms that a reduction in mortgage interest rates results in an increase in housing prices. Herwartz and Xu (2020) and Feng et al. (2017) indicate that during periods of macroeconomic shocks, housing prices are more strongly influenced by institutional factors and credit supply than by interest rates themselves. Crnadak et al. (2025), Wang (2025), Ouyang (2024) and Nworah, et. al. (2023) demonstrate the ambiguous relationship that exists between inflation and housing prices. Han (2010), examining the impact of price risk on property demand, argues that this demand depends on financial risk, as well as on the strength of hedging incentives. When incentives are strong, property is perceived as a hedge and demand is stimulated, and when incentives are weaker, demand decreases. In turn, Gomez-Gonzalez et al. (2024) finds that the impact of macroeconomic uncertainty varies. Previous research also confirms the ambiguous relationship between GDP and housing prices. Most studies indicate a positive relationship, explained by increased income and demand during economic expansion (Feng 2025; Li, et al. 2024).

The literature highlights the negative impact of terrorist attacks, health crises, and war and related migration on the property market. War and war-related migration have a spatially differentiated impact on the housing market. For example, Ukraine has seen a decline in demand accompanied by a rise in prices (Naumova et al. 2024; Hrabynskyi 2022). In neighbouring countries, some studies indicate a statistically insignificant price increase after the influx of refugees (Głuszak and Trojanek 2024), while others confirm a strong increase in rental and purchase prices (Cosmulese and Zhavoronok 2025). In turn, during terrorist attacks, the effect of fear exacerbates medium-term declines in property prices, especially in areas directly exposed to the risk (Lepage 2023; Itzhak 2018). Similarly, the COVID-19 pandemic caused a decline in property prices and a redistribution of demand between city centres and suburbs (Del Giudice et al. 2020; D'Lima et al. 2022). Some studies highlight the potential safe-haven role of real estate during periods of heightened uncertainty (Hudson-Wilson et al. 2005; Boudry et al. 2022).

The literature review reveals a significant research gap. Firstly, research on the role of GPR in shaping the dynamics of the housing market is undeveloped. Secondly, existing research on this market overlooks the CEE region, especially countries with a strategic location for the whole of Europe. Additionally, Poland represents a relevant case study as an EU border country directly exposed to the consequences of the Russia-Ukraine war.

Methodology

A two-stage research procedure was used. In the first stage (diagnostic stage), a vector autoregression (VAR) model comprising five variables was estimated (Table 1) (Sims 1993; Lütkepohl 2013, Novales 2017). In the second stage (explanatory stage), individual GPR categories were used (GPR Index decomposition). Statistically significant GPR types



responsible for the observed price responses were identified using MLR.

The estimation of the VAR model was preceded by stationarity tests (ADF) (Said and Dickey 1984). The price variable was log-transformed and differentiated (dlog), and the remaining variables were differentiated to the first differences (Enders 2015). The VAR model equation is as follows:

$$Y_t = A_0 + A_1 Y_{t-1} + \dots + A_p Y_{t-p} + \epsilon_t$$

where: Y_t is the endogenous variable vector; A_i indicates the lag parameter matrices; p denotes the order of the model lags; ϵ_t represents the vector of random components.

Lag length was selected using standard information criteria (AIC, BIC, FPE, HQIC) (Akaike 2003; Tu and Xu 2012). The response dynamics were examined using Impulse Response Functions (IRF) and Forecast Error Variance Decomposition (FEVD) (Lütkepohl 2018).

The VAR model was used to provide a general assessment of the dynamics of the interdependencies between the GPR Index, housing prices, and the control variables (Table 1). The second stage of the research focused on analysing the impact of individual GPR categories, eliminating the limitations of the aggregate index.

In the second stage, MLR models were estimated, described by the following equation:

$$\hat{Y} = b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + b_6 x_6 + b_7 x_7 + b_8 x_8 + b_9 x_9 + b_{10} x_{10} + b_{11} x_{11} + b_{12} x_{12} + \zeta$$

Where: b_0 denotes constant term; b_i denotes partial regression factors; ζ denotes a random component.

As in the first stage, the price variable was log-transformed and differenced (dlog), and the remaining variables were differenced to their first differences. Stationarity was verified using the Augmented Dickey–Fuller (ADF) test. The selection of explanatory variables was based on theoretical assumptions (Iacoviello 2005; Adams and Füss 2010; Saiz 2007; Caldara and Iacoviello 2022) (Table 1).



Table 1: Structure of the variables

Method	Variable
VAR	Housing_price
	GPR*
	CPI
	Rate**
	UA_immig'***
MLR	War_Threats_(CAT.1)*
	Peace_Threats_(CAT.2)*
	Military_Buildups_(CAT.3)*
	Nuclear_Threats_(CAT.4)*
	Terror_Threats_(CAT.5)*
	War_Beginning_(CAT.6)*
	War_Escalation_(CAT.7)*
	Terror_Acts_(CAT.8)*
	Real_Wage****
	Mortgage_Rate****
Immigration_UA****	
Safe_Credit_Dummy	

Note: *GPR Index; **National Bank of Poland (NBP) policy rate; ***Immigration from Ukraine to Poland; **** Statistics Poland (GUS).

Source: Author's elaboration.

During the analysis, model diagnostics were performed (Durbin-Watson (DW) statistics and residual autocorrelation function analysis). Inference was based on robust estimators: HC3 (heteroskedasticity-consistent) in the initial specification and HAC (Newey-West) in the dynamic models. Multicollinearity was assessed using the VIF index. A sequential specification strategy ensured stationarity and valid residual properties. The model calculations were performed using Python software.

Results

Five variables were included in the VAR model (Table 1). Most of the variables exhibited non-stationarity (ADF test, $p > 0.05$). Non-stationary variables were log-differenced (dlog_prices, d_GPR, d_CPI, d_Rate, and d_UA_immig). Information criteria (AIC, BIC, FPE, HQIC) clearly indicated a lag of 1 as optimal for the VAR model (Table 2).

Table 2: VAR order selection (* highlights the minimums)

	AIC	BIC	FPE	HQIC
0	5.791	5.951	327.5	5.855
1	4.770*	5.726*	118.1*	5.150*
2	4.914	6.667	137.9	5.611

Source: Author's elaboration based on NBP (2025) and Caldara and Iacovello (2025).



The housing price equation shows strong inertia with $\beta = 0.49$, and $p < 0.001$. At the same time, d_CPI and d_Rate did not demonstrate a statistically significant impact on housing prices in the analysed period; d_GPR had no significant direct impact on changes in housing prices, although the parameter remains close to the significance threshold ($p = 0.093$); and d_UA_immig proved statistically significant ($p = 0.012$) (Table 3).

Table 3: Results for the equation $dlog_prices$

	coefficient	std. error	t-stat	prob
const	0.003911	0.002178	1.795	0.073
L1.dlog_prices	0.493890	0.074445	6.634	0.000
L1.d_GPR	0.000133	0.000079	1.679	0.093
L1.d_CPI	0.000255	0.001920	0.133	0.894
L1.d_Rate	-0.004082	0.004970	-0.821	0.411
L1.d_UA_immig	0.000068	0.000027	2.506	0.012

Source: Author's elaboration based on NBP (2025) and Caldara and Iacovello (2025).

The remaining model equations confirm that GPR affects the economy through indirect channels. GPR significantly increases the inflow of immigrants ($\beta = 0.84$; $p = 0.018$), reflecting forced mobility during periods of increased international tension. Furthermore, an increase in GPR increases interest rates ($p = 0.013$), indicating a monetary policy response to increased uncertainty or pressure on the risk premium (Table 4).

Table 4: Results for the other equations

Results for the equation d_GPR

	coefficient	std. error	t-stat	prob
const	1.428156	3.338664	0.428	0.669
L1.dlog_prices	35.828180	114.092760	0.314	0.754
L1.d_GPR	-0.314670	0.121064	-2.599	0.009
L1.d_CPI	-1.027219	2.942733	-0.349	0.727
L1.d_Rate	-1.977580	7.616903	-0.260	0.795
L1.d_UA_immig	-0.026782	0.041884	-0.639	0.523

Results for the equation d_CPI

	coefficient	std. error	t-stat	prob
const	-0.131089	0.138535	-0.946	0.344
L1.dlog_prices	7.068361	4.734176	1.493	0.135
L1.d_GPR	0.006897	0.005023	1.373	0.170
L1.d_CPI	0.550137	0.122106	4.505	0.000
L1.d_Rate	0.287713	0.316057	0.910	0.363
L1.d_UA_immig	0.001597	0.001738	0.919	0.358



Results for the equation d_Rate

	coefficient	std. error	t-stat	prob
const	-0.041136	0.049796	-0.826	0.409
L1.dlog_prices	2.033046	1.701693	1.195	0.232
L1.d_GPR	0.004468	0.001806	2.474	0.013
L1.d_CPI	0.052009	0.043891	1.185	0.236
L1.d_Rate	0.532845	0.113606	4.690	0.000
L1.d_UA_immig	0.000666	0.000625	1.067	0.286

Results for the equation d_UA_immig

	coefficient	std. error	t-stat	prob
const	15.457368	9.813762	1.575	0.115
L1.dlog_prices	60.458278	335.367423	0.180	0.857
L1.d_GPR	0.838587	0.355860	2.357	0.018
L1.d_CPI	-7.252785	8.649950	-0.838	0.402
L1.d_Rate	-0.560087	22.389336	-0.025	0.980
L1.d_UA_immig	-0.041915	0.123114	-0.340	0.734

Source: Author's elaboration based on NBP (2025) and Caldara and Iacovello (2025).

The residual correlation matrix provides an additional assessment of the model quality. The interresidual correlations remain low to moderate. The highest correlations are found for the pair d_CPI and d_Rate ($r = 0.387$) and for d_GPR and d_Rate ($r = 0.255$). In the remaining cases, the correlation is lower ($|r| < 0.23$) and indicates a lack of interdependence between the random components (Table 5).

Table 5: Correlation matrix of residuals

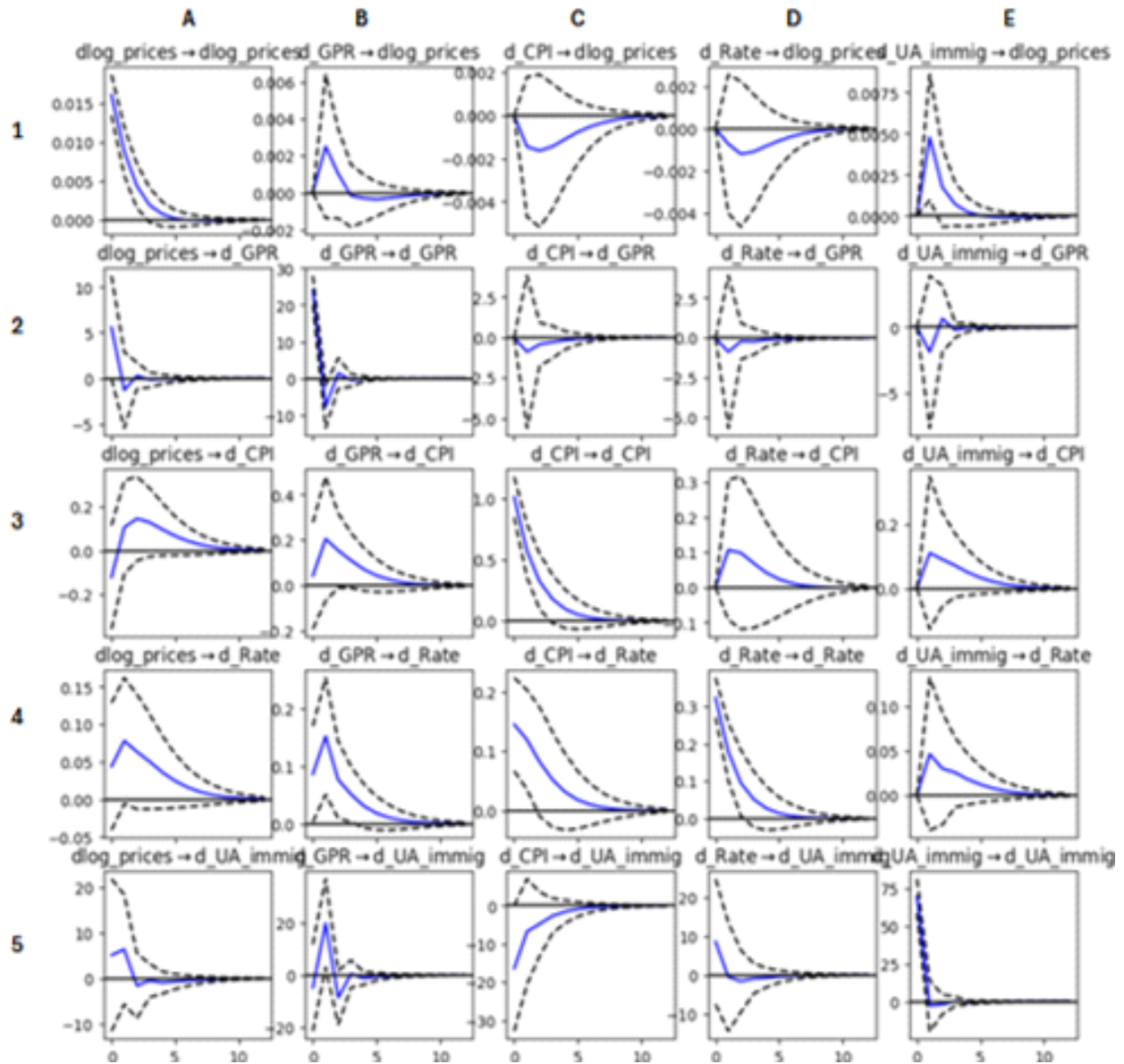
	dlog_prices	d_GPR	d_CPI	d_Rate	d_UA_immig
dlog_prices	1.000000	0.227486	-0.120080	0.118758	0.070368
d_GPR	0.227486	1.000000	0.012571	0.254832	-0.050413
d_CPI	-0.120080	0.012571	1.000000	0.386976	-0.236150
d_Rate	0.118758	0.254832	0.386976	1.000000	0.007191
d_UA_immig	0.070368	-0.050413	-0.236150	0.007191	1.000000

Source: Author's elaboration based on NBP (2025) and Caldara and Iacovello (2025).

IRF analysis reveals that the GPR shock is associated with increases in interest rates and immigration. However, its relationship with housing prices is small and fades quickly (Fig. 1). These results confirm that the direct price response to GPR is limited and subordinated to indirect channels. In turn, the FEVD indicates that short-term housing price volatility is determined by its own shocks, while in the longer term, the contribution of intermediate variables, particularly immigration and interest rates, increases.



Figure 1: Impulse responses, IRF (orthogonalised)



Source: Author’s elaboration based on NBP (2025) and Caldara and Iacovello (2025).

In the d_UA_immig equation, the d_GPR variable confirms that an increase in GPR leads to an increased inflow of immigrants ($\beta = 0.84$). The housing price equation, however, indicates that an increase in immigration positively affects housing prices ($p = 0.012$) (Table 3).

The second potential mechanism for transmitting GPR to housing prices is the interest rate channel. In the d_Rate equation, the d_GPR parameter is statistically significant ($p = 0.013$). This result indicates that an increase in GPR is linked to interest rates, which translates into housing prices. At the same time, in the housing price equation, interest rates remain an element of the mechanism shaping price dynamics. This suggests an indirect monetary transmission channel. The IRF response also confirms this mechanism (IRF 3B, Fig. 1).



The aim of the second stage of the study was to identify the types of GPR that were statistically significant for housing prices. In this stage, MLR analysis was conducted using eight explanatory variables corresponding to individual GPR categories (CAT.1–CAT.8).

First, a dynamic baseline model including only control variables (without GPR) was estimated, with a lagged dependent variable. This model was statistically significant: $F = 28.76$; $p < 0.001$, and $R^2 = 0.482$. Strong price inertia ($\beta = 0.503$; $p < 0.001$) and a significant positive impact of the ‘Safe Credit 2%’ programme ($\beta = 0.0179$; $p < 0.001$) were observed. Real wage growth was significant and negative ($\beta = -0.171$; $p < 0.003$), while immigration from Ukraine proved statistically insignificant ($p < 0.754$). The model did not exhibit autocorrelation problems ($DW = 2.24$), and the estimation was performed using HAC errors. The Wald test confirms the joint significance of the GPR variables ($\chi^2 = 13.28$; $p < 0.001$), indicating that they improve the model fit relative to the baseline version.

The estimation procedure for the model incorporating individual GPR variables was performed sequentially. The starting point was a static regression model across variable levels (Model 1). The model demonstrated good fit ($R^2 = 0.966$; $p < 0.001$), but $p > 0.05$, $DW: 0.803$, and elevated VIF values. The obtained results clearly indicate the risk of spurious regression in models estimated across variable levels.

To address the problem of non-stationarity, the variables were transformed to first differences (Model 2). Model 2 was estimated using heteroscedasticity-robust standard errors (HC3). The model exhibited limited explanatory power ($R^2 = 0.184$), and the model as a whole was not statistically significant ($p = 0.142$) and did not explain the price dynamics.

To improve the model, a lagged dependent variable (lag_d_log_price) was introduced, resulting in a dynamic autoregressive model (Model 3). This change significantly improved the estimation quality: R^2 increased to 0.595, and $p < 0.001$. The housing market exhibits strong price inertia. The autoregressive term eliminates autocorrelation ($DW = 2.27$), and residuals satisfy normality assumptions. Some explanatory variables demonstrated statistical significance (e.g. d_CAT_2 – a negative effect, $p = 0.031$; d_CAT_3 – a positive effect, bordering on significance). The other macroeconomic determinants remained insignificant. Despite improved statistical properties, the model still contained an excess number of predictors. Therefore, statistically insignificant variables were removed while the core theoretical determinants were retained (Model 4). In addition to the basic model (Model A), a robustness check (Model B) was conducted, and an alternative specification was applied in which the categorical variables were replaced by the aggregated GPR Index (PC1) (Model C). All models used the HAC (Newey–West) estimator, which corrects for heteroscedasticity and autocorrelation in the random term (Table 6).

All models are statistically significant ($R^2 = 0.48$ – 0.58) and pass standard diagnostic tests ($DW \approx 2.2$; $VIF < 1.2$). In all specifications, the parameter with lagged price dynamics remains stable and positive (0.50 – 0.54 ; $p < 0.01$). This result confirms the strong inertia of price processes.

The change in $\Delta \log(\text{Wage})$ is negative and statistically significant. In the first-differences model, this result reflects the short-term interdependence of wage and housing price changes, not a structural income effect. The model does not establish causality. Therefore, this result should be interpreted with caution and treated as a correlation within the adopted empirical specification, rather than as evidence of a negative impact of wage growth on housing prices.



In contrast, the effect of Δ Mortgage Rate is positive, but its significance is weak and unstable. It likely reflects the procyclical coexistence of interest rates and real estate prices during expansion phases, when both variables adjust to typical macroeconomic shocks.

Table 6: Results of the multiple linear regression – dependent variable: Δ log(Price)

Variables	Baseline GPR Categories Model (A)			Robustness Check Model (B)			Alternative Model (C)		
	coef	std err	p-value	coef	std err	p-value	coef	std err	p-value
	Constant	0.003	0.002	p < 0.01	0.006	0.002	p < 0.01	0.007	0.002
Lagged Δ log(Price)	0.516	0.054	p < 0.01	0.537	0.054	p < 0.01	0.503	0.061	p < 0.01
Δ log(Wage)	-0.139	0.054	p < 0.05	-0.153	0.055	p < 0.01	-0.170	0.057	p < 0.01
Δ Mortgage Rate	0.007	0.003	p < 0.06	0.005	0.003	-	0.007	0.004	p < 0.10
Δ Immigration (UA)	0.000	0.000	-	0.000	0.000	p < 0.05	0.000	0.000	-
Safe Credit Dummy	0.017	0.003	p < 0.01	0.018	0.003	p < 0.01	0.016	0.004	p < 0.01
Military_Buildups_(CAT.3)	0.013	0.004	p < 0.01	0.017	0.003	p < 0.01	-	-	-
Peace_Threats_(CAT.2)	-0.100	0.080	p < 0.01	0.180	0.079	p < 0.05	-	-	-
Aggregate GPR (PC1)	-	-	-	-	-	-	0.001	0.001	-
Model statistics									
Observations	72			68			72		
R ²	0.533			0.584			0.484		
F-statistic	28.19; p < 0.01			31.64; p < 0.01			37.42; p < 0.01		
HAC standard errors	Yes			Yes			Yes		

Source: Author’s elaboration based on NBP (2025) and Caldara and Iacovello (2025).

The effect of Δ Immigration(UA) is unstable and significant only in model B. The limited stability of this parameter is consistent with the results of the VAR analysis, which indicated the indirect nature of migration risk transmission. In contrast, the effect of the preferential loan program (Safe Credit Dummy) clearly stands out from the other variables, remaining positive and significant in all models (0.016–0.018; p < 0.01), indicating the significant role of domestic financing instruments in shaping short-term price dynamics.

The influence of geopolitical risk is selective. Military_Buildups_(CAT.3) is positive and significant in Models A and B (1.3–1.7%; p < 0.01). However, the Peace_Threats_(CAT.2) parameter changes sign across models. This indicates limited estimation stability and suggests that this effect should be interpreted with caution.

Model C, which includes the aggregated GPR indicator (PC1), shows no significant effect on price dynamics. This suggests a lack of direct market reaction to the overall level of geopolitical uncertainty and the greater importance of selected risk categories. The findings provide partial support for the hypothesis of differential market reactions to geopolitical risk types, while the aggregate GPR remains insignificant. Given the parameter instability, the results should be interpreted as short-term relationships.



Discussion

The results contribute to the literature on the relationship between GPR and the housing market in border economies, demonstrating the indirect and selective nature of this relationship. Unlike studies focusing on the stock market (Snarska et al. 2025; Zaremba et al. 2022), the results confirm that the real estate market reacts differently than highly liquid assets (Baek, Liu and Noh 2024; Bekiros et al. 2020).

The analysis indicates two indirect mechanisms: demographic and monetary. An increase in GPR is associated with the influx of migrants and changes in interest rates. The positive relationship between migration and housing prices is consistent with studies examining the effects of war and refugee flows in the region (Naumova et al. 2024; Hrabynskiy 2022; Cosmulese and Zhavoronok 2025), although this effect is not entirely stable. The interest rate response aligns with the literature emphasising the importance of credit conditions during periods of macroeconomic shocks (Herwartz and Xu 2020; Feng et al. 2017; Garriga et al. 2019; Hromada 2024).

Models with GPR decomposition show that a significant positive effect of the Military Buildups category may indicate an increase in housing demand when a threat materialises, which is consistent with the concept of the security function of real estate (Hudson-Wilson et al. 2005; Boudry et al. 2022). The instability of the Peace Threats effect, on the other hand, suggests an asymmetric and specification-sensitive market response, similar to studies on the effects of terrorist attacks (Itzhak 2018; Lepage 2023). The negative short-term relationship between wage growth and housing prices should be interpreted with caution, as the literature indicates a positive long-term relationship with income (Feng 2025; Li et al. 2024). However, the effect of the preferential lending programme remains clear and stable, confirming the importance of domestic financing instruments (Garriga et al. 2019; Hromada 2024). Overall, the response is indirect and selective, with the aggregate GPR playing no significant role.

Conclusion

The analyses indicate that the aggregate GPR does not directly affect short-term housing price dynamics in Poland. Its impact is indirect and occurs primarily through migration and the response of interest rates. This result suggests that geopolitics shapes the housing market through demographic and financial variables rather than through direct price impulses.

The study's main limitation is the small number of quarterly observations, which affects the robustness of the estimates. The analysis of a single country limits the generalisability of the conclusions. Furthermore, the media-based GPR indicator may not capture local risk perceptions. Further research should include a comparative analysis of other EU border countries.

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