Property Taxes and Residential Real Estate

Theory and E(U)mpirics

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Agenda

1. Motivation and related literature
2. Data and methodology
3. Results and robustness checks
4. Conclusions
5. References



Why recurrent property taxation?

- **Fiscal pressure:** higher debt and persistent deficits have narrowed fiscal space in Europe.
- **Housing affordability:** high prices relative to incomes make entry into homeownership difficult especially for FTHB.
- **A policy candidate:** recurrent property taxes can raise revenue at relatively low economic cost, compared with other tax instruments (Arnold et al., 2011).

Tax capitalization

- Higher expected property-tax payments reduce the price buyers are willing to pay, holding housing and local public services constant (Oates, 1969).

$$\Delta P_t = -\sum_{s=1}^{\infty} \frac{E_t[\Delta T_{t+s}]}{(1+r)^s}.$$

- Under full capitalization, the price reduction equals the discounted value of the additional tax payments.
- The Texas–California model comparison discussed in Horwich (2024) illustrates how higher recurrent taxes can lower purchase prices and down-payment requirements, helping buyers with limited savings. Annual tax payments remain part of ownership costs.

Related literature

- **Sweden:** little overall price response to a national property-tax reduction, except for high-value homes (Elinder and Persson, 2017).
- **Shanghai:** properties subject to higher tax rates experience lower relative prices (Lyu, 2024).
- Capitalization estimates differ across studies, reflecting differences in housing supply, local public services and empirical methods (Guilfoyle, 2000).

Research contribution

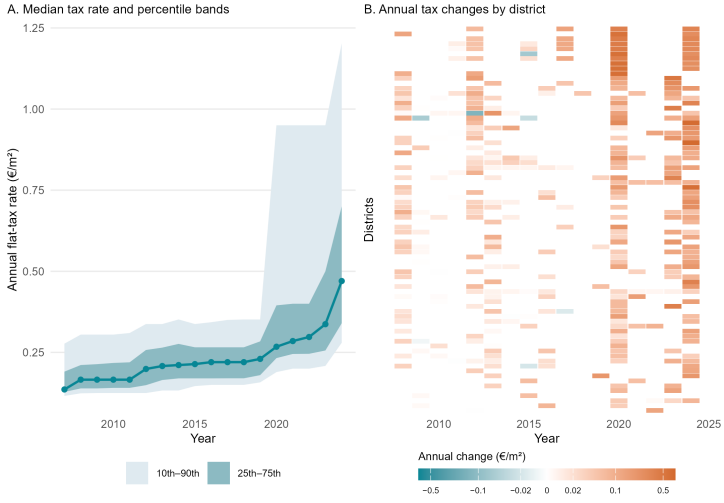
- Existing estimates of property-tax capitalization differ across countries and reforms.
- For Slovakia, we use local tax-rate variation to estimate the magnitude and timing of price adjustment.

Data

- Annual flat-price data and statutory tax rates on flats, covering 79 districts over 2007–2024.
- Tax rates collected from district-seat municipalities' websites and local tax ordinances, expressed in EUR/m^2 per year.
- Flat prices are deflated using the national GDP deflator and expressed in logarithms.

Sources: Flat prices: United Classifieds; flat-tax rates: authors' compilation from municipal websites and local tax ordinances (VZN); GDP deflator: ŠÚSR.

Tax variation



Nominal annual tax rates on flats. Districts ordered by mean tax rate in panel B. Teal = decrease; white = unchanged; orange = increase.

Control variables

Variable group	Regressors
Local demand conditions	Wage growth, unemployment, net migration.
Housing supply	Completions and starts per 1,000 existing dwellings; dwellings per resident.
Housing-market heterogeneity	Initial log flat price interacted with year.

Specifications with and without local controls are estimated on the same sample.

Sources: wages, migration, population, housing stock, completions and starts: ŠÚSR; unemployment: UPSVaR; Variables constructed by the authors.

The comparison is within regional housing markets

- **District fixed effects** absorb persistent local differences. In growth models, they allow districts to have different average growth rates.
- **Region-by-year fixed effects** absorb shocks shared by districts in the same region and year. Initial-price interactions allow different exposure to the housing cycle.
- **Policy-level clustering** allows errors to move together across years and across districts sharing one city policy, notably Bratislava and Košice.

Econometric methods

- **First differences:** estimate the relationship between annual real-price growth and the same-year change in the tax rate.
- **Local projections:** estimate cumulative price changes separately at each horizon, allowing the timing of adjustment to vary without imposing a particular lag profile (Jordà, 2005).
- **Distributed lags:** relate annual price growth to current and lagged tax changes. Summing the coefficients gives the cumulative price response.

Estimation samples: local projections, 2010–2020 tax-change years, 858 observations; distributed lags, 2012–2024, 1,014 observations.

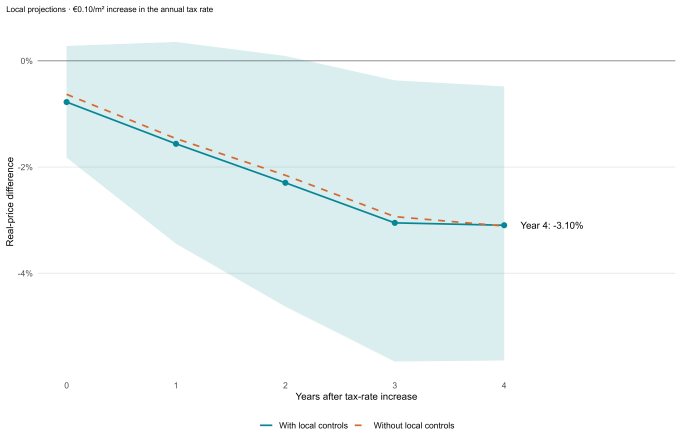
Little evidence of immediate adjustment

	Dependent variable: $\Delta \log P_{it}$	
	(1)	(2)
$\Delta\tau_{it}$	−0.0031	−0.0031
	(0.0298)	(0.0303)
Local covariates	No	Yes
District FE	Yes	Yes
Region × year FE	Yes	Yes
Initial price × year	Yes	Yes
Observations	1,248	1,248

Policy-clustered standard errors in parentheses. Sample: 2009–2024. τ is the annual rate in EUR/m^2; P is the real flat price.

Source: Authors' estimates.

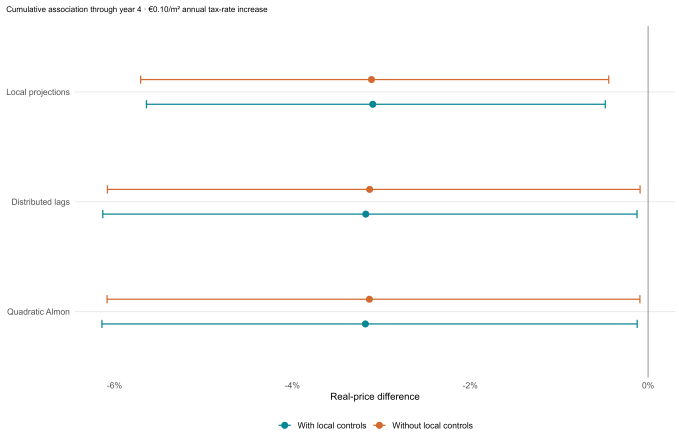
A delayed negative association with prices



Local projections: -3.05% **at year three and** -3.10% **at year four.**

Source: Authors' estimates.

A second dynamic model gives a similar result

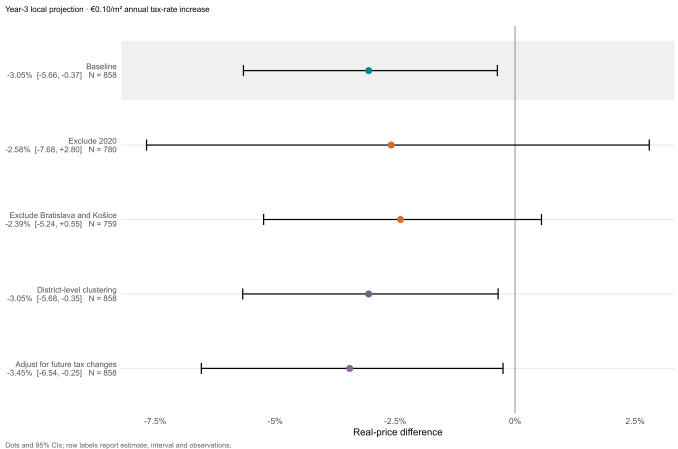


Similar year-four estimates across methods.

Quadratic Almon restricts the lag profile to a smooth quadratic curve.

Source: Authors' estimates.

Robustness depends on the sample



Excluding 2020 or the two largest cities preserves the negative sign, but the confidence intervals include zero.

Source: Authors' estimates.

Robustness: fiscal controls

- Municipal fiscal conditions may influence both tax decisions and local housing-market developments.
- The post-2019 accumulated-tax specification includes year interactions with current spending, capital spending and personal-income-tax dependence measured in 2019.
- Adding these controls changes the accumulated-tax coefficient from -0.0450 to -0.0419. Both estimates are statistically insignificant; the sample contains 345 observations.

Source: Authors' estimates. Ministry of Finance of the Slovak Republic, Results of Municipal Financial Management and FIN 1-12 Financial Statements (2019).

Conclusions

- We provide new evidence on the magnitude and timing of property-tax capitalization in Slovakia, extending the limited evidence for Central and Eastern European housing markets.
- Across local projections and distributed-lag models, a €0.10/m² increase in the annual tax rate is associated with approximately 3% lower real flat prices after three to four years, while the same-year relationship is close to zero.
- These findings are consistent with capitalization, although sample sensitivity and potentially endogenous tax decisions limit their causal interpretation.

Thank you for your attention!



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References I

- Arnold, J. M., et al. (2011). Tax Policy for Economic Recovery and Growth. *The Economic Journal*, 121(550), F59–F80. doi:10.1111/j.1468-0297.2010.02415.x.
- Borge, L.-E., and Rattsø, J. (2014). Capitalization of Property Taxes in Norway. *Public Finance Review*, 42(5), 635–661. doi:10.1177/1091142113489845.
- Elinder, M., and Persson, L. (2017). House price responses to a national property tax reform. *Journal of Economic Behavior & Organization*, 144, 18–39. doi:10.1016/j.jebo.2017.09.017.
- Guilfoyle, J. P. (2000). The Effect of Property Taxes on Home Values. *Journal of Real Estate Literature*, 111–127.
- Horwich, J. (2024). How higher property taxes increase home affordability. Federal Reserve Bank of Minneapolis. Research summary.

References II

- Jordà, Ò. (2005). Estimation and Inference of Impulse Responses by Local Projections. *American Economic Review*, 95(1), 161–182. doi:10.1257/0002828053828518.
- Lyu, X. (2024). Revisiting property tax capitalization. *Regional Science and Urban Economics*, 108, 104039. doi:10.1016/j.regsciurbeco.2024.104039.
- OECD (2022). *Housing Taxation in OECD Countries*. OECD Publishing. doi:10.1787/03dfe007-en.
- Oates, W. E. (1969). The Effects of Property Taxes and Local Public Spending on Property Values: An Empirical Study of Tax Capitalization and the Tiebout Hypothesis. *Journal of Political Economy*, 957–971.
- Oliviero, T., Sacchi, A., Scognamiglio, A., and Zazzaro, A. (2019). House prices and immovable property tax: Evidence from OECD countries. *Metroeconomica*, 70(4), 776–792. doi:10.1111/meca.12253.

References III

- Poterba, J. M. (1984). Tax Subsidies to Owner-Occupied Housing: An Asset-Market Approach. *The Quarterly Journal of Economics*, 99(4), 729–752. doi:10.2307/1883123.

- Sommer, K., and Sullivan, P. (2018). Implications of US Tax Policy for House Prices, Rents, and Homeownership. *American Economic Review*, 108(2), 241–274. doi:10.1257/aer.20141751.

Slovakia: local-projection specification

$$p_{i,t+h} - p_{i,t-1} = \alpha_i^h + \lambda_{r(i),t}^h + \beta_h \Delta\tau_{it} + \sum_{j=1}^{2} \theta_j^h \Delta\tau_{i,t-j} + \delta_t^h p_{i,0} + X_{it}'\gamma_h + u_{it}^h.$$

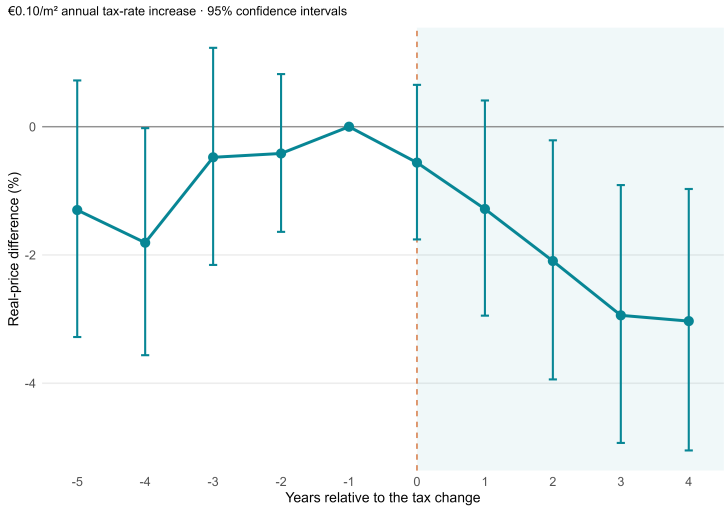
- p: log real flat price. τ: nominal annual flat-tax rate in EUR/m^2. Horizons $h = 0, \ldots, 4$ (Jordà, 2005).
- X: optional local covariates. Region-by-year effects and year-specific initial-price slopes appear in every specification.
- Common event-year sample: 2010–2020. Policy-clustered standard errors include small-sample and fixed-effect adjustments.

Slovakia: coefficients behind the main price path

	Dependent variable: $p_{i,t+h} - p_{i,t-1}$				
Horizon h	0	1	2	3	4
Panel A: with local covariates					
$\Delta\tau_{it}$	-0.0779	-0.1574	-0.2323^{*}	-0.3098^{**}	-0.3144^{**}
	(0.0531)	(0.0967)	(0.1210)	(0.1368)	(0.1335)
Panel B: without local covariates					
$\Delta\tau_{it}$	-0.0632	-0.1475	-0.2178^{*}	-0.2978^{**}	-0.3159^{**}
	(0.0513)	(0.0956)	(0.1176)	(0.1355)	(0.1362)
Observations	858	858	858	858	858

Policy-clustered SEs in parentheses. $^{*}p < 0.10$; $^{**}p < 0.05$. Both panels include district FE, region $\times$ year FE, initial-price $\times$ year interactions, and two lagged tax changes. Coefficients are per EUR 1/m^2; main figures report $100[\exp(0.1\beta_h) - 1]$.

Slovakia: coefficients behind the main price path



Year −1 is normalized to zero. District and region-by-year fixed effects, initial-price interactions and economic controls included.

Slovakia: additional checks answer different questions

- **Three-year differences:** a EUR 0.10/m^2 net tax increase is associated with -1.38% price growth over three years ($p < 0.05$; 1,014 observations, with wage and unemployment changes). This model has region-by-year effects and no district effects.
- **Accumulated tax histories:** several coefficients are negative, but anchor years, discounting and rolling windows change the exposure measure. These are diagnostic associations, not directly comparable capitalization estimates.
- **Error correction:** the lagged real-tax coefficient is negative but imprecise (-0.0653, SE 0.0411). The short panel does not establish a long-run equilibrium relationship.

The main evidence comes from the dynamic price path, rather than a count of negative coefficients.

Slovakia: cumulative responses across models

	Local projections, $h = 4$		Distributed lags, $\sum_{j=0}^{4} \beta_j$	
	(1)	(2)	(3)	(4)
Cumulative coefficient	-0.3159^{**}	-0.3144^{**}	-0.3181^{**}	-0.3226^{**}
	(0.1362)	(0.1335)	(0.1550)	(0.1555)
Local covariates	No	Yes	No	Yes
District FE	Yes	Yes	Yes	Yes
Region $\times$ year FE	Yes	Yes	Yes	Yes
Initial price $\times$ year	Yes	Yes	Yes	Yes
Observations	858	858	1,014	1,014

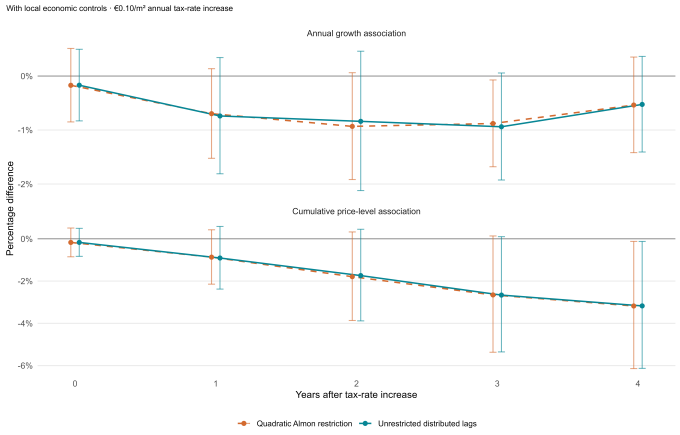
Policy-clustered SEs in parentheses. $^{**}p < 0.05$. Native coefficients per EUR 1/m^2. Distributed-lag sum SEs include coefficient covariances. LP event years: 2010–2020. Distributed-lag equation years: 2012–2024.

Slovakia: robustness regression table

	Dependent variable: $p_{i,t+3} - p_{i,t-1}$			
	(1) Baseline	(2) Earlier controls	(3) No 2020	(4) No BA/KE
$\Delta\tau_{it}$	-0.3098^{**}	-0.3088^{**}	-0.2616	-0.2417
	(0.1368)	(0.1340)	(0.2695)	(0.1486)
District FE	Yes	Yes	Yes	Yes
Region $\times$ year FE	Yes	Yes	Yes	Yes
Initial price $\times$ year	Yes	Yes	Yes	Yes
Observations	858	858	780	759

Policy-clustered SEs in parentheses. $^{**}p < 0.05$. All models include two tax-change lags. Column (2): earlier wage, unemployment, population and dwelling-stock controls. Column (3): exclude event-year 2020. Column (4): exclude Bratislava and Košice city districts. Coefficients are per EUR 1/m^2.

Slovakia: annual and cumulative adjustment



Pointwise 95% CIs; policy-level clustering; full coefficient covariances.
Panels use different vertical scales; quadratic lag restriction in the Almon specification.

Annual growth coefficients and cumulative price differences answer different questions.

Slovakia: distributed-lag specification

$$\Delta p_{it} = \alpha_i + \lambda_{r(i),t} + \sum_{j=0}^{4} b_j \Delta \tau_{i,t-j} + \delta_t p_{i,0} + X_{it}'\gamma + u_{it}.$$

- The b_j coefficients describe annual growth associations. A one-off change in the annual tax rate can affect growth over several years.
- The cumulative log-price response through horizon h is $B_h = \sum_{j=0}^{h} b_j$.
- Its variance includes all covariance terms: $\mathrm{Var}(B_h) = \mathbf{1}' V_h \mathbf{1}$.
- Quadratic Almon imposes $b_j = a_0 + a_1 j + a_2 j^2$, reducing the number of freely estimated lag parameters.

Slovakia: fiscal-exposure specification

$$p_{it} = \alpha_i + \lambda_{r(i),t} + \beta C_{it}^{2019} + \rho \tau_{it}^{\text{real}} + \delta_t p_{i,0} + X_{it}'\gamma + Z_{i,2019}'\phi_t + u_{it}.$$

$$C_{it}^{2019} = \sum_{s=2020}^{t} \frac{\tau_{is} - \tau_{i,2019}}{D_s}.$$

- $Z_{i,2019}$ contains standardized current spending, capital spending and PIT dependence, interacted separately with year. Outcomes are restricted to 2020 onward.
- Predetermined fiscal exposure can capture different post-2019 paths associated with earlier budget structures, without controlling directly for contemporaneous spending responses.
- C^{2019} sums real tax-rate differences above the 2019 anchor. Its coefficient is not the response to a single EUR 0.10 tax-rate increase.

Slovakia: fiscal-control robustness

	Dependent variable: log real flat price	
	(1)	(2)
Accumulated exposure, C^{2019}	−0.0450	−0.0419
	(0.0310)	(0.0380)
Current real tax rate	−0.0396	−0.0374
	(0.0641)	(0.0690)
2019 fiscal exposure × year	No	Yes
Local covariates and FE	Yes	Yes
Initial price × year	Yes	Yes
Observations	345	345

Policy-clustered SEs in parentheses. Neither accumulated-exposure coefficient is significant at 10%. Both columns use the same post-2019 fiscal-data sample. FE are district and region-by-year.

Slovakia: interpretation of additional estimators

- **Accumulated histories** relate price levels to past real tax exposure, conditional on the current rate. Alternative anchors and retention rates test sensitivity to how exposure is defined.
- **Three-year differences** relate multi-year price changes to net tax changes over the same window. This checks a medium-term relationship without imposing the annual lag profile.
- **Error correction** allows growth to depend on lagged prices, lagged real taxes and the current real-tax change. It diagnoses adjustment dynamics; the short panel does not establish cointegration.