Welfare Effects of Property Taxation

Max Löffler
(Maastricht U & U Cologne)

Sebastian Siegloch
(U Cologne & ECONtribute)

EEA Rotterdam
August 27, 2024

Motivation

- Property taxes account for about one third of total capital tax revenues across Western countries (Zucman, 2015)
- We know little about the real effects of property taxation
- Particularly true for the welfare effects of the property tax (Oates and Fischel, 2016)
- OECD: "Taxes on immovable property among the least distortive tax instruments"
- If true, it is (mostly) about the distributional effects of property taxation

Motivation

- Property taxes account for about one third of total capital tax revenues across Western countries (Zucman, 2015)
- We know little about the real effects of property taxation
- Particularly true for the welfare effects of the property tax (Oates and Fischel, 2016)
- OECD: "Taxes on immovable property among the least distortive tax instruments"
- If true, it is (mostly) about the distributional effects of property taxation

WHO BEARS THE BURDEN OF THE PROPERTY TAX?

This Paper

1. Sufficient statistics approach to study welfar effects of property taxation
   - Add distributional perspective to efficiency-centered sufficient statistics approach
   - Approach nests standard textbook incidence model as well as full-fledged spatial equilibrium model
   - Allows for local public goods (benefit view) as well as the capital tax view
2. Reduced form evidence exploiting institutional setting of property taxation in Germany
   - Substantial variation: about 5,200 reforms of the property tax
   - Micro housing price data from *ImmobilienScout24* combined with administrative data
3. New approach to simulate welfare effects
   - Simulate welfare effects across income distribution using household micro data
   - Household allowed to be various agents simultaneously: worker, renter, firm owner, landlord

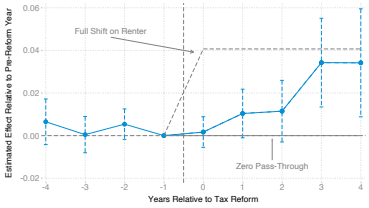
Contribution to Literature

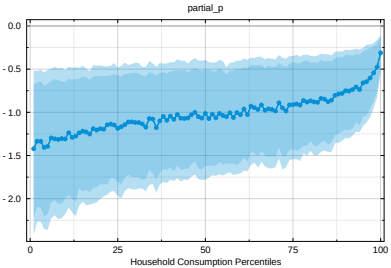
Preview of Findings

1. Theory: Equity effects depend on a price responses on housing and labor market, amenity response captures efficiency margin

2. Empirics: Close to full pass-through of tax to total tax-inclusive rents in the medium-run

3. Simulation: Property tax is regressive, efficient use of tax revenues can reduce adverse distributional effects





Basic Set-Up

- Derivation of distributional effects of property taxes using a sufficient statistics approach (Chetty, 2009)
- Household
  - Household derives utility from housing, a composite consumption good (numéraire), and local public goods/amenities of city c
  - Household pays the property-tax-inclusive, total rent q_i per square meter of housing: $q_c = p_c + t_c$
  - Household may receive income y_i from various sources; here: wages, profits, rental income: $y_i = w_c l_i + \pi_c e_i + p_c s_i$
  - Households maximize utility $u_i(x_i, h_i, l_i, e_i, s_i, A_c)$ s.t. to the budget constraint $q_c h_i + x_i = y_i$
- Using simple envelope conditions, we can derive welfare effects

Welfare Predictions

Proposition (Household Welfare)

The money-metric effect of a small increase in city c's property tax t_c on household i's utility is given by:

$$\Delta W_i := \frac{\mathrm{d}u_i/\mathrm{d}t_c}{\partial u_i/\partial x_i} = -h_i^* \frac{\mathrm{d}q_i^*}{\mathrm{d}t_c} + l_i^* \frac{\mathrm{d}w_c^*}{\mathrm{d}t_c} + e_i^* \frac{\mathrm{d}\pi_c^*}{\mathrm{d}t_c} + s_i^* \frac{\mathrm{d}p_c^*}{\mathrm{d}t_c} + \delta_i \frac{\mathrm{d}A_c^*}{\mathrm{d}t_c} \qquad \text{with } \delta_i = \frac{\partial u_i/\partial A_c}{\partial u_i/\partial x_i}. \quad (1)$$

- Welfare depends on
  - the pass-through of tax increases on total rent
  - households pre-reform behavior (consumption and income streams)
  - the change in local amenities
- Individual welfare effects ΔW_i can be aggregated to social welfare effects $\Delta W := \sum_i g_i \Delta W_i$ using marginal social welfare weights g_i (Saez and Stantcheva, 2016).

Efficiency and Distribution

- Most sufficient statistics approaches focus on efficiency (Kleven, 2021)
- Our proposition captures this margin via the amenity effect
- We extend common approach by introducing distributional effects, which are governed by price responses
- Adding the equity dimension is important as the proposition is implementable at household level using microdata
- Level of disaggregation depends on data quality and identification of price/amenity responses
- In our analysis: price/amenity responses at least at city-level, pre-reform quantities observed at individual level

Relation to Other Modeling Approaches

- Partial Equilibrium: Nests simplest textbook case: one renter, one landlord, no public goods
- Capital Taxes and General Equilibrium: Incorporates interaction with other sectors, such as capital market (Mieszkowski, 1972) or other markets, e.g. construction sector (Ahlfeldt et al., 2015)
- Tiebout Sorting: Accounts for benefit view through effect on local public goods (Tiebout, 1956, Hamilton, 1976)
- Quantative Spatial Equilibrium: Proposition is a short-cut to the welfare prediction of structural spatial equilibrium models

(Epple et al., 2001, Kline, 2010, Moretti, 2011, Redding and Rossi-Hansberg, 2017) ▸ Spatial Eq. Results

Local Property Taxes in Germany (*Grundsteuer B*)

- Set by each of the 11,500 German municipalities
- Most important tax on property in Germany, revenue 12 billion EUR in 2013, accounts for 21% of directly controlled local taxes ▸ Municipal Finances
- $\textit{Tax Liability} = \underbrace{\textit{Federal Tax Rate} \times \textit{Municipal Scaling Factor}}_{\text{Local Property Tax Rate}} \times \textit{Assessed Value}$
  - *Assessed Value*: fixed, determined by states in 1964, or at 1964 prices (West Germany)
  - *Federal Tax Rate*: stable, differentiated by house type, 0.32 % on average ▸ Federal Tax Rates
  - *Municipal Scaling Factor*: varies, city councils votes on it annually ▸ Tax Variation

→ Decreasing effective tax rates (wrt market value) in absence of reforms

- Only systematic reason for municipalities to raise property tax: improve long-run fiscal sustainability

(Romer and Romer, 2010, Guajardo et al., 2014, Alesina et al., 2015, Fuest et al., 2018, Lichter et al., 2024) ▸ Effect on municipal finances

Statutory Incidence

- Landlord to submit property tax to fiscal authorities
- By regulation property tax is included in annual ancillary cost
  (together with fees for garbage/sewage, fresh water, sometimes central heating costs)
- Renters pay a monthly advance on these ancillary cost
- Settlement of ancillary costs after the end of the year based on actual costs
- Effective statutory incidence is on the renter

Data Sources and Sample

Housing market microdata

- Source: *ImmobilienScout24* provided by the research data center FDZ Ruhr at RWI
- Offered rents for new leases
- Main variable: total tax-inclusive rent per square meter after standard hedonic correction
- Other variables: Offered sales prices, main characteristics of buildings, location (municipality)

Administrative municipality data

- Sources: Various official statistics
- Data on property taxes, population, GDP, municipal expenditures, business profits, housing permits, unemployed, average wages, commuting zones, etc.

Estimation sample

Descriptive Statistics

- Focus on West Germany
- Years 2008–2015: Data availability housing price data and event study design
- Calculate average annual municipal house prices

Empirical Model: Event Study Design

- Event study designs with 4 leads and 4 lags using a 1st-diff distributed-lag model (Suárez Serrato and Zidar, 2016)
- Regress change in outcome $Y_{m,t}$ in muni m, year t on leads and lags of property tax rate changes:

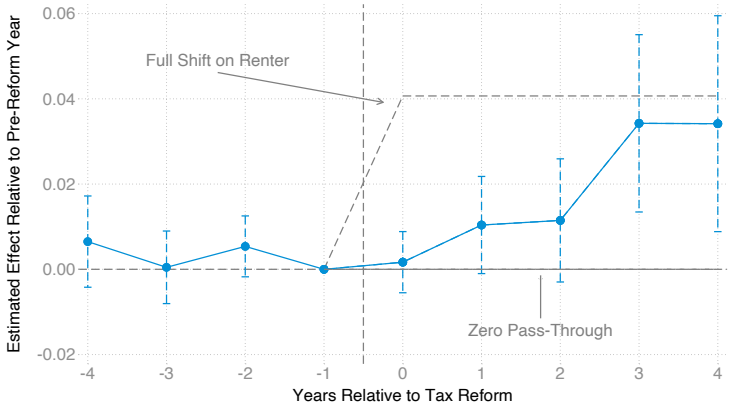
$$\Delta \ln Y_{c,t} = \sum_{3}^{4} \gamma_j \Delta PropertyTaxRate_{c,t-j} + \psi \Delta X_{c,t} + \theta_{r(c),t} + \varepsilon_{c,t} \tag{2}$$

  - First difference takes out municipal fixed effects μ_c
  - MSA-by-year fixed effects $\theta_{r,t}$ to pick up secular shocks
  - Depending on the specification: time-varying municipal controls $X_{c,t}$
  - Standard errors $\varepsilon_{m,t}$ clustered at municipal level

- Dynamic treatment effects β_j are calculated as follows (Schmidheiny and Siegloch, 2023)

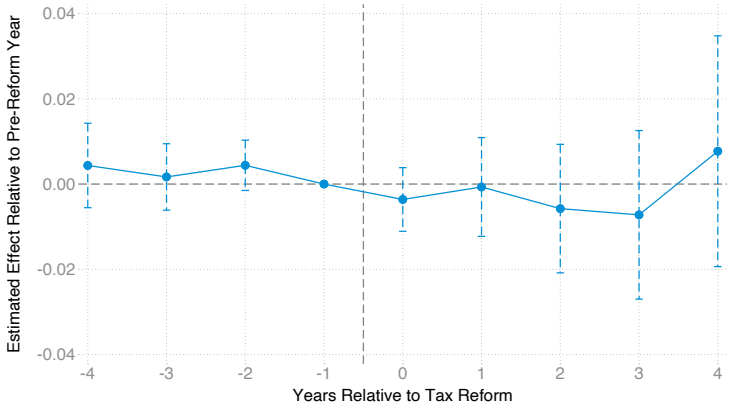
$$\widehat{\beta}_j = \begin{cases} -\sum_{k=j+1}^{-1} \widehat{\gamma}_k & \text{if } -4 \leq j \leq -2 \\ 0 & \text{if } j = -1 \\ \sum_{k=0}^{j} \widehat{\gamma}_k & \text{if } 0 \leq j \leq 4. \end{cases} \tag{3}$$

Baseline Effect of Property Taxes on Total Rents (including Taxes)



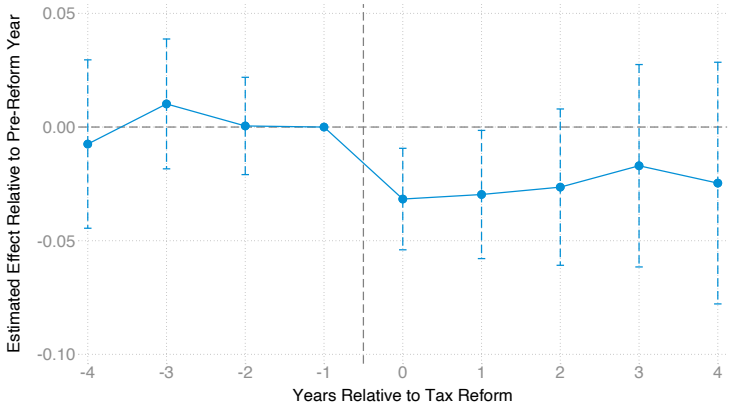
Notes: This figure illustrates the estimated treatment effect of a one percentage point increase in the property tax rate on total tax-inclusive rents (in logs) relative to the pre-reform year. The underlying econometric model is described in equations (2) and (3). The specification accounts for lags in the local business tax rate and MSA-by-year fixed effects. Observations are weighted by average population levels over the sample period. Vertical bars indicate 95% confidence intervals. Standard errors are robust to clustering at the municipality level. Dashed gray lines indicate the implied estimates for either zero or full shifting of taxes from landlords to tenants based on the corresponding average tax-to-rent ratio reported in the German Income and Expenditure Survey (EVS, 2013).

Mechanism: Reporting – Effects on Net-of-Tax Rents



Notes: This figure illustrates the estimated treatment effect of a one percentage point increase in the property tax rate on net-of-tax rents (in logs) relative to the pre-reform year. The underlying econometric model is described in equations (2) and (3). The specification accounts for lags in the local business tax rate and MSA-by-year fixed effects. Observations are weighted by average population levels over the sample period. Vertical bars indicate 95% confidence intervals. Standard errors are robust to clustering at the municipality level. Dashed gray lines indicate the implied estimates for either zero or full shifting of taxes from landlords to tenants based on the corresponding average tax-to-rent ratio reported in the German Income and Expenditure Survey (EVS, 2013).

Mechanism: Salience – Share of Ads including Property Tax Due

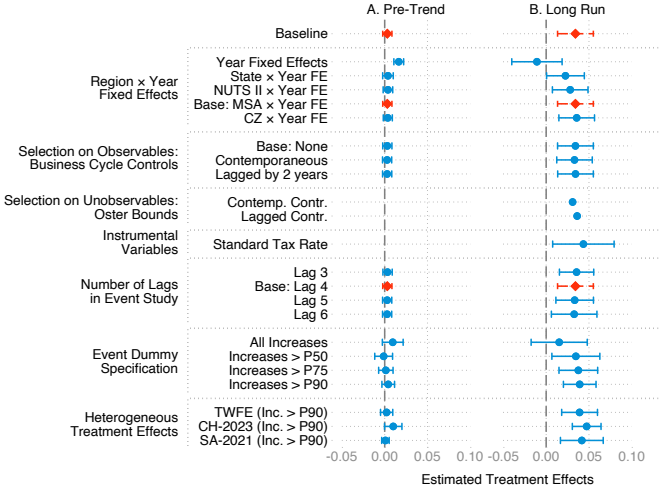


Notes: This figure illustrates the estimated treatment effect of a one percentage point increase in the property tax rate on share of ads that includes information on the property taxes to be paid relative to the pre-reform year. The underlying econometric model is described in equations (2) and (3). The specification accounts for lags in the local business tax rate and MSA-by-year fixed effects. Observations are weighted by average population levels over the sample period. Vertical bars indicate 95% confidence intervals. Standard errors are robust to clustering at the municipality level.

Probing Identification

1. Regional confounders: Account for local shocks more flexibly, e.g., CZ-by-year fixed effects
2. Municipal confounders: No pre-trends in local business cycle variables; control for local business cycles
3. Selection on unobservables: Calculate Oster (2019) bounds
4. IV strategy: Use state-level changes in reference tax rate (IV Model) (First Stage) (Reduced Form)
5. Lag lengths: Test long-run effects, change assignment to T and C group
6. Large event : Event dummy specifications with (large) tax increases
7. Heterogeneous treatment effects: Apply estimators of Sun and Abraham (2021), de Chaisemartin and D'Haultfœuille (2020, 2024)

Probing Identification



Notes: This figure presents the results for seven of out the eight identification checks outlined before. Estimates depict the estimated treatment effect of a one percentage point increase in the property tax rate on total tax-inclusive rents (in logs) relative to the pre-reform year. The baseline estimates are shown in red, results from alternative specifications are depicted in blue. Panel A presents summary estimates of pre-treatment trends, i.e., the average coefficient in the four years prior to a tax reform. Panel B shows the long-run effect measured as the average estimate of the third and fourth lag in the property tax rate. All regressions also account for leads and lags in the local business tax rate. Observations are weighted by average population levels over the sample period. Horizontal bars indicate 95% confidence intervals. Standard errors are robust to clustering at the municipality level.

Further Robustness Checks

1. Accounting for local business tax changes ▸ Results
2. Fixed effects instead of first differences ▸ Results
3. Minimum number of ads per municipality-year cell ▸ Results
4. Weights: population, ads ▸ Results
5. Including East Germany ▸ Results
6. Hedonic correction ▸ Results

Data and Empirical Implementation

- We use Proposition 1 to simulate the welfare effects of a property tax change on the household level
- Rely on household microdata (EVS, German Income and Expenditure Survey) to observe pre-reform quantities (incomes and expenditures) at household-level
- Use long-run reduced form effects on total and net-of-tax rents presented above
  - Introduce heterogeneity by estimating the rent effect for different apartment types (size, age)
  - Account for owner-occupied housing by simulating changes in tax payments based on imputed rents
- Estimate (heterogeneous) wage and business income effects using administrative municipal data
- Estimate amenity effect using the change in property tax revenue
- Calibrate local public good preference δ to different benchmark values

Estimates of Prices Effects for Simulation

Panel A – Effects on Total and Net Rents

	All Rental Ads		By Apartment Size			By Construction Year		
	Total Rent (1)	Net Rent (2)	Below 60m² (3)	Between 60–80m² (4)	Above 80m² (5)	Before 1949 (6)	Between '49–'90 (7)	After 1990 (8)
Long-Run Effect	0.034***	0.001	-0.000	0.033**	0.050***	0.041	0.017	0.003
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.032)	(0.015)	(0.022)
Muni. × Year Obs.	23,303	23,236	23,303	23,303	23,303	23,303	23,303	23,303

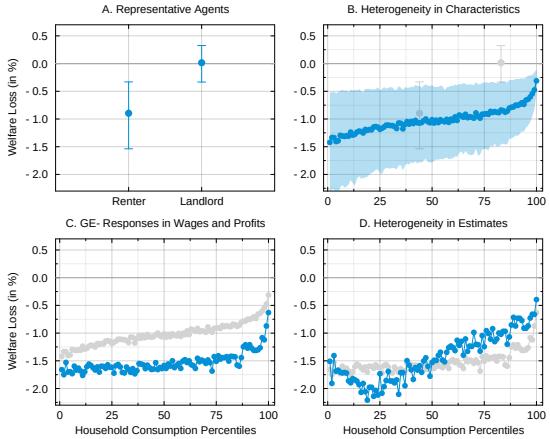
Panel B – Effects on Wages, Profits, and Public Goods

	Wage Earnings					Public Goods	
	Average Wage (9)	P25 Wage (10)	P50 Wage (11)	P75 Wage (12)	Business Profits (13)	Prop Tax Reven. (14)	Munic. Expenses (15)
Long-Run Effect	-0.007	-0.056	-0.021	0.013	-0.035	0.508***	-0.067*
	(0.011)	(0.047)	(0.018)	(0.010)	(0.132)	(0.026)	(0.037)
Muni. × Year Obs.	37,781	38,782	38,782	38,782	8,347	41,190	41,286

Notes: This table depicts long-run price effects for various outcomes (in logs) in response to a one percentage point increase in the property tax rate relative to the pre-reform year. The underlying econometric model is described in equations (2) and (3). The specification also accounts for leads and lags in the local business tax rate and MSA-by-year fixed effects. Observations are weighted by average population levels over the sample period. Full event-study estimates are depicted in Appendix Figure 29. Standard errors in parentheses are robust to clustering at the municipality level (* $p < .1$, ** $p < .05$, *** $p < .01$.) See Appendix **??** for detailed information on all variables.

▸ Wages ▸ Profits ▸ Public Goods

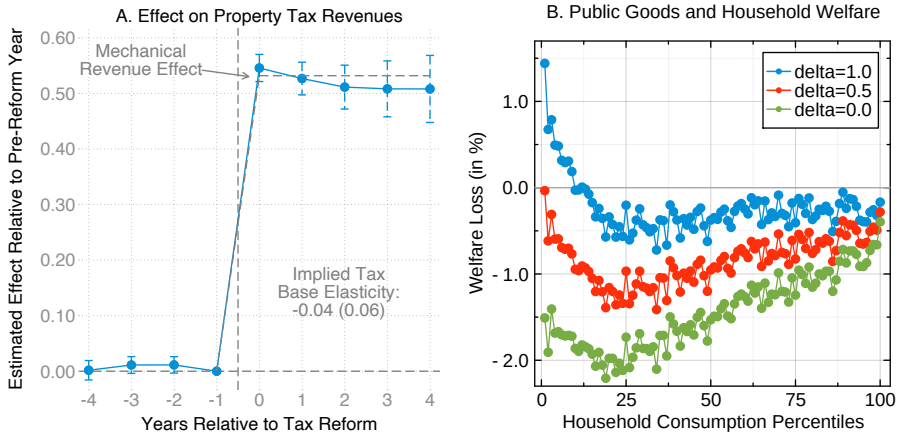
Simulation Results: Welfare Effects of Property Taxes Due to Price Changes



Notes: This figure illustrates the relative welfare consequences of a one percentage point increase in the local property tax over the household consumption distribution (in percent). We calculate relative welfare losses as money-metric utility changes in euro per year divided by annual household consumption. Starting from a stylized benchmark case presented in Panel A, we introduce more heterogeneity in our welfare simulations step-by-step as we move to Panel-D: Panel A reports welfare in a partial-equilibrium model with two representative agents (landlords and renters). Panel B additionally accounts for differences in the numbers of these two agents, their different positions in the consumption distribution, and their housing expenditures; Panel C additionally introduces general equilibrium effects on the labor market (via wage and business income effects); Panel D additionally allows for heterogeneity in price effects of rents and wages. The gray coefficients/dots indicate the estimates from the previous panel to improve comparability. We simulate these changes for each household in the German Income and Expenditure Survey (EVS, 2013); Section **??** provides more details on the empirical implementation. The curves are based on average changes within percentiles of the consumption distribution across households using sampling weights and the OECD-modified equivalence scale. Shaded blue areas and vertical bars correspond to empirical 95% confidence bounds using 1,000 bootstrap replications.

▸ absolute welfare changes ▸ CIs for GE models

Simulation Results: Welfare Effects of Property Taxes including Public Goods



Notes: This figure illustrates the estimated treatment effect of a one percentage point increase in the property tax rate on property tax revenues (in logs) relative to the pre-reform year (Panel A). The underlying econometric model is described in equations (2) and (3). The specification also accounts for leads and lags in the local business tax rate and MSA-by-year fixed effects. Observations are weighted by average population levels over the sample period. Vertical bars indicate 95% confidence intervals. Standard errors are robust to clustering at the municipality level. The dashed gray line indicates the implied estimate for tax revenues without any behavioral responses, i.e., the mechanical effect on tax revenues. Panel B illustrates the relative welfare consequences of a one percentage point increase in the local property tax rate along the household consumption distribution for different marginal valuations of public goods and services vs. private consumption ($\delta_i = [1, 0.5, 0]$). We calculate relative welfare losses as money-metric utility changes in euro per year divided by annual household consumption. We simulate these changes for each household in the German Income and Expenditure Survey (EVS, 2013); Section ?? provides more details on the empirical implementation. The curves are based on average changes within percentiles of the consumption distribution across households using sampling weights and the OECD-modified equivalence scale.

Concluding Remarks

"ARE LOCAL PROPERTY TAXES REGRESSIVE, PROGRESSIVE, OR WHAT?"

(Oates and Fischel, 2016)

Concluding Remarks

"ARE LOCAL PROPERTY TAXES REGRESSIVE, PROGRESSIVE, OR WHAT?"

(Oates and Fischel, 2016)

1. The property tax is not progressive

Concluding Remarks

"ARE LOCAL PROPERTY TAXES REGRESSIVE, PROGRESSIVE, OR WHAT?"

(Oates and Fischel, 2016)

1. The property tax is not progressive
2. The property tax can be approximately welfare-neutral if public goods are provided

Concluding Remarks

"ARE LOCAL PROPERTY TAXES REGRESSIVE, PROGRESSIVE, OR WHAT?"

(Oates and Fischel, 2016)

1. The property tax is not progressive
2. The property tax can be approximately welfare-neutral if public goods are provided efficiently and individuals indifferent b/w marginal private and public good
3. The property tax is, hence, regressive in most settings

Appendix

Contributions to the literature

1. Theoretical approach combines ...
   - ... sufficient statistics techniques
     Chetty (2009), Kleven (2021)
   - ... spatial equilibrium and local labor market models
     Rosen (1979), Roback (1982), Albouy (2009), Glaeser (2009), Kline (2010), Moretti (2011), Kline and Moretti (2014), Ahlfeldt et al. (2015), Diamond (2016), Suárez Serrato and Zidar (2016), Fajgelbaum et al. (2019), Brülhart et al. (2024)
   - ... property tax views
     Marshall (1890), Edgeworth (1897), Bickerdike (1902), Simon (1943), Tiebout (1956), Oates (1969), Mieszkowski (1972), Hamilton (1976), Mieszkowski and Zodrow (1989), Fischel (1992), Zodrow (2001b,a)
2. Reduced-form evidence on ...
   - ... housing market effects of property taxes
     Orr (1968, 1970, 1972), Heinberg and Oates (1970), Hyman and Pasour (1973), Dusansky et al. (1981), Carroll and Yinger (1994), Palmon and Smith (1998), de Bartolomé and Rosenthal (1999), Buettner (2003), Lyytikäinen (2009), Ferreira (2010), Shan (2010), Lutz (2015)
   - ... local public goods/amenities
     Bradbury et al. (2001), Bayer et al. (2007), Cellini et al. (2010), Boustan (2013), Suárez Serrato and Wingender (2016), Schönholzer and Zhang (2017), Fajgelbaum et al. (2019), Brülhart et al. (2024)
3. Welfare/distributional effects ...
   - ... over the income distribution
   - ... complementing structural heterogeneous agent models
     Suárez Serrato and Zidar (2016), Diamond (2016), Fajgelbaum and Gaubert (2020), Brülhart et al. (2024)

Property tax views

Traditional view (Edgeworth, 1897, Simon, 1943, Netzer, 1966)

- Tax introduced in single municipality, perfectly elastic capital supply
- Tenants bear the full tax burden of property taxation

Capital tax view (Mieszkowski, 1972, Mieszkowski and Zodrow, 1989)

- Extends "old view" with Harberger general equilibrium model
- Capital owners bear the national average burden of property taxes

Benefit tax view (Tiebout, 1956, Oates, 1969, Hamilton, 1976, Fischel, 1992)

- Property taxes finance local public goods, work as a non-distortive fee
- Households are mobile and choose "optimal municipality"

Hard to provide systematic empirical evidence for different views (Oates and Fischel, 2016)

- General equilibrium aspects hard to pin down empirically
- Empirics focused on partial analyses (as in corporate tax literature)

Proof of Proposition ?? (Household Welfare)

- Using indirect utility $v_i(r_i^{C*}, y_i^*, g_c^*)$, we are interested in a small increase of the property tax t_c

$$\frac{\mathrm{d}v_i}{\mathrm{d}t_c} = \frac{\partial v_i}{\partial r}\frac{\mathrm{d}r_i^{C*}}{\mathrm{d}t_c} + \frac{\partial v_i}{\partial y}\frac{\mathrm{d}y_i^*}{\mathrm{d}t_c} + \frac{\partial v_i}{\partial g}\frac{\mathrm{d}g_c^*}{\mathrm{d}t_c} \tag{4}$$

- Envelope theorem and Roy's identity allows to simplify the first term on the right-hand side

$$\frac{\mathrm{d}v_i}{\mathrm{d}t_c} = -h_i^*\frac{\partial v_i}{\partial y}\frac{\mathrm{d}r_i^{C*}}{\mathrm{d}t_c} + \frac{\partial v_i}{\partial y}\frac{\mathrm{d}y_i^*}{\mathrm{d}t_c} + \frac{\partial v_i}{\partial g}\frac{\mathrm{d}g_c^*}{\mathrm{d}t_c}. \tag{5}$$

- Normalizing by the marginal utility from income, we get the money-metric welfare effect

$$\Delta W_i = \frac{\mathrm{d}v_i/\mathrm{d}t_c}{\mathrm{d}v_i/\mathrm{d}y} = -h_i^*\frac{\mathrm{d}r_i^{C*}}{\mathrm{d}t_c} + \frac{\mathrm{d}y_i^*}{\mathrm{d}t_c} + \delta_i^g\frac{\mathrm{d}g_c^*}{\mathrm{d}t_c} \qquad \text{with } \delta_i^g = \frac{\partial v_i/\partial g}{\partial v_i/\partial y}, \tag{6}$$

Comparison to spatial equilibrium model

- Multiply with marginal utility from income:

$$\frac{\mathrm{d}v_i}{\mathrm{d}t_c} = -\frac{\partial v_i}{\partial y_i^*} h_i^* \frac{\mathrm{d}r_i^{C*}}{\mathrm{d}t_c} + \frac{\partial v_i}{\partial y_i^*} \left(\frac{\mathrm{d}y_i^{W*}}{\mathrm{d}t_c} + \frac{\mathrm{d}y_i^{F*}}{\mathrm{d}t_c} + \frac{\mathrm{d}y_i^{L*}}{\mathrm{d}t_c} \right) + \frac{\partial v_i}{\partial g_c^*} \frac{\mathrm{d}g_c^*}{\mathrm{d}t_c}.$$

- Impose assumptions that are necessary in structural models, e.g.
  - Marginal utility of private income: $\frac{\partial V_i}{\partial y_i^*} = (1-\delta)$
  - Marginal utility of public good: $\frac{\partial V_i}{\partial g_c^*} = \delta$
  - Worker i is neither firm owner nor landlord ($y_i^F = y_i^L = 0$)

$$\frac{\mathrm{d}V_i}{\mathrm{d}t_c} = -(1-\delta) \left[h_i^* \frac{\mathrm{d}r_i^{C*}}{\mathrm{d}t_c} - \frac{\mathrm{d}y_i^{W*}}{\mathrm{d}t_c} \right] + \delta \frac{\mathrm{d}g_c^*}{\mathrm{d}t_c}.$$

- which is equivalent to formula for renter welfare in a fully specified structural spatial model

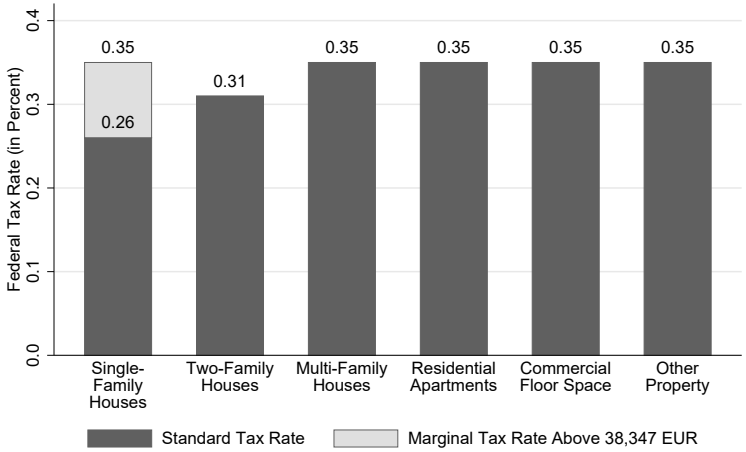
(Kline and Moretti, 2014, Suárez Serrato and Zidar, 2016)

$$\frac{dW^H}{d\ln\tau_c} = -(1-\delta) \left[\alpha + \alpha \frac{d\ln r_c^{H*}}{d\ln\tau_c} - \frac{d\ln w_c^*}{d\ln\tau_c} \right] + \delta \frac{d\ln G_c^*}{d\ln\tau_c}$$

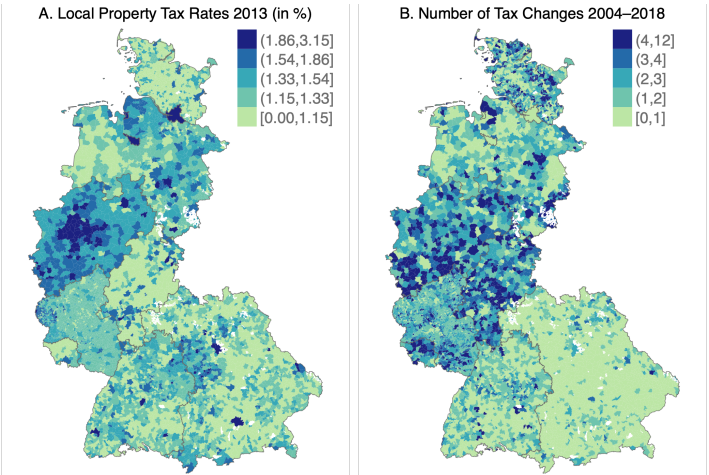
Municipal Revenues and Local Public Goods

- In 2013, the average (median) annual revenues of municipalities was 2,691 (2,353) euro per capita
- 28% of the revenues are coming from local taxes (thereof business tax 79% and property tax 21%)
- Share of total municipal revenues from property taxes 5% (US: 12%)
- Local public goods/services less important in Germany (no schools, police, highways)
- About 80% of total municipal expenditures are spent on keeping up the usual administrative duties (employees, buildings, subsidize public firms, welfare costs); 15% of the expenditures are used for investment projects

Federal Tax Rates for West Germany (in %)



Variation in Local Property Taxes



Notes: The left panel of this figure shows the local property tax rates in 2013 for all West German municipalities, assuming a federal tax rate of 0.32 percent. The right panel depicts the number of local property tax changes by municipality in the period 1990–2018. Municipalities are grouped into population-weighted quintiles and shaded according to the tax rate or the number of tax changes, respectively. Jurisdictional boundaries are as of December 31, 2015. Gray lines indicate federal state borders. White areas indicate unpopulated unincorporated areas (*gemeindefreie Gebiete*). See Appendix **??** for detailed information on all variables. *Maps:* © GeoBasis-DE / BKG 2019.

Simple Example for Rents

- Introduction of a 20 EUR property tax on apartments in Cologne

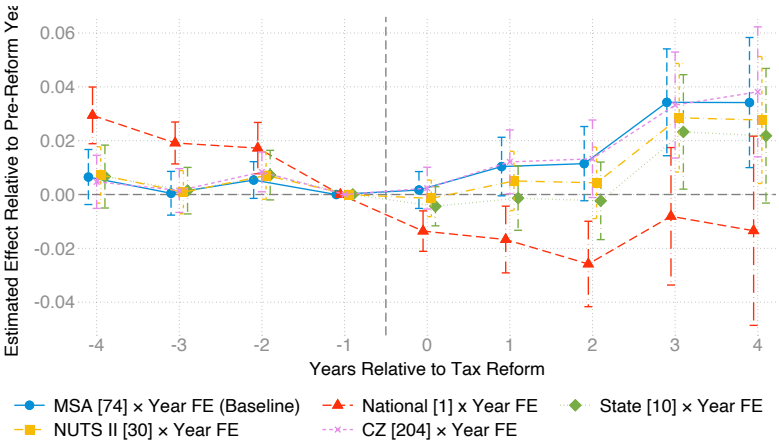
	Pre Tax	**After Tax Introduction**	
Invoice/rent bill (in EUR)		Full pass-through to tenant	No pass-through to tenant
Net Rent (producer price)	400	400	380
Operating costs	30	30	30
Property tax	0	20	20
Gross Rent (consumer price)	430	450	430

Descriptive Statistics

Variable	Mean	SD	P10	P25	P50	P75	P90
Panel A – Housing Prices							
Average Rent (in €/m²)	9.09	2.06	7.03	7.71	8.57	10.08	11.73
Panel B – Fiscal Variables							
Local Property Tax Rate (in %)	1.30	0.30	0.96	1.09	1.28	1.48	1.71
Standard Tax Rate (in %)	0.97	0.28	0.59	0.70	0.99	1.22	1.32
Local Business Tax Rate (in %)	13.85	1.89	11.55	12.25	13.82	15.40	16.62
Expenditures per Capita (in €)	2,519.20	1,212.27	1,488.05	1,773.01	2,263.85	3,047.11	3,799.63
Revenues per Capita (in €)	2,621.72	1,351.18	1,518.37	1,817.87	2,345.59	3,188.67	3,930.63
Property Taxes per Capita (in €)	155.11	48.96	94.80	119.89	150.23	183.73	221.41
Panel C – Economic Indicators							
Average Daily Wages (in €)	71.67	14.83	53.67	61.94	70.62	80.53	91.35
Business Profits per Capita (in €)	4,215.87	5,390.21	1,362.86	2,118.60	3,256.91	5,072.34	7,454.63
Local Population Levels	153,801	283,491	5,428	11,960	32,030	124,577	548,547
Local GDP per Capita (in €)	37,753	16,385	24,088	27,247	32,599	41,573	59,925
Local Unemployment Rate (in %)	7.03	2.92	3.70	4.74	6.55	8.66	11.25

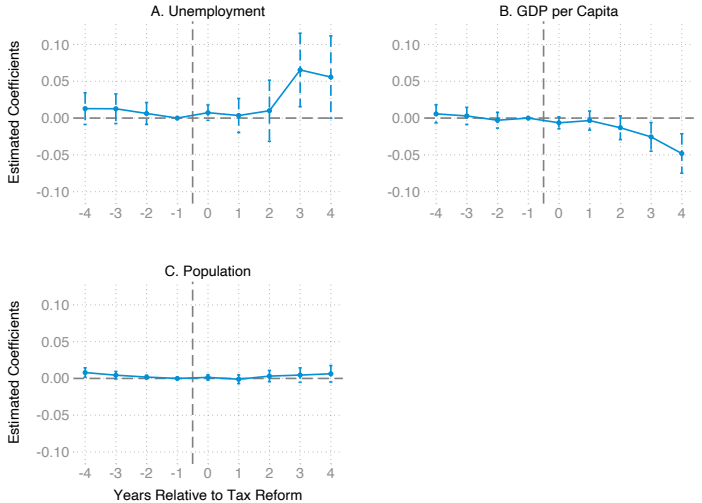
Notes: This table provides descriptive statistics for the baseline estimation sample. Means are weighted by average population levels over the sample period. See Table **??** for detailed information on all variables.

Importance of Regional Confounders



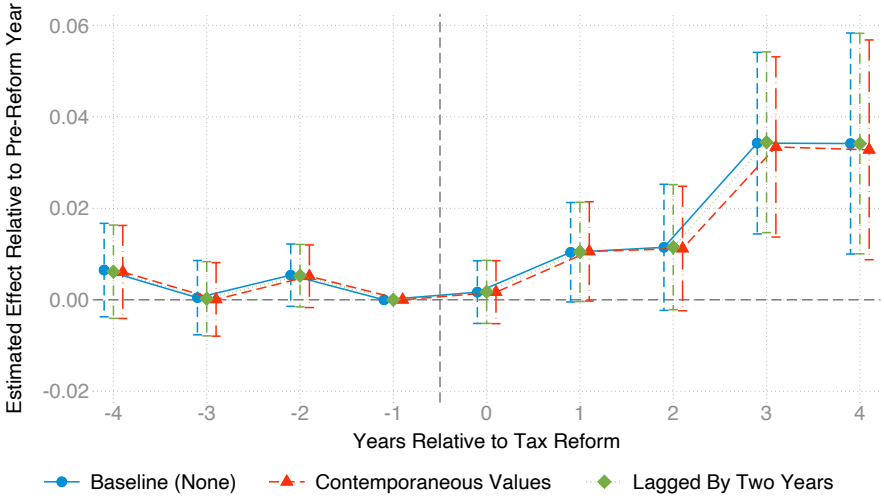
Notes: This figure illustrates the estimated treatment effect of a one percentage point increase in the property tax rate on total tax-inclusive rents (in logs) relative to the pre-reform year using various alternative regional time trend specifications. The underlying econometric model is described in equations (2) and (3). The specification also accounts for leads and lags in the local business tax rate and year fixed effects at various regional levels (see legend). Observations are weighted by average population levels over the sample period. Vertical bars indicate 95% confidence intervals. Standard errors are robust to clustering at the municipality level.

Effect of Property Taxes on Local Business Cycle Outcomes



Notes: This figure illustrates the estimated treatment effect of a one percentage point increase in the property tax rate on local business cycle measures relative to the pre-reform year. The underlying econometric model is described in equations (2) and (3). All specifications also account for leads and lags in the local business tax rate and MSA-by-year fixed effects. Observations are weighted by average population levels over the sample period. Vertical bars indicate 95% confidence intervals. Standard errors are robust to clustering at the municipality level.

Accounting for Local Business Cycle Confounders



Notes: This figure illustrates the estimated treatment effect of a one percentage point increase in the property tax rate on total tax-inclusive rents (in logs) relative to the pre-reform year using different sets of control variables for local business cycles. The underlying econometric model is described in equations (2) and (3). All specifications also account for leads and lags in the local business tax rate and MSA-by-year fixed effects. Observations are weighted by average population levels over the sample period. Vertical bars indicate 95% confidence intervals. Standard errors are robust to clustering at the municipality level.

Selection on Unobservables

Table: Bounded Estimates Following Oster (2019)

	(1) Uncontrolled Estimate	(2) Controlled Estimate	(3) Bounded Estimate
Panel A – Using Contemporaneous Controls			
Medium-Run Effect	0.034***	0.033***	0.031
	(0.011)	(0.011)	
Number of Observations	23,303	23,295	
Adjusted R-squared	0.003	0.004	
Panel B – Using Lagged Control Variables			
Medium-Run Effect	0.034***	0.034***	0.036
	(0.011)	(0.011)	
Number of Observations	23,303	23,294	
Adjusted R-squared	0.003	0.003	

Notes: This table illustrates the bounded estimates for the treatment effect of a one percentage point increase in the property tax rate on total rents (in logs) relative to the pre-reform year. Bounds have been obtained using the approximation in Oster (2019) and calibrating $\delta = 1$ and $R^2_{max} = 1.3 \cdot R^2_{controlled}$. Panel A presents bounds using contemporaneous business cycle control variables (population, unemployment, county-level GDP) for the controlled model. Panel B relies on the same control variables lagged by two years. The underlying

Instrumental variables approach

- Each state s set a standard tax rate (*Fiktiver Hebesatz*), which is increasing over time
- One can show that municipalities have incentive to (Buettner, 2003, Egger et al., 2010, Baskaran, 2014, Rauch and Hummel, 2016)
  - increase own property tax rate when standard rate increase
  - incentive is increasing in the difference between new standard rate and own tax rate
- We translate this into the following instrumental variable

$$IV_{m,t} = StandardTaxRateIncrease_{s,t} \cdot \frac{StandardTaxRate_{s,t} - PropertyTaxRate_{m,t-1}}{PropertyTaxRate_{m,t-1}} \tag{7}$$

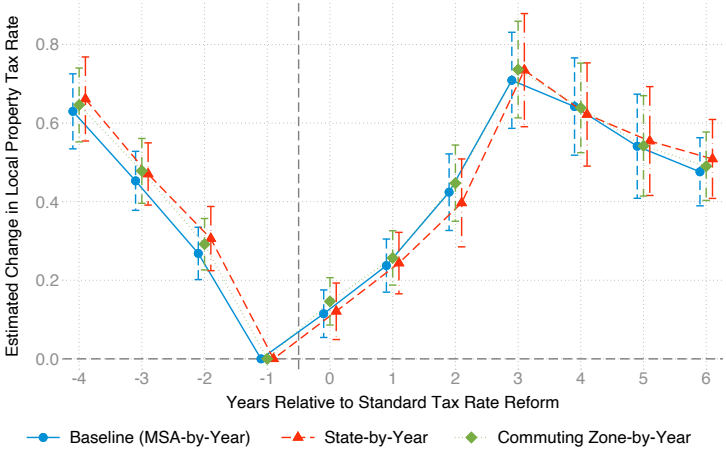
  where $StandardTaxRateIncrease_{s,t}$ is a dummy indicating a standard rate hike in state s and year t
- The first stage equation is given by

$$\Delta PropertyTaxRate_{m,t} = \sum_{j=-\underline{j}+1}^{\bar{j}} \eta_j IV_{m,t-j} + \delta \Delta X_{m,j} + \zeta_{r,t} + \epsilon_{m,t}, \tag{8}$$

First Stage | Reduced Form

First Stage Results Using Standard Tax Rate Increases

Figure: First Stage Results Using Standard Tax Rate Increases



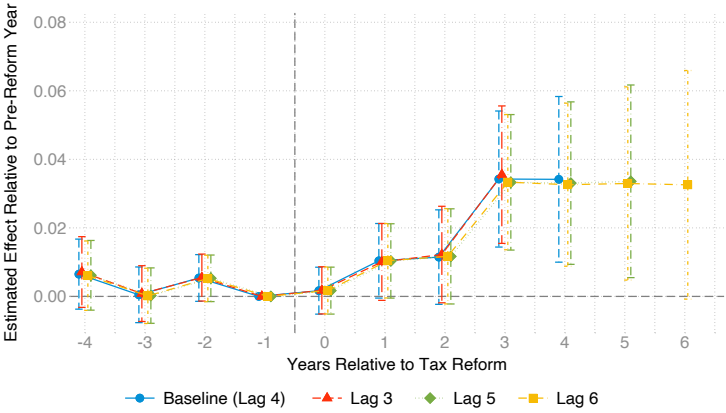
Notes: This figure shows the estimated treatment effects of state-level reforms in the standard tax rate on local property tax rates using alternative specifications to account for regional confounders. Formally, we

Effect of Standard Tax Rate Changes on Gross Rents

Notes: This figure illustrates the estimated reduced-form effect of the standard tax rate IV defined in equation (7) on total tax-inclusive rents (in logs) relative to the year before a standard tax rate increase. The underlying econometric model is analogous to equations (2) and (3). The specification also accounts for leads and lags in the local business tax rate and MSA-by-year fixed effects. Observations are weighted by average population levels over the sample period. Municipalities in the states Baden-Württemberg and Saarland are excluded from the estimation sample. Vertical bars indicate 95% confidence intervals. Standard errors are robust to clustering at the municipality level.

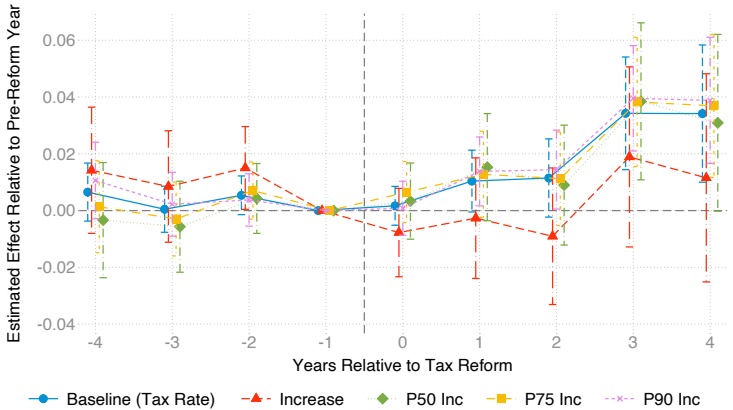
◂ Identification ◂ IV Approach

Robustness: Adding lags



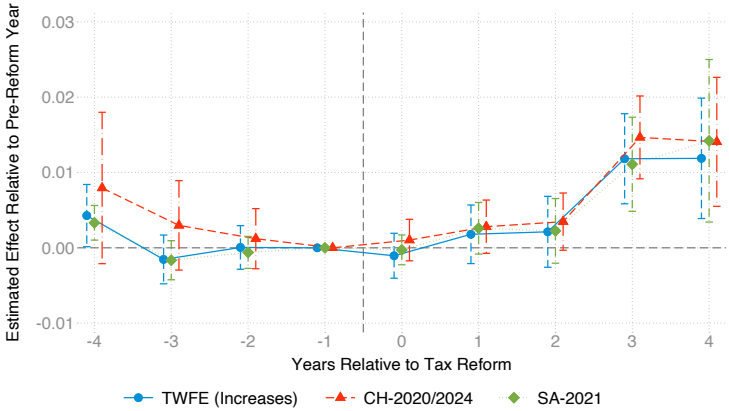
Notes: This figure illustrates the estimated treatment effect of a one percentage point increase in the property tax rate on total tax-inclusive rents (in logs) relative to the pre-reform year for different lag lengths. The underlying econometric model is described in equations (2) and (3). All specifications account lags in the local business tax rate and MSA-by-year fixed effects. Observations are weighted by average population levels over the sample period. Vertical bars indicate 95% confidence intervals. Standard errors are robust to clustering at the municipality level.

Effect of Property Taxes on Gross Rents: Increase Dummies (re-scaled)



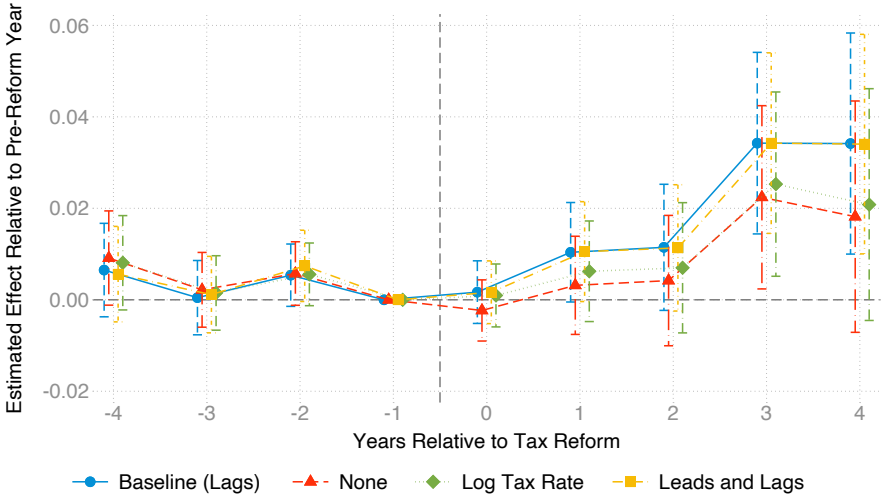
Notes: This figure illustrates the estimated treatment effect of property tax changes on gross rents (in logs) relative to the pre-reform year using alternative definitions of event study variables. The baseline specification scales any change in property tax rates with the size of the tax change. The other specifications shown in the legend use simply event indicators for any tax increase or larger tax increases (greater or equal to the P50, P75 or P90 of the tax increase distribution). The underlying econometric model is described in equations (2) and (3). All specifications also account for leads and lags in the local business tax rate and MSA-by-year fixed effects. Observations are weighted by average population levels over the sample period. Vertical bars indicate 95% confidence intervals. Standard errors are robust to clustering at the municipality level.

Effect of Property Taxes on Gross Rents: Heterogeneous Treatment Effects



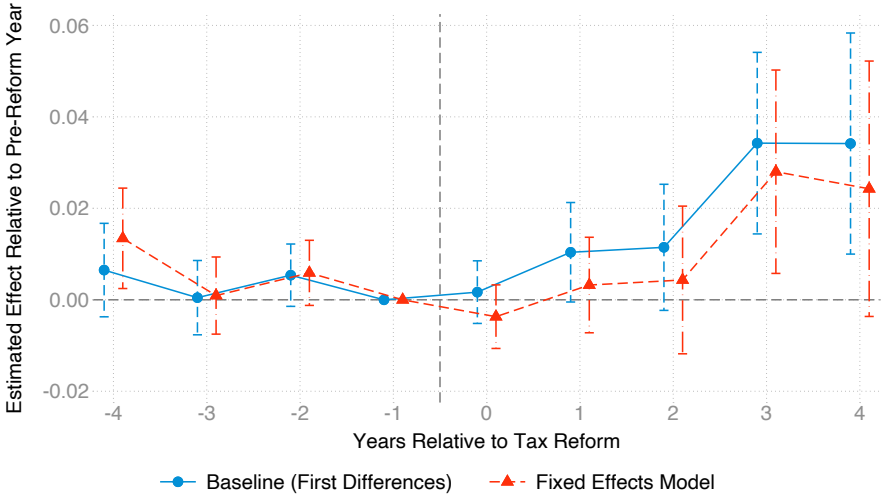
Notes: This figure illustrates the estimated treatment effect of large property tax increases on gross rents (in logs) relative to the pre-reform year using alternative definitions of event study variables. Large property tax changes are defined as being above the median of the property tax distribution. The sample is restricted to municipalities with either no or one large change. The underlying econometric model is similar to equation (2) with the exception that we use a dichotomous treatment variable indicating a tax change instead of a continuous one. The baseline two-way fixed effects (TWFE) model is contrasted with models that account for heterogeneous treatment effects as indicated in the legend: CD2020 stands for de Chaisemartin and D'Haultfœuille (2020), SA2021 for Sun and Abraham (2021); and BJS 2022 for Borusyak et al. (2023). All specifications also account for leads and lags in the local business tax rate and MSA-by-year fixed effects. Observations are weighted by average population levels over the sample period. Vertical bars indicate 95% confidence intervals. Standard errors are robust to clustering at the municipality level.

Robustness: Accounting for Local Business Tax Changes



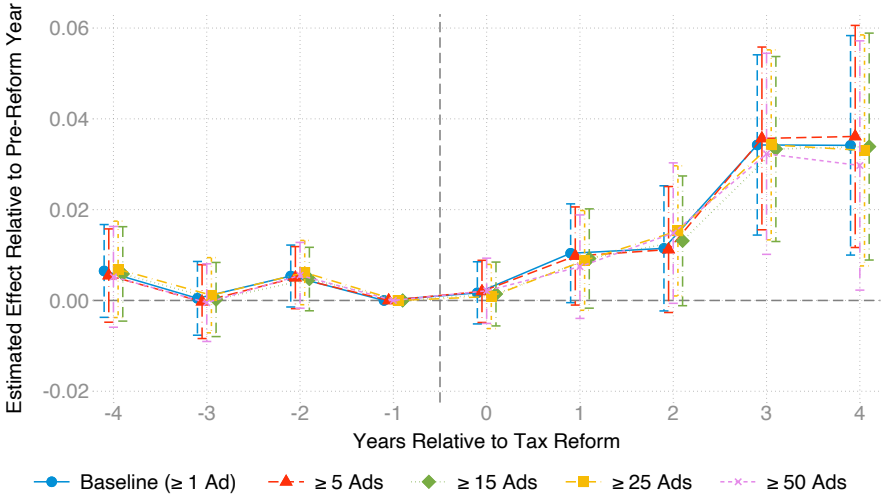
Notes: This figure illustrates the estimated treatment effect of a one percentage point increase in the property tax rate on total tax-inclusive rents (in logs) relative to the pre-reform year using different sets of control variables for local business cycles. The underlying econometric model is described in equations (2) and (3). All specifications also account for leads and lags in the local business tax rate and MSA-by-year fixed effects. Observations are weighted by average population levels over the sample period. Vertical bars indicate 95% confidence intervals. Standard errors are robust to clustering at the municipality level.

Robustness: First Differences vs. Fixed Effects



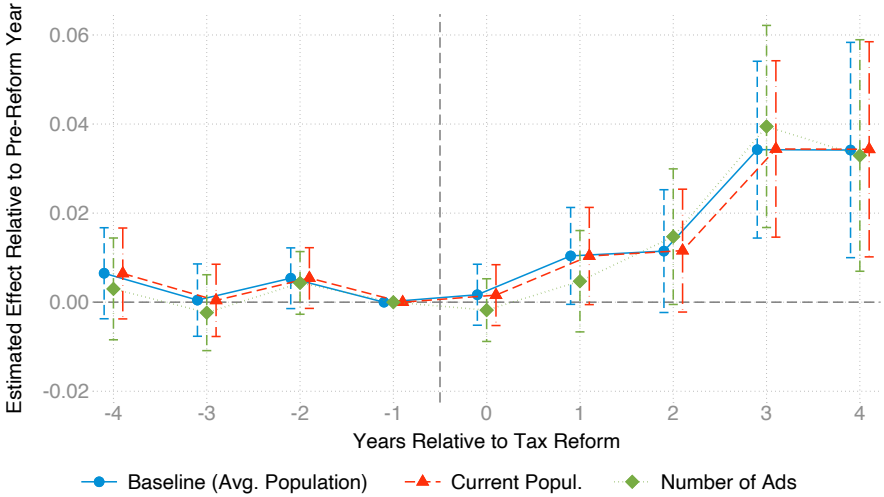
Notes: This figure illustrates the estimated treatment effect of a one percentage point increase in the property tax rate on total tax-inclusive rents (in logs) relative to the pre-reform year using different sets of control variables for local business cycles. The underlying econometric model is described in equations (2) and (3). All specifications also account for leads and lags in the local business tax rate and MSA-by-year fixed effects. Observations are weighted by average population levels over the sample period. Vertical bars indicate 95% confidence intervals. Standard errors are robust to clustering at the municipality level.

Robustness: Number of ads per muni-year



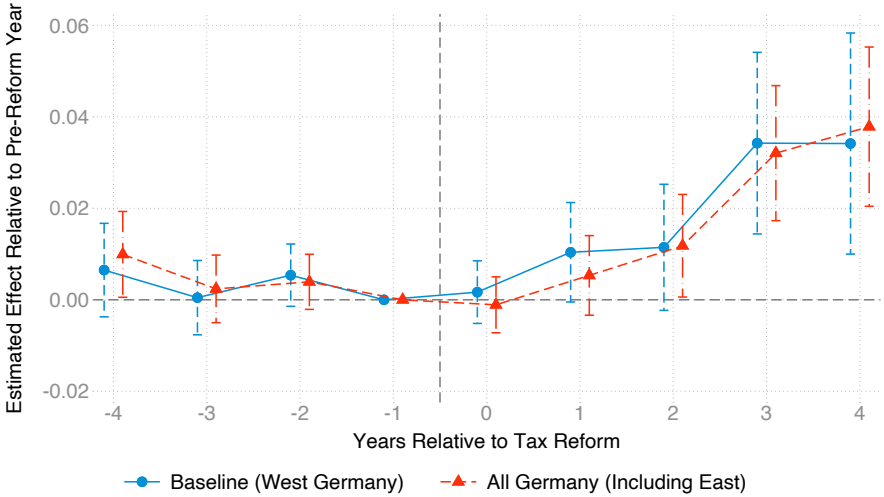
Notes: This figure illustrates the estimated treatment effect of a one percentage point increase in the property tax rate on total tax-inclusive rents (in logs) relative to the pre-reform year using different sets of control variables for local business cycles. The underlying econometric model is described in equations (2) and (3). All specifications also account for leads and lags in the local business tax rate and MSA-by-year fixed effects. Observations are weighted by average population levels over the sample period. Vertical bars indicate 95% confidence intervals. Standard errors are robust to clustering at the municipality level.

Robustness: Weights



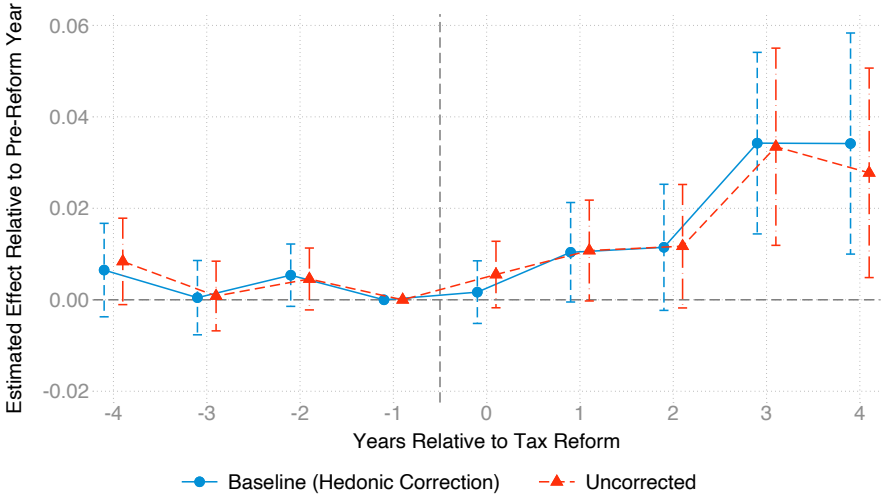
Notes: This figure illustrates the estimated treatment effect of a one percentage point increase in the property tax rate on total tax-inclusive rents (in logs) relative to the pre-reform year using different sets of control variables for local business cycles. The underlying econometric model is described in equations (2) and (3). All specifications also account for leads and lags in the local business tax rate and MSA-by-year fixed effects. Observations are weighted by average population levels over the sample period. Vertical bars indicate 95% confidence intervals. Standard errors are robust to clustering at the municipality level.

Robustness: Including East Germany



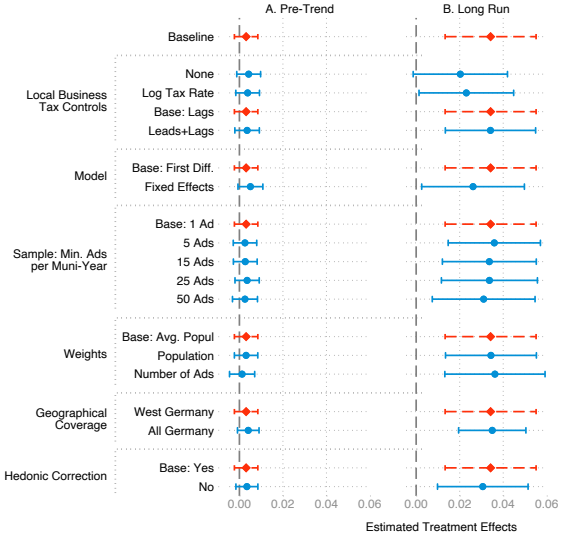
Notes: This figure illustrates the estimated treatment effect of a one percentage point increase in the property tax rate on total tax-inclusive rents (in logs) relative to the pre-reform year using different sets of control variables for local business cycles. The underlying econometric model is described in equations (2) and (3). All specifications also account for leads and lags in the local business tax rate and MSA-by-year fixed effects. Observations are weighted by average population levels over the sample period. Vertical bars indicate 95% confidence intervals. Standard errors are robust to clustering at the municipality level.

Robustness: Hedonic Correction of Rents

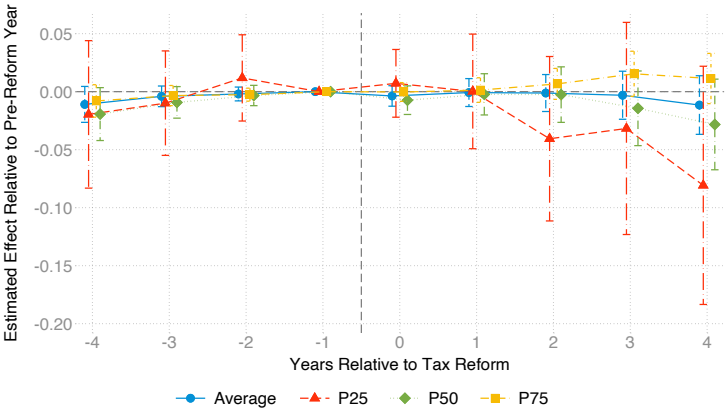


Notes: This figure illustrates the estimated treatment effect of a one percentage point increase in the property tax rate on total tax-inclusive rents (in logs) relative to the pre-reform year using different sets of control variables for local business cycles. The underlying econometric model is described in equations (2) and (3). All specifications also account for leads and lags in the local business tax rate and MSA-by-year fixed effects. Observations are weighted by average population levels over the sample period. Vertical bars indicate 95% confidence intervals. Standard errors are robust to clustering at the municipality level.

Robustness Checks

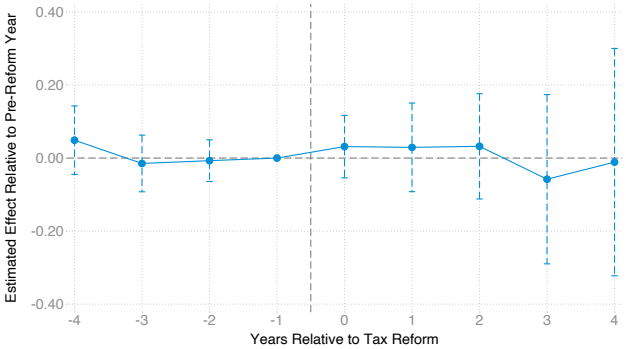


Reduced-form effects on Wages



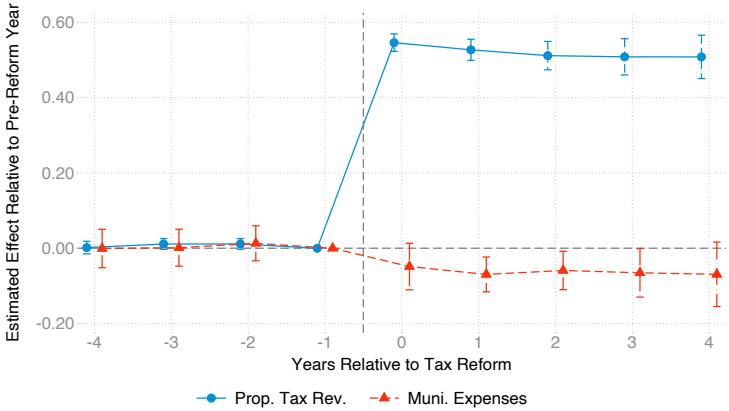
Notes: This figure illustrates the estimated treatment effect of a one percentage point increase in the property tax rate on various measures of municipal wages relative to the pre-reform year. The underlying econometric model is described in equations (2) and (3). The specification accounts for lags in the local business tax rate and MSA-by-year fixed effects. Observations are weighted by average population levels over the sample period. Vertical bars indicate 95% confidence intervals. Standard errors are robust to clustering at the municipality level.

Reduced-Form Effects on Business Incomes



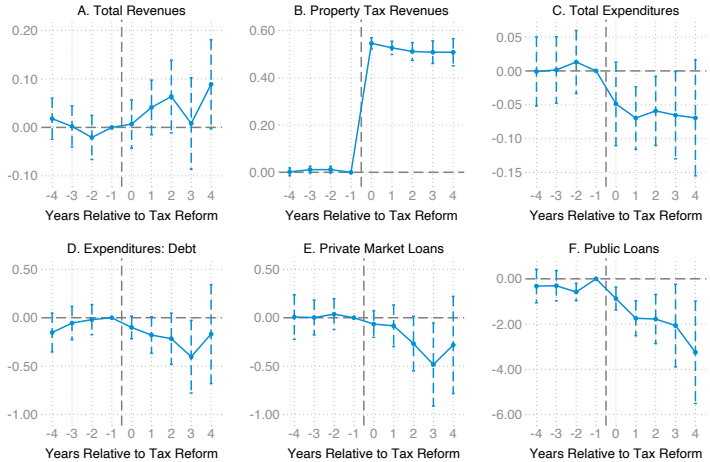
Notes: This figure illustrates the estimated treatment effect of a one percentage point increase in the property tax rate on business incomes relative to the pre-reform year. The underlying econometric model is described in equations (2) and (3). All specifications also account for leads and lags in the local business tax rate and MSA-by-year fixed effects. Observations are weighted by average population levels over the sample period. Vertical bars indicate 95% confidence intervals. Standard errors are robust to clustering at the municipality level.

Reduced-form effects on Local Public Goods



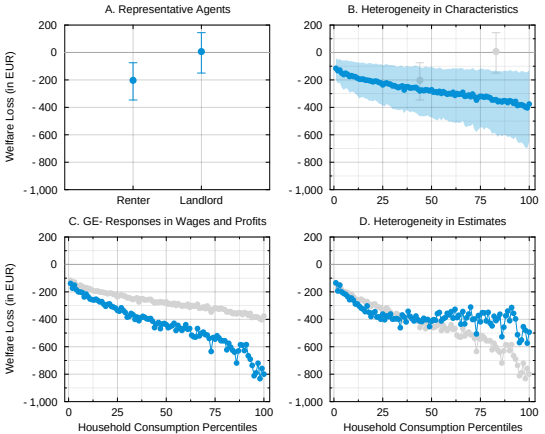
Notes: This figure illustrates the estimated treatment effect of a one percentage point increase in the property tax rate on two measures of local public goods (the property tax revenues and the municipal expenses) relative to the pre-reform year. The underlying econometric model is described in equations (2) and (3). The specification accounts for lags in the local business tax rate and MSA-by-year fixed effects. Observations are weighted by average population levels over the sample period. Vertical bars indicate 95% confidence intervals. Standard errors are robust to clustering at the municipality level.

Effect of Property Taxes on Municipal Finances



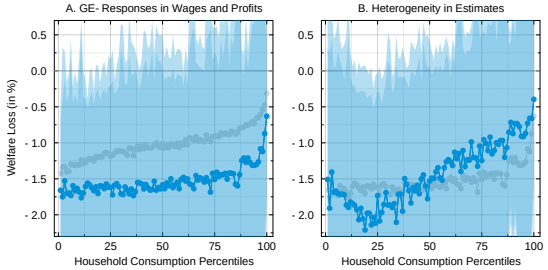
Notes: This figure illustrates the estimated treatment effect of a one percentage point increase in the property tax rate on municipal revenues and expenditures relative to the pre-reform year. The underlying econometric model is described in equations (2) and (3). All specifications also account for leads and lags in the local business tax rate and MSA-by-year fixed effects. Observations are weighted by average population levels over the sample period. Vertical bars indicate 95% confidence intervals. Standard errors are robust to clustering at the municipality level.

Simulation Results: Absolute Welfare Effects of Property Taxes



Notes: This figure illustrates average absolute money-metric utility changes for each percentile along the consumption distribution (in euro per year). Starting from a stylized benchmark case presented in Panel A, we introduce more heterogeneity in our welfare simulations step-by-step as we move to Panel-D: Panel A reports welfare in a partial-equilibrium model with two representative agents (landlords and renters). Panel B additionally accounts for differences in the numbers of these two agents, their different positions in the consumption distribution, and their housing expenditures; Panel C additionally introduces general equilibrium effects on the labor market (via wage and business income effects); Panel D additionally allows for heterogeneity in price effects of rents and wages. The gray coefficients/dots indicate the estimates from the previous panel to improve comparability. We simulate these changes for each household in the German Income and Expenditure Survey (EVS, 2013); Section ?? provides more details on the empirical implementation. The curves are based on average changes within percentiles of the consumption distribution across households using sampling weights and the OECD-modified equivalence scale. Shaded blue areas and vertical bars correspond to empirical 95% confidence bounds using 1,000 bootstrap replications.

Additional Inference Tests



Notes: This figure illustrates the relative welfare consequences of a one percentage point increase in the local property tax over the household consumption distribution (in percent). We calculate relative welfare losses as money-metric utility changes in euro per year divided by annual household consumption. Absolute welfare changes are depicted in Appendix Figure 32. This graph complements Panels C and D of Figure ?? by depicting empirical 90 and 95% confidence bounds using 1,000 bootstrap replications (darker and lighter blue shaded areas). See the original figure notes for details on the simulation.

- Relatively large standard errors on business income estimate (small sample) leads to large CIs in simulation
- Bootstrap inference on distributional effects: 987/1000 replications yield a regressive pattern (positive slope) when adding GE effects

Model – Workers (=Tenants)

- Choose city c where they supply one unit of labor, earning wage w_c
- Maximize over (homogeneous) housing h & composite good x
- Pay rental price r and local property tax $\tau_c = (1 + t_c)$
- Utility also depends on a city-specific consumption amenities with exogenous part, $\overline{A}_c$ and an endogenous local public good G_c, financed out of property tax revenues
- Indirect worker utility:

$$V_{ic}^H = a_0 + (1 - \delta) \left[\ln w_c - \alpha \ln r_c^H - \alpha \ln \tau_c \right] + \ln \overline{A}_c + \delta \ln G_c + \ln e_{ic}$$

- Have a individual-location specific idiosyncratic preference $e_{ic} \sim$ EV-I with scaling parameter σ^W
- Set-up gives rise to conditional logit model, which yields labor supply N_c^S and housing demand H_c^D

Model – Firms

- Firms operate under monopolistic competition and locate in a city c (Suárez Serrato and Zidar, 2016)
- Produce a trabable output good Y_{jc} using labor N_{jc} and commercial floor space M_{jc}
- Firm profits in city c depend on
  - city-specific production amenities B_c
  - firm-city specific productivity $\omega_{jc} \sim$ EV-I with scaling parameter σ^F
- Firms pay a property tax $\kappa\tau_c$, with $\kappa \geq 0$
- Firm value:

$$\Pi_{jc}^F = b_0 + \ln B_c - \beta \ln w_c - (1-\beta) \ln r_c^M - (1-\beta) \ln(\tau_c \kappa) + \omega_{jc}$$

- Set-up gives rise to conditional logit model, which yields aggregate labor demand N_c^D and aggregate commercial floor space demand M_c^D

Model – Construction Sector

- Competitive construction sector, producing residential and commercial floor space, $S_c = H_c + M_c$
- In equilibrium, arbitrage condition between two types of floor space, such that $r_c^M = \phi r_c^H$ with $\phi \geq 1$ capturing stricter regulations, and $H_c = \mu S_c$ (Ahlfeldt et al., 2015)
- Cobb-Douglas constant returns production function with land L_c and capital K_c as inputs (Epple et al., 2010)

$$S_c = H_c + M_c = L_c^{\gamma} K_c^{1-\gamma}$$

- Profit maximization yields land demand L_c^D and capital demand K_c

Model – Land Owners (and Capitalists)

- Standard assumption: land owners are absent, i.e., income from land not spent within city (Kline and Moretti, 2014, Ahlfeldt et al., 2015, Diamond, 2016)
- Land supply is given by simple function $\ln L_c = \theta \ln l_c$ with supply elasticity $\theta > 0$ and land price l_c
- Capital is traded at the world market so supply is perfectly elastic with fixed price s

Model – Local Governments

- Municipal government may use property tax revenues to finance local public good G_c
- For now, we assume the PG only affects consumptive amenities A_c
- For simplicity, assume $r_c^H = r_c^M, \kappa = 1$
- Given share ψ of property tax revenues spent on local public good, rest distributed lump-sum
- Budget constraint

$$G_c = \psi(H_c + M_c) r_c^H t_c = \psi S_c r_c^H t_c$$

Model – Example: Effect of property taxes on rents

- Zoom in on effect of a property tax increase on rents

$$\frac{d \ln r_c^{H*}}{d \ln \tau_c} = \frac{\frac{d \ln H^D}{d \ln \tau_c}}{\frac{d \ln H^S}{d \ln r_c^H} - \frac{d \ln H^D}{d \ln r_c^H}}$$

- effective housing supply, $\frac{d \ln H^S}{d \ln r_c^H}$, accounts for equilibrium effects of land via output elasticity and supply elasticites of land (γ, θ)
- effective housing demand $\frac{d \ln H^D}{d \ln r_c^H}$ accounts for labor and commercial floor space equilibrium effects via location preferences of workers and firms (σ^W, σ^F), production technology (β), product demand (ρ)
- Standard textbook result: incidence determined by relative supply and demand elasticities

Model – Quantity Effects of the Property Tax Increase

$$\frac{d \ln H_c^*\left(\tau_c, G_c^*[\tau_c]\right)}{d \ln \tau_c} = \underbrace{\frac{\partial \ln H_c^*}{\partial \ln \tau_c}}_{<0} + \underbrace{\frac{\partial \ln H_c^*}{\partial \ln G_c^*}}_{>0} \frac{\partial \ln G_c^*}{\partial \ln \tau_c}$$

$$\frac{d \ln L_c^*\left(\tau_c, G_c^*[\tau_c]\right)}{d \ln \tau_c} = \underbrace{\frac{\partial \ln L_c^*}{\partial \ln \tau_c}}_{<0} + \underbrace{\frac{\partial \ln L_c^*}{\partial \ln G_c^*}}_{>0} \frac{\partial \ln G_c^*}{\partial \ln \tau_c}$$

$$\frac{d \ln N_c^*\left(\tau_c, G_c^*[\tau_c]\right)}{d \ln \tau_c} = \underbrace{\frac{\partial \ln N_c^*}{\partial \ln \tau_c}}_{<0} + \underbrace{\frac{\partial \ln N_c^*}{\partial \ln G_c^*}}_{>0} \frac{\partial \ln G_c^*}{\partial \ln \tau_c}$$

References I

Ahlfeldt, G. M., Redding, S. J., Sturm, D. M. and Wolf, N. (2015). The Economics of Density: Evidence From the Berlin Wall, *Econometrica* **83**(6): 2127–2189.

Albouy, D. (2009). The Unequal Geographic Burden of Federal Taxation, *Journal of Political Economy* **117**(4): 635–667.

Alesina, A., Favero, C. and Giavazzi, F. (2015). The output effect of fiscal consolidation plans, *Journal of International Economics* **96**: S19–S42.

Baskaran, T. (2014). Identifying Local Tax Mimicking With Administrative Borders and a Policy Reform, *Journal of Public Economics* **118**: 41–51.

Bayer, P., Ferreira, F. and McMillan, R. (2007). A Unified Framework for Measuring Preferences for Schools and Neighborhoods, *Journal of Political Economy* **115**(4): 588–638.

Bickerdike, C. F. (1902). Taxation of Site Values, *Economic Journal* **12**(48): 472–484.

Borusyak, K., Javarel, X. and Spiess, J. (2023). Revisiting Event Study Designs: Robust and Efficient Estimation, *Review of Economic Studies* **forthcoming**.

Boustan, L. P. (2013). Local Public Goods and the Demand for High-Income Municipalities, *Journal of Urban Economics* **76**(3): 71–82.

Bradbury, K. L., Meyer, C. J. and Case, K. E. (2001). Property Tax Limits, Local Fiscal Behavior, and Property Values: Evidence from Massachusetts Under Proposition 2 1/2, *Journal of Public Economics* **80**(2): 287–311.

Brülhart, M., Danton, J., Parchet, R. and Schläpfer, J. (2024). Who Bears the Burden of Local Taxes?, *American Economic Journal: Economic Policy* (forthcoming).

Buettner, T. (2003). Tiebout Visits Germany: Land Tax Capitalization in a Sample of German Municipalities.

Carroll, R. J. and Yinger, J. (1994). Is The Property Tax a Benefit Tax? The Case of Rental Housing, *National Tax Journal* **47**(2): 295–316.

Cellini, S. R., Ferreira, F. and Rothstein, J. (2010). The Value of School Facility Investments: Evidence from a Dynamic Regression Discontinuity Design, *The Quarterly Journal of Economics* **125**(1): 215–261.

References II

Chetty, R. (2009). Sufficient Statistics for Welfare Analysis: A Bridge Between Structural and Reduced-Form Methods, *Annual Review of Economics* **1**: 451–488.

de Bartolomé, C. A. M. and Rosenthal, S. S. (1999). Property Tax Capitalization in a Model with Tax-Deferred Assets, Standard Deductions, and the Taxation of Nominal Interest, *Review of Economics and Statistics* **81**(1): 85–95.

de Chaisemartin, C. and D'Haultfœuille, X. (2020). Two-Way Fixed Effects Estimators with Heterogeneous Treatment Effects, *American Economic Review* **110**(9): 2964–96.

de Chaisemartin, C. and D'Haultfœuille, X. (2024). Difference-in-Differences Estimators of Intertemporal Treatment Effects, *The Review of Economics and Statistics* pp. 1—-45.

Diamond, R. (2016). The Determinants and Welfare Implications of US Workers' Diverging Location Choices by Skill: 1980–2000, *American Economic Review* **106**(3): 479–524.

Dusansky, R., Ingber, M. and Karatjas, N. (1981). The Impact of Property Taxation on Housing Values and Rents, *Journal of Urban Economics* **10**(2): 240–255.

Edgeworth, F. Y. (1897). The Pure Theory of Taxation, *Economic Journal* **7**(25): 46–70.

Egger, P., Koethenbuerger, M. and Smart, M. (2010). Do Fiscal Transfers Alleviate Business Tax Competition? Evidence from Germany, *Journal of Public Economics* **94**: 235–246.

Epple, D., Gordon, B. and Sieg, H. (2010). A New Approach to Estimating the Production Function for Housing, *American Economic Review* **100**(3): 905–924.

Epple, D., Romer, T. and Sieg, H. (2001). Interjurisdictional Sorting and Majority Rule: An Empirical Analysis, *Econometrica* **69**(9): 1437–1454.

EVS (2013). Income and Expenditure Survey – Einkommens- und Verbrauchsstichprobe, Research Data Center of the Federal Statistical Office and Statistical Offices of the Länder.

Fajgelbaum, P. D. and Gaubert, C. (2020). Optimal Spatial Policies, Geography, and Sorting, *Quarterly Journal of Economics* **135**(2): 959–1036.

References III

Fajgelbaum, P. D., Morales, E., Suárez Serrato, J. C. and Zidar, O. (2019). State Taxes and Spatial Misallocation, *Review of Economic Studies* **86**(1): 333–376.

Ferreira, F. (2010). You Can Take It With You: Proposition 13 Tax Benefits, Residential Mobility, and Willingness to Pay for Housing Amenities, *Journal of Public Economics* **94**(9–10): 661–673.

Fischel, W. A. (1992). Property Taxation and The Tiebout Model: Evidence for the Benefit View From Zoning and Voting, *Journal of Economic Literature* **30**(1): 171–177.

Fuest, C., Peichl, A. and Siegloch, S. (2018). Do Higher Corporate Taxes Reduce Wages? Micro Evidence from Germany, *American Economic Review* **108**(2): 393–418.

Glaeser, E. L. (2009). The Death and Life of Cities, *in* R. P. Inman (ed.), *Making Cities Work: Prospects and Policies for Urban America*, Princeton University Press, pp. 22–62.

Guajardo, J., Leigh, D. and Pescatori, A. (2014). Expansionary austerity? international evidence, *Journal of the European Economic Association* **12**(4): 949–968.

Hamilton, B. W. (1976). Capitalization of Intrajurisdictional Differences in Local Tax Prices, *American Economic Review* **66**(5): 743–753.

Heinberg, J. D. and Oates, W. E. (1970). The Incidence of Differential Property Taxes on Urban Housing: A Comment and Some Further Evidence, *National Tax Journal* **23**(1): 92–98.

Hyman, D. N. and Pasour, E. C. J. (1973). Property Tax Differentials and Residential Rents in North Carolina, *National Tax Journal* **26**(2): 303–307.

Kleven, H. (2021). Sufficient Statistics Revisited, *Annual Review of Economics* **13**(1): 515–538.

Kline, P. (2010). Place Based Policies, Heterogeneity, and Agglomeration, *American Economic Review: Papers and Proceedings* **100**(2): 383–387.

Kline, P. and Moretti, E. (2014). People, Places, and Public Policy: Some Simple Welfare Economics of Local Economic Development Programs, *Annual Review of Economics* **6**(1): 629–662.

References IV

Lichter, A., Löffler, M., Isphording, I., Nguyen, T.-V., Poege, F. and Siegloch, S. (2024). Profit Taxation, R&D Spending, and Innovation, *American Economic Journal: Economic Policy* (forthcoming).

Lutz, B. (2015). Quasi-Experimental Evidence on the Connection between Property Taxes and Residential Capital Investment, *American Economic Journal: Economic Policy* **7**(1): 300–330.

Lyytikäinen, T. (2009). Three-Rate Property Taxation and Housing Construction, *Journal of Urban Economics* **65**(3): 305–313.

Marshall, A. (1890). *Principles of Economics*, 8th edn, MacMillan and Co., London.

Mieszkowski, P. (1972). The Property Tax: An Excise Tax Or a Profits Tax?, *Journal of Public Economics* **1**(1): 73–96.

Mieszkowski, P. and Zodrow, G. R. (1989). Taxation and The Tiebout Model: The Differential Effects of Head Taxes, Taxes on Land Rents, and Property Taxes, *Journal of Economic Literature* **27**(3): 1098–1146.

Moretti, E. (2011). Local Labor Markets, *in* O. Ashenfelter and D. Card (eds), *Handbook of Labor Economics*, Vol. 4B, North-Holland, pp. 1237–1313.

Netzer, D. (1966). *Economics of the Property Tax*, Brookings Institution, Washington, DC.

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* **77**(6): 957–971.

Oates, W. E. and Fischel, W. A. (2016). Are Local Property Taxes Regressive, Progressive, Or What?, *National Tax Journal* **69**(2): 415–434.

Orr, L. L. (1968). The Incidence of Differential Property Taxes on Urban Housing, *National Tax Journal* **21**(3): 253–262.

Orr, L. L. (1970). The Incidence of Differential Property Taxes: A Response, *National Tax Journal* **23**(1): 99–101.

Orr, L. L. (1972). The Incidence of Differential Property Taxes on Urban Housing: Reply, *National Tax Journal* **25**(2): 217–220.

Oster, E. (2019). Unobservable Selection and Coefficient Stability: Theory and Evidence, *Journal of Business & Economic Statistics* **37**(2): 187–204.

Palmon, O. and Smith, B. A. (1998). New Evidence on Property Tax Capitalization, *Journal of Political Economy* **106**(5): 1099–1111.

References V

Rauch, A. and Hummel, C.-A. (2016). How to Stop the Race to the Bottom – Empirical Evidence from North Rhine-Westphalia, *International Tax and Public Finance* **23**: 911–933.

Redding, S. J. and Rossi-Hansberg, E. (2017). Quantitative Spatial Economics, *Annual Review of Economics* **9**: 21–58.

Roback, J. (1982). Wages, Rents, and the Quality of Life, *Journal of Political Economy* **90**(6): 1257–1278.

Romer, C. D. and Romer, D. H. (2010). The macroeconomic effects of tax changes: Estimates based on a new measure of fiscal shocks, *American Economic Review* **100**(3): 763–801.

Rosen, S. (1979). Wage-Based Indexes of Urban Quality of Life, *in* P. Mieszkowski and M. Straszheim (eds), *Current Issues in Urban Economics*, Johns Hopkins University Press, Baltimore, pp. 74–104.

Saez, E. and Stantcheva, S. (2016). Generalized Social Marginal Welfare Weights for Optimal Tax Theory, *American Economic Review* **106**(1): 24–45.

Schmidheiny, K. and Siegloch, S. (2023). On Event Studies and Distributed-Lags in Two-Way Fixed Effects Models: Identification, Equivalence, and Generalization, *Journal of Applied Econometrics* **38**(5): 695–713.

Schönholzer, D. and Zhang, C. (2017). Valueing Local Public Goods using Municipal Annexations, *mimeo* .

Shan, H. (2010). Property Taxes and Elderly Mobility, *Journal of Urban Economics* **67**(6): 194–205.

Simon, H. A. (1943). The Incidence of a Tax on Urban Real Property, *Quarterly Journal of Economics* **57**(3): 398–420.

Suárez Serrato, J. C. and Wingender, P. (2016). Estimating the Incidence of Government Spending, *Working Paper* .

Suárez Serrato, J. C. and Zidar, O. (2016). Who Benefits from State Corporate Tax Cuts? A Local Labor Market Approach with Heterogeneous Firms, *American Economic Review* **106**(9): 2582–2624.

Sun, L. and Abraham, S. (2021). Estimating Dynamic Treatment Effects in Event Studies with Heterogeneous Treatment Effects, *Journal of Econometrics* **225**(2): 175–199.

Tiebout, C. M. (1956). A Pure Theory of Local Expenditures, *Journal of Political Economy* **64**(5): 416–424.

Zodrow, G. R. (2001a). Reflections on the New View and the Benefit View, *in* W. E. Oates (ed.), *Property Taxation and Local Government Finance*, Lincoln Institute of Land Policy, Cambridge, Massachusetts, pp. 79–111.

Zodrow, G. R. (2001b). The Property Tax as a Capital Tax: A Room with Three Views, *National Tax Journal* **54**(1): 139–156.

Zucman, G. (2015). Taxing across Borders: Tracking Personal Wealth and Corporate Profits, *Journal of Economic Perspectives* **28**(4): 121–148.