The Tax Elasticity of Capital Gains and Revenue-Maximizing Rates

Ole Agersnap
Princeton University

Owen Zidar
Princeton University, NBER

December 22, 2020

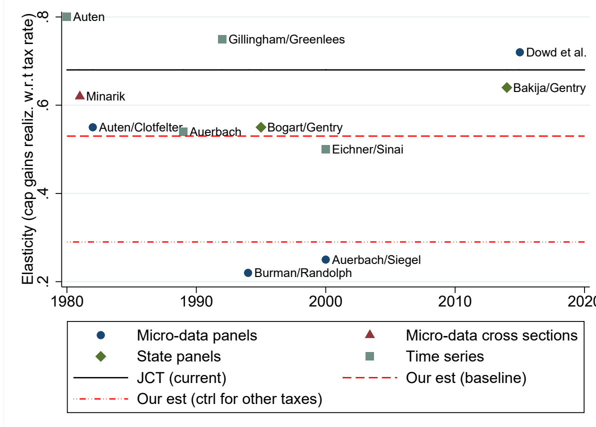
Appendices for Online Publication

This document contains several sections, all of which provide additional detail for readers of "The Tax Elasticity of Capital Gains and Revenue-Maximizing Rates". Section A provides supplemental figures and tables. Section B provides a detailed overview of our data sources and adjustments we make to the data in our analysis. Section C describes the differences between our approach and estimation using semi-logs. Section D details several simulation exercises we conduct to test whether our methods are biased. Section E provides a derivation for our main theoretical model.

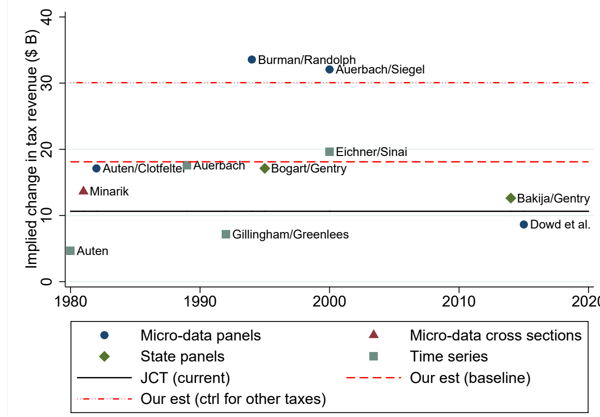
A Appendix Figures

Figure A.1: Estimates from the Capital Gains Literature

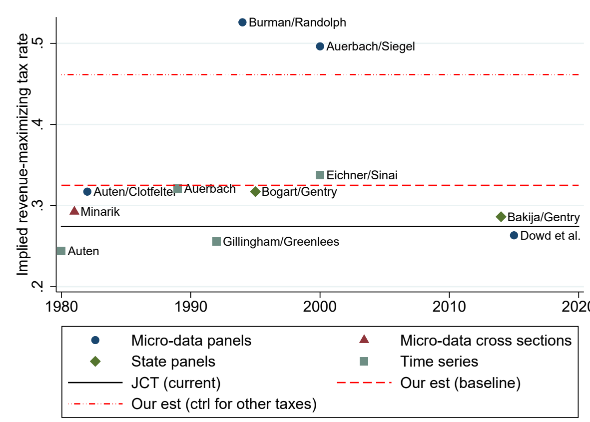
(a) Elasticities



(b) Revenue from 5 pp tax increase

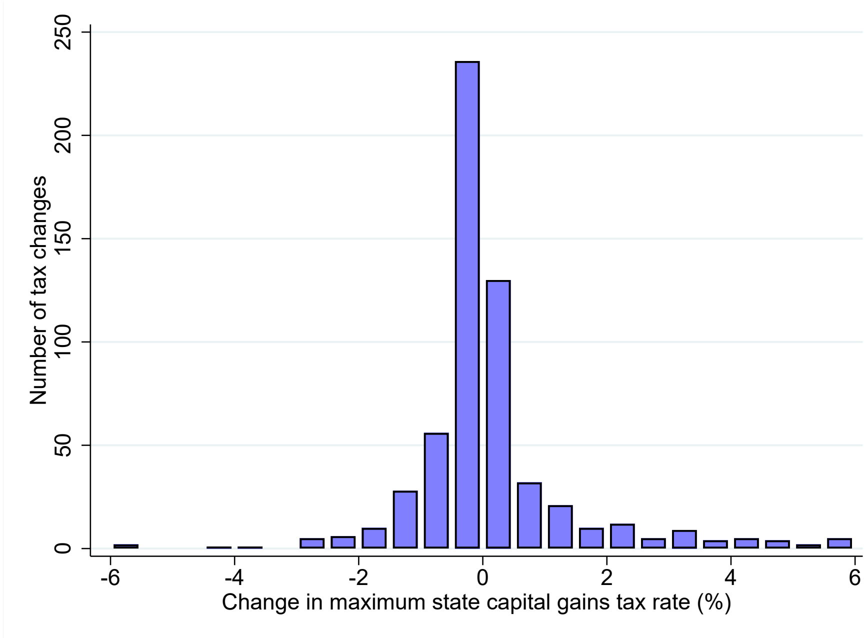


(c) Revenue-maximizing tax rate



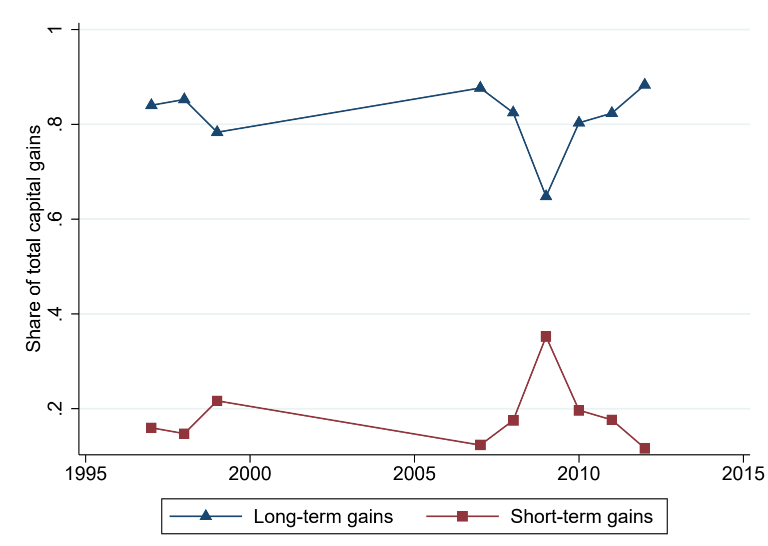
Notes: This figure compares our results with those from the previous literature on capital gains. With the exception of Dowd, McClelland and Muthitacharoen (2015), the elasticities reported in panel (a) are calculated with respect to a tax rate of 22% and are taken from Tables 1 and B-1 from Gravelle (2020). The relevant marginal tax rates in the Dowd et al. paper are those in place between 1999 and 2008, which average around 17 percent. The tax increase analyzed in panel (b) is a 5 percentage point increase, from 17.8% (the effective federal capital gains tax rate in 2018) to 22.8%, assuming that realizations and revenues begin at their 2018 levels ($891 B and $158 B respectively). We calculate revenue-maximizing rate using equation (6) from the text, using an average state tax rate of 6.4% (its 2016 population-weighted value).

Figure A.2: Histogram of State Capital Gains Tax Rate Changes



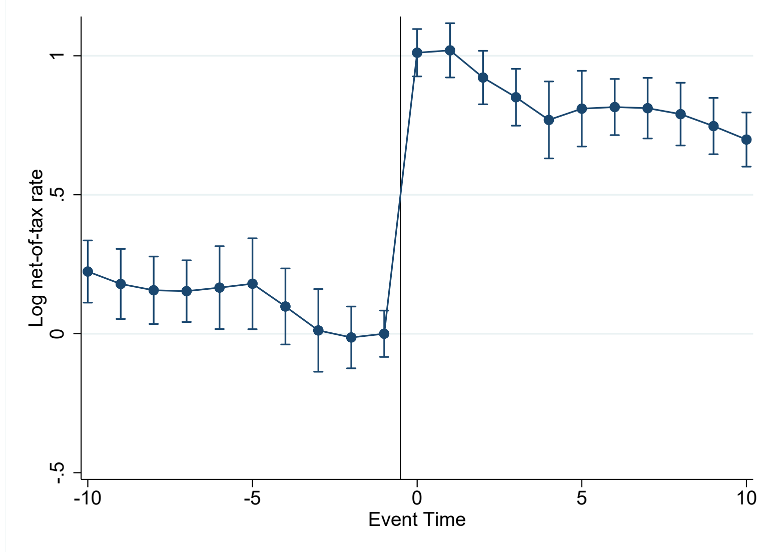
Notes: This figure shows the distribution of the size of changes in the top state capital gains tax rate throughout our panel, including changes to the statutory tax rate as well as deductibility and other minor provisions of the tax code. It has been censored at 6%, so tax changes of more than 6 percentage points in absolute value appear in the left- or rightmost bin in this figure. The figure does not include state-years where the tax rate stayed the same, i.e. changed by 0.

Figure A.3: Long- and short-term share of capital gains



Notes: Data from the IRS SOI series "Short-term and Long-term Capital Gains and Losses" classified by size of adjusted gross income and selected asset type (accessible at `https://www.irs.gov/statistics/soi-tax-stats-sales-of-capital-assets-reported-on-individual-tax-returns`). More precisely, the long-term gain series corresponds to total gains reported in returns with long-term gain transactions. The short-term gain series corresponds to total gains reported in returns with short-term gain transactions. We calculate total capital gains as the sum of these two series. We use cross-sectional data, which are available for 1985, 1997-1999, and 2007-2012. Although panel data are available for 1999-2007, the IRS warns that extrapolations from the panel to the general population should be made with "extreme caution". Due to the IRS' warning, we have omitted data for these years.

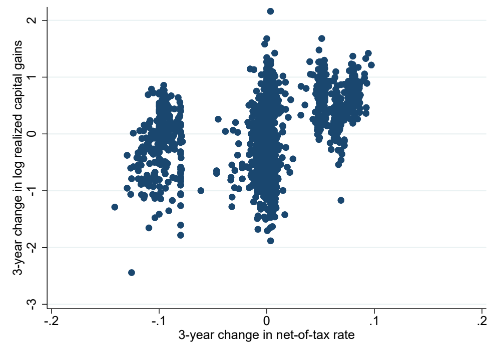
Figure A.4: The Effect of Net-of-Tax Rate Changes on the Net-of-Tax Rate over Time



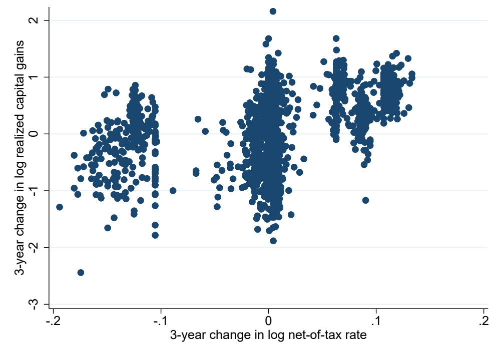
Notes: This figure uses our direct projections framework from equation (1), but with the outcome variable being the net-of-tax rate itself, and excluding the controls for capital gains tax reforms in other years. This creates a specification where the treatment effect from time -1 to time 0 is 1 by construction, but where the point estimates in other years show the degree of mean reversion in tax rates. A decline in point estimates following the initial jump indicates mean reversion, as states that lower tax rates tend to partially revert back towards higher tax rates over time and vice versa. The estimated coefficients are normalized to equal 0 at time -1. Standard errors are clustered at the state level.

Figure A.5: Scatterplots, 3-year Changes in Log Capital Gains, Net-of-Tax Rate, and Log Net-of-Tax Rate

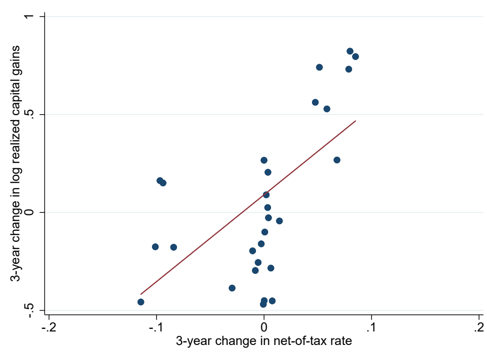
(a) Log capital gains and net-of-tax rate



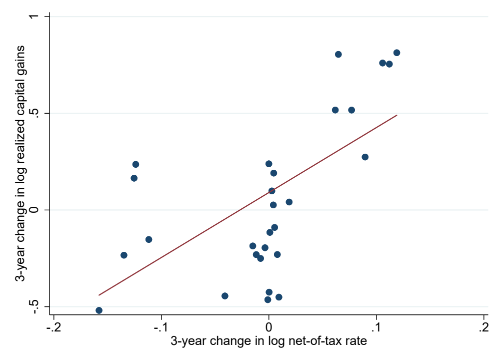
(b) Log capital gains and log net-of-tax rate



(c) Binscatter, log capital gains and net-of-tax rate



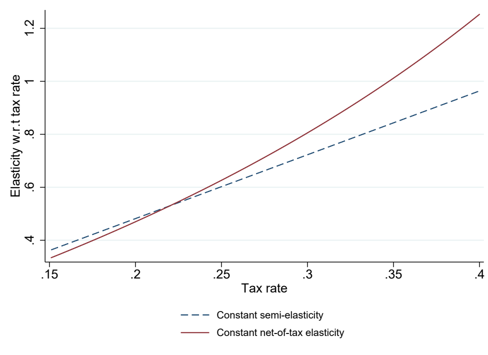
(d) Binscatter, log capital gains and log net-of-tax rate



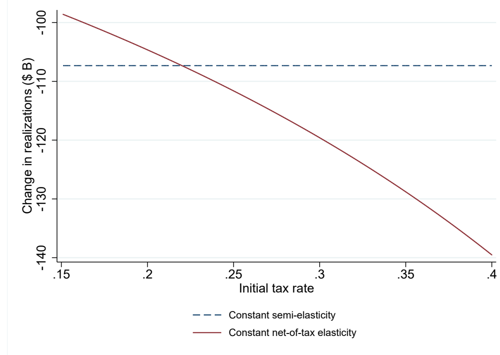
Notes: This figure shows two scatterplots of our state-year data on tax rates and realized capital gains, as well as corresponding binned scatterplots. In all plots, the variable on the vertical axis is the three-year change in log realized capital gains (2018 dollars). In the plots on the left, the variable on the horizontal axis is the three-year change in the net-of-tax rate by state (using the maximum combined federal and state capital gains tax rate, as we describe in section 2), while in the plots on the right, the horizontal axis shows the three-year change in the log net-of-tax rate. The plots in the top row are standard scatterplots, while the plots in the bottom row are the corresponding binned scatter plots, using 30 bins. The regression corresponding to the line of best fit in the scatterplot in panel (c) has an R^2 of 0.1304, and in panel (b) the R^2 is 0.1352.

Figure A.6: Comparing Elasticity Assumptions

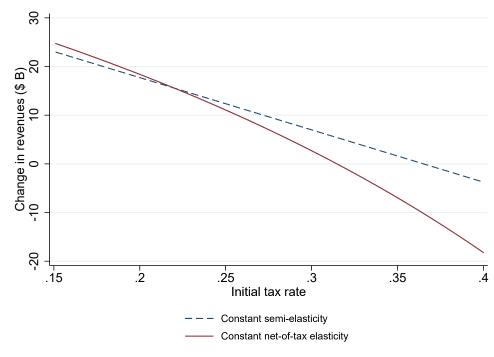
(a) Elasticities



(b) Realizations



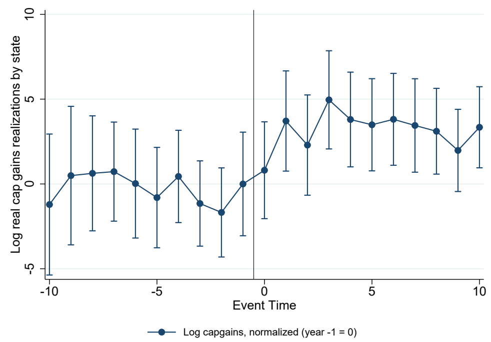
(c) Revenues



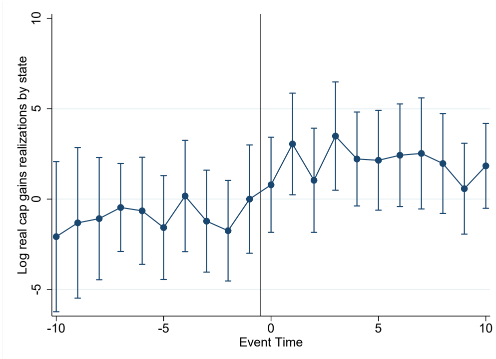
Notes: This figure supplements the discussion in section 3.1 of models of capital gains realizations that either assume a constant semi-elasticity (models of the form $\log CG_t = \gamma \cdot \tau_t$), or a constant net-of-tax elasticity (of the form $\log CG_t = \delta \cdot \log(1 - \tau_t)$). We here show some implications of these models at various tax rates when either the semi-elasticity or the net-of-tax elasticity is assumed to be constant for all tax rates. All calculations are based on a tax rate elasticity of 0.53 at 22%, corresponding to a semi-elasticity of 2.41 and a net-of-tax rate elasticity of 1.88. Panel (a) shows, at each given tax rate, what is obtained when converting the semi-elasticity or net-of-tax elasticity to an elasticity with respect to the tax rate. We also evaluate the implications of both models for realizations (panel b) and tax revenue (panel c) under a 5 percentage point tax increase relative to the tax rate on the horizontal axis. We assume initial realizations equal to $891 billion regardless of starting tax rate. This figure is equal to net capital gains realizations in 2018 according to data from Piketty, Saez and Zucman (2018). Total tax rates observed in our data range from 0.15 to 0.37, comparable to the range of rates presented here.

Figure A.7: The Effect of Net-of-Tax Rate Changes on Capital Gains Realizations, by Specification

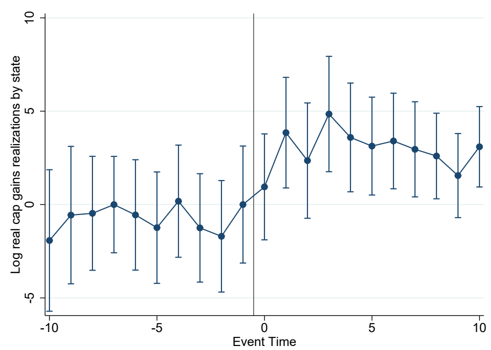
(a) Control for GDP



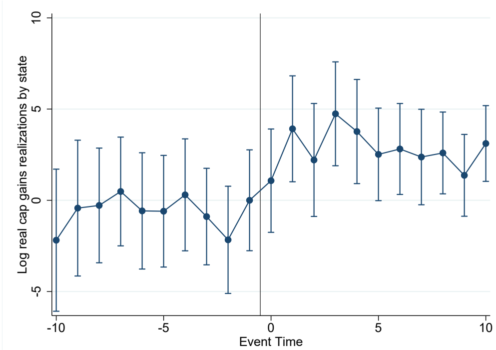
(b) Control for GDP growth*year



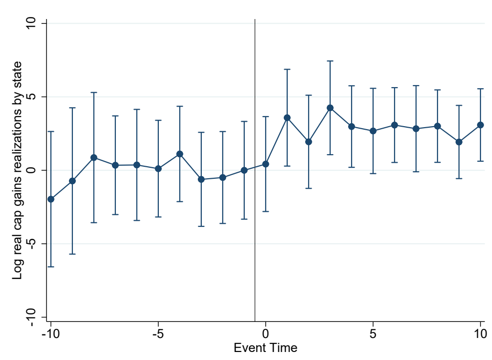
(c) Control for unemployment



(d) Large reforms only

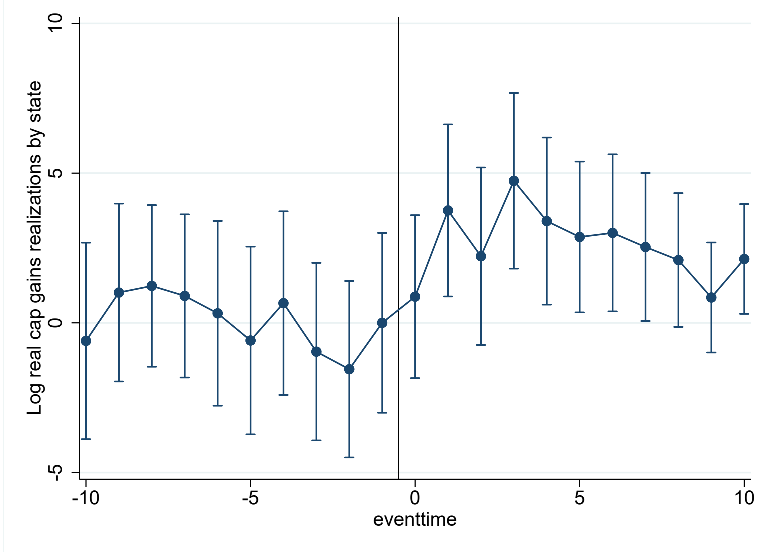


(e) Control for other taxes



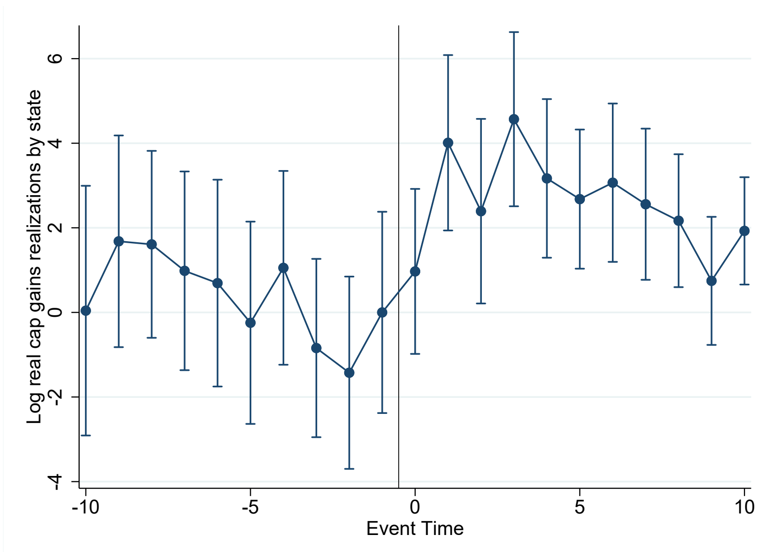
Notes: This figure shows the five series from panel (b) of Figure 2 individually. Panel (a) in this figure controls linearly for GDP in the year before the reform; panel (b) controls for a set of dummies interacting GDP growth tertiles and years, where the GDP growth tertile is determined separately in each year by grouping states according to GDP growth over the three years prior to the reform; panel (c) controls for the unemployment rate in the year prior to the capital gains tax reform. Panel (d) uses a specification that interacts the variable for changes in the net-of-tax rate with indicators for reforms greater or smaller than 1 percentage point in magnitude – the reported point estimates are for the interaction with the large reform dummy, such that the effects shown in this panel are idetified only from larger reforms. Panel (e) includes controls for changes in the state personal income and corporate tax rates in each year from 10 years before until 10 years after the capital gains reform. In all cases, we plot the estimated coefficients for the impact of a one-period change in the total (federal and state) log net-of-tax capital gains tax rate on log capital gains realizations. Capital gains are in real terms and standard errors are clustered at the state level. Estimates have been normalized to 0 in period -1. We include state and year fixed effects.

Figure A.8: Baseline Specification as Event Study



Notes: This figure shows a variation of our baseline graph in Figure 2 that uses a classic event study specification in which all plotted coefficients are estimated within the same single regression rather than the direct projections approach. The specification used is $y_{s,t} = \sum_{h=-10}^{10} \beta_h \Delta \log\left(1 - \tau_{s,t-h}\right) + \gamma_s + \phi_t + \varepsilon_{s,t}$ (where Δ indicates a one-period change), and the figure plots the point estimates for $\beta_{-10}, \beta_{-9}, \ldots, \beta_{10}$. Capital gains are in real terms and the estimated coefficients are normalized to equal 0 at time -1. Standard errors are clustered at the state level.

Figure A.9: The Effect of Net-of-Tax Rate Changes on Capital Gains Realizations – No Controls for Other Capital Gains Tax Reforms

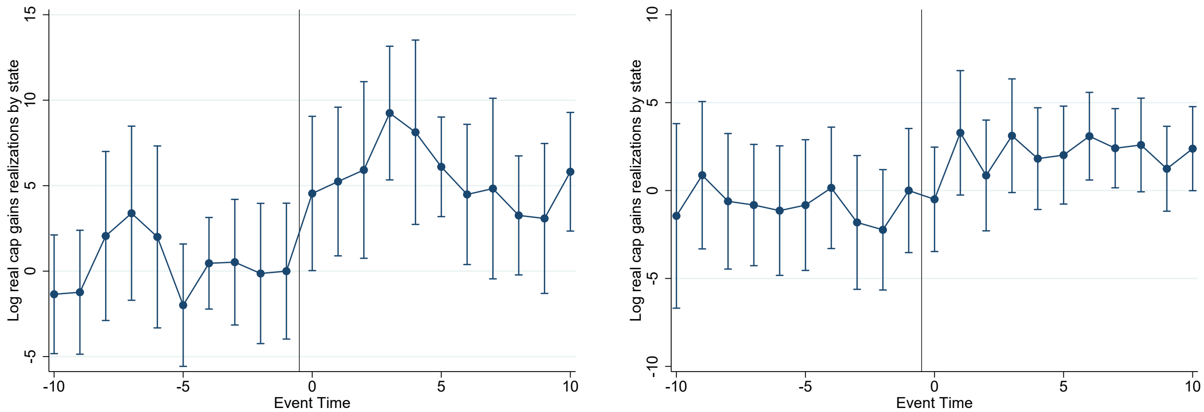


Notes: This figure is analogous to panel (a) of Figure 2, but without controls for other changes in the capital gains tax rate before and after the reform of interest. Realized capital gains are in real terms, and the estimated coefficients are normalized to equal 0 at time -1. Standard errors are clustered at the state level.

Figure A.10: The Effect of Net-of-Tax Rate Changes on Capital Gains Realizations – Tax Cuts and Increases

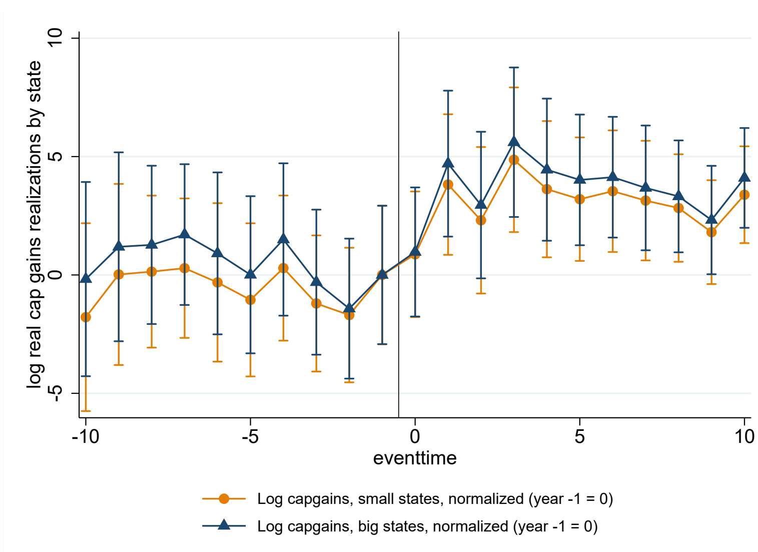
(a) Tax cuts only

(b) Tax increases only



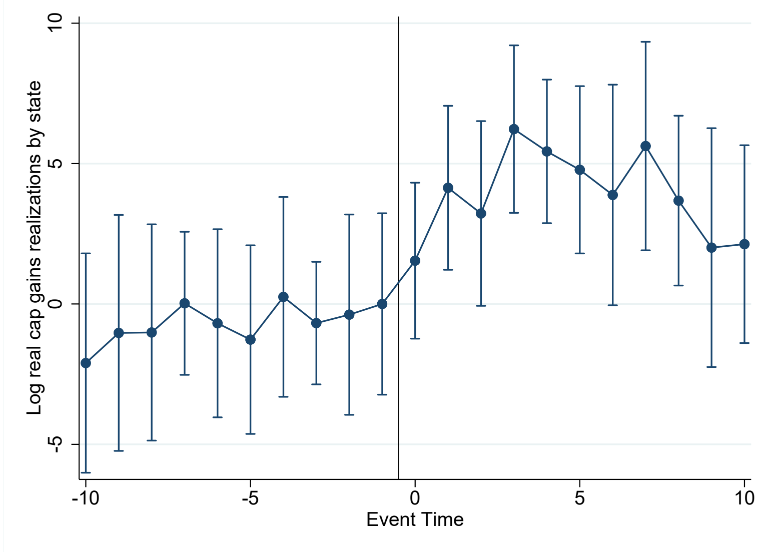
Notes: This figure is analogous to panel (a) of Figure 2, but shows the effects of tax cuts and tax increases separately. Specificatlly, we modify the baseline specification in equation (1) by estimating separate coefficients for tax increases and decreases, i.e., we use the specification $y_{s,t+h} = \beta_h^{cut} \times \mathbf{1}(\Delta\tau_{s,t} < 0) \times \Delta \log(1-\tau_{s,t}) + \times \beta_h^{inc} \times \mathbf{1}(\Delta\tau_{s,t} > 0) \times \Delta \log(1-\tau_{s,t}) + \mathbf{X}'_{s,t}\mathbf{\Lambda}_h + \gamma_{s,h} + \phi_{t,h} + \varepsilon_{s,t,h}$, where $\mathbf{1}(\Delta\tau_{s,t} < 0)$ is an indicator for tax cuts, $\mathbf{1}(\Delta\tau_{s,t} > 0)$ is an indicator for tax increases, and β_h^{cut} and β_h^{inc} are the corresponding tax-change-direction-specific coefficients. Panel (a) reports the coeffcients $\{\beta_h^{cut}\}_{h=-10}^{10}$, and panel (b) reports $\{\beta_h^{inc}\}_{h=-10}^{10}$ from this specification. Realized capital gains are in real terms, and the estimated coefficients are normalized to equal 0 at time -1. Standard errors are clustered at the state level.

Figure A.11: The Effect of Net-of-Tax Rate Changes on Capital Gains Realizations in the 10 most populous states versus the rest



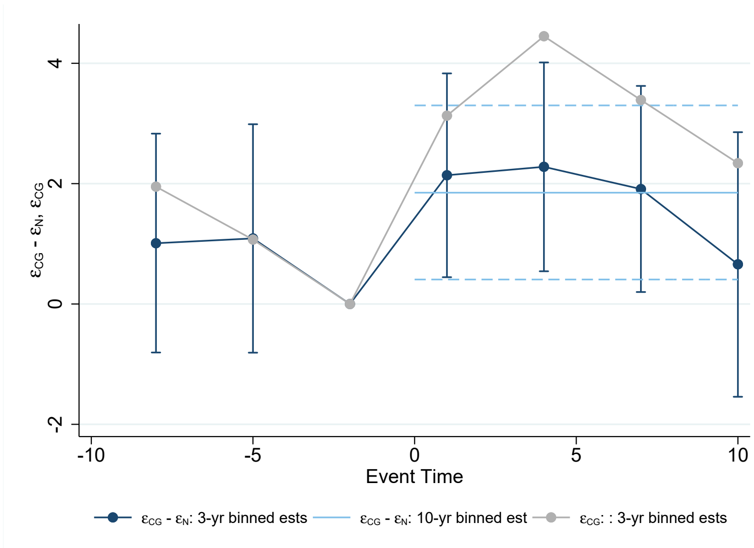
Notes: This figure is analogous to panel (a) of Figure 2, but interacts the main right-hand-side variable of interest with an indicator for belonging to the 10 most populous states, lagged by 10 years relative to the reform to avoid any potential confounding effects of recent population growth or decline. This thus creates two sets of treatment effects, one for larger and one for smaller states. Realized capital gains are in real terms, and the estimated coefficients are normalized to equal 0 at time -1. Standard errors are clustered at the state level.

Figure A.12: The Effect of Net-of-Tax Rate Changes on Capital Gains Realizations After 1990



Notes: This figure is analogous to panel (a) of Figure 2, but restricts the specification to only estimate the effects of reforms after 1990. We do use realizations data from prior to 1990 to estimate the pre-trend, and we also include reforms from before 1990 when in our set of controls for capital gains tax reforms in the years surrounding the reform of interest. Realized capital gains are in real terms, and the estimated coefficients are normalized to equal 0 at time -1. Standard errors are clustered at the state level.

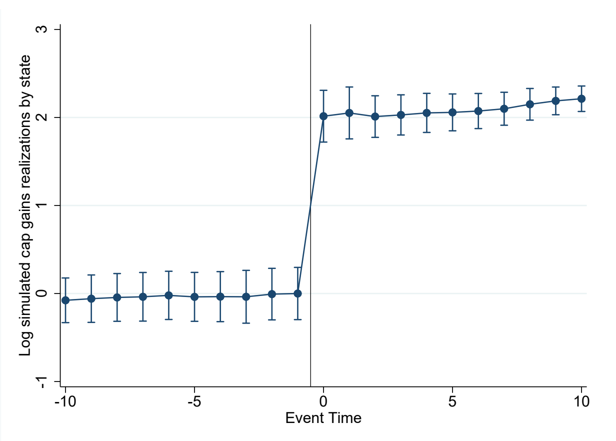
Figure A.13: Binned Elasticity Estimates, Event Study Specification



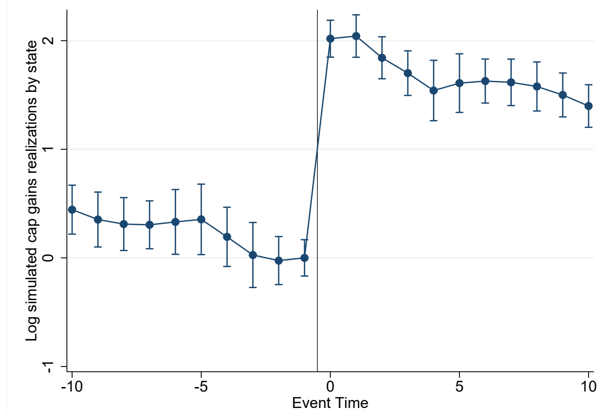
Notes: This figure is analogous to panel (c) of Figure 3, but uses an event study specification where elasticities at different horizons are estimated jointly within the same regression model rather than using separate regressions for each coefficient as in the direct projections case. Specifically, for the three-year bins, instead of equation 2, we run a single regression of the form $y_{s,t} = \beta_{-9}\Delta_3 \log(1-\tau_{s,t+9}) + \beta_{-6}\Delta_3 \log(1-\tau_{s,t+6}) + \cdots + \beta_9 \Delta_3 \log(1-\tau_{s,t-9}) + \gamma_s + \phi_t + \varepsilon_{s,t}$. Using capital gains realizations as the outcome variable, the grey line then plots elasticity estimates $\hat{\varepsilon}^{CG}$ as the difference between the coefficients $\beta_t - \beta{-}3$ from this regression. Migration elasticities $\hat{\varepsilon}^N$ are calculated correspondingly, using our migration variable from the main text as the outcome variable, and the dark blue line then plots the estimated policy-relevant elasticity, $\hat{\varepsilon}^R = \hat{\varepsilon}^{CG} - \hat{\varepsilon}^N$. For the estimates in the 0-10 year bin, we run a separate regression $y_{s,t} = \tilde{\beta}_{-9}\Delta_3 \log(1-\tau_{s,t+9}) + \tilde{\beta}_{-6}\Delta_3 \log(1-\tau_{s,t+6}) + \tilde{\beta}_{-3}\Delta_3 \log(1-\tau_{s,t+3}) + \tilde{\beta}_0 \Delta_{11} \log(1-\tau_{s,t}) + \tilde{\gamma}_s + \tilde{\phi}_t + \tilde{\varepsilon}_{s,t}$ and estimate the 0-10 year elasticity as the difference $\tilde{\beta}_0 - \tilde{\beta}_{-3}$. Standard errors are clustered at the state level.

Figure A.14: Estimating Effects of Simulated Tax Changes Assuming a Constant Elasticity

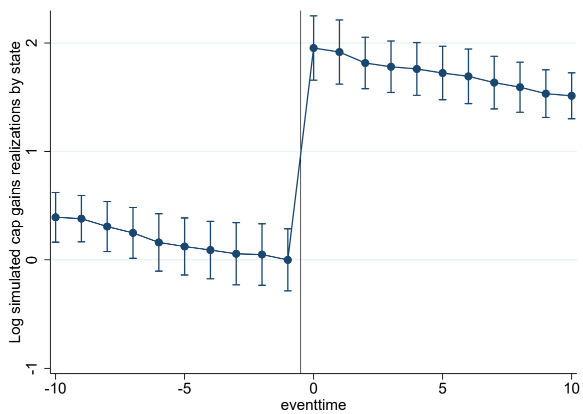
(a) Direct projection, control for reforms in surrounding years



(b) Direct projection, no controls for other reforms



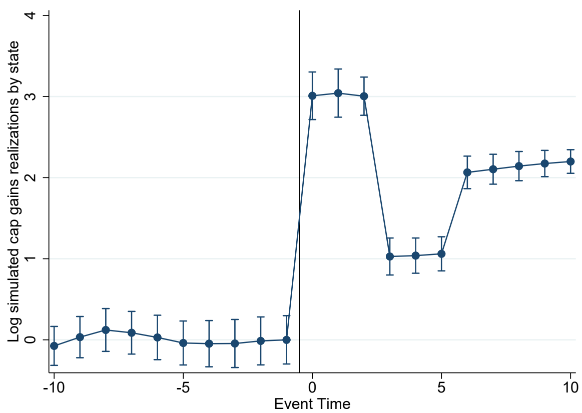
(c) Event study



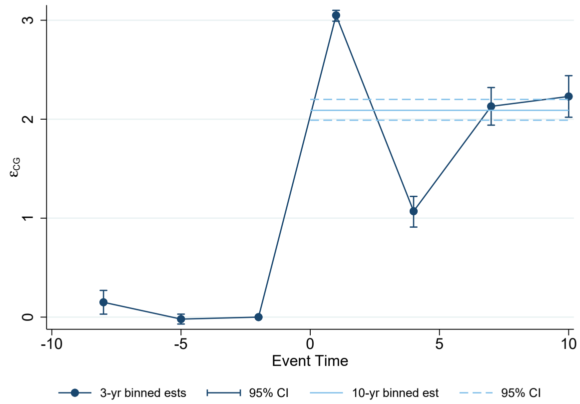
Notes: This figure shows the outcome of the simulation exercise detailed in Appendix Section D. We simulate a log capital gains realizations variable which is generated in such a way that it has a true empirical elasticity of 2 with respect to the net-of-tax rate, constant across all horizons. The figures use three different methods to estimate the impact of changes in the net-of-tax rate on this simulated outcome variable. Panel (a) shows the outcome of a direct projections estimation exactly as specified in equation (1), panel (b) shows the outcome of a similar specification that excludes the controls for tax reforms in other years, and panel (c) shows the outcome of an event study specification. Estimates have been normalized to 0 in period -1. We include state and year fixed effects. See Appendix Section D for further details.

Figure A.15: Estimating Effects of Simulated Tax Changes Assuming a Time-Varying Elasticity

(a) Direct projection, control for reforms in surrounding years



(b) 3-year and 10-year binned estimates



Notes: This figure shows the outcome of the simulation exercise detailed in Appendix Section D. Unlike Figure A.14, we here generate an outcome variable for which the true elasticity with respect to the net-of-tax rate is 3 in years 0-2 following the reform, 1 in years 3-5, and 2 in the following years. Panel (a) shows the outcome of a direct projections estimation exactly as specified in equation (1). Panel (b) shows the outcome of the estimation using binned specifications as outlined in section 2.2. We include state and year fixed effects. See Appendix Section D for further details.

Table A.1: Largest Capital Gains Tax Changes by State-Year

	Year	Δ tax rate	Post-change tax rate	Δ net of tax rate	Post-change net of tax rate
Largest tax decreases					
Oklahoma	2005	-7.97	0.19	5.19	83.83
Alaska	1980	-5.80	0.00	1.79	72.79
Rhode Island	2003	-4.46	4.82	2.67	75.82
Montana	2005	-3.84	6.11	2.50	79.98
New York	1978	-3.00	7.50	9.90	81.75
Vermont	2002	-2.99	5.20	1.81	75.65
Vermont	1994	-2.94	9.28	1.76	65.21
Kansas	1988	-2.84	3.87	1.34	69.21
Wisconsin	1984	-2.60	4.00	1.30	78.00
North Carolina	2014	-2.18	5.80	1.27	71.73
Largest tax increases					
Maine	1989	8.50	8.50	-6.12	65.88
Hawaii	2016	7.30	14.55	-4.51	66.50
Utah	1987	6.14	7.75	-11.96	67.23
Minnesota	1987	5.99	9.00	-12.03	66.46
District of Columbia	1987	5.60	10.00	-11.95	65.85
New Mexico	1987	5.38	8.50	-11.67	66.77
Idaho	1987	5.20	8.20	-11.54	66.96
Delaware	1987	4.92	8.80	-11.47	66.59
Kansas	1987	4.83	6.71	-11.19	67.87
Montana	2003	4.71	9.38	-3.12	72.86

Notes: This table shows the largest year-by-year changes in top marginal state capital gains tax rates, measured using TAXSIM and presented as percentages. Tax changes are relative to previous year.

Table A.2: Policy Regressions

	Tax Increases		Tax Decreases	
	Estimate	Standard Error	Estimate	Standard Error
Unemployment (t-1)	1.2372	0.4009	0.7959	0.5581
Unemployment (t-4)	0.2352	0.4537	-0.6874	0.5517
GDP per capita, USD 1000 (t-1)	-0.0000	0.0020	0.0080	0.0044
GDP per capita, USD 1000 (t-4)	-0.0014	0.0020	-0.0077	0.0044
Max. state income tax (t-1)	0.9204	0.4928	1.9205	0.7455
State corporate tax (t-1)	0.6303	0.2792	-0.0142	0.3590
State in middle CGT tertile (t-1)	0.0119	0.0268	0.0425	0.0378
State in highest CGT tertile (t-1)	0.0018	0.0339	0.0440	0.0484
Constant	0.0036	0.0474	-0.0132	0.0452

Notes: This table shows the results of two OLS regressions aiming to determine whether economic conditions, previous capital gains rates, and other tax rates predict changes in the capital gains tax rate. The outcome variables are dummies for increases and decreases in the state capital gains tax rate at time t, respectively. The variables "Unemployment", "Max state income tax" and "State corporate tax" are measured as decimal numbers, not percentages. We do not include fixed effects. Standard errors are clustered at the state level.

Table A.3: Capital Gains and Income Tax Changes by State-Year

Income tax rate	**Capital gains tax rate** Decreased	Unchanged	Increased	Total
Decreased	75.1% (259)	0.7% (10)	13.8% (33)	14.4% (302)
Unchanged	13.6% (47)	98.5% (1484)	18.8% (45)	75.4% (1576)
Increased	11.3% (39)	0.9% (13)	67.4% (161)	10.2% (213)
Total	100.0% (345)	100.0% (1507)	100.0% (239)	100.0% (2091)

Notes: This table relates the direction of year-by-year changes in state capital gains and income tax rates. Within each column, the percentages show the share of income tax changes that went in the given direction. The rates used are maximum state capital gains and wage tax rates, calculated for a hypothetical high-income taxpayer for years 1977-2017 by Daniel Feenberg for NBER. Tax changes are relative to previous year. Observation (state-year) counts are in parentheses.

Table A.4: Capital Gains Semi-Elasticities and Revenue-Maximizing Tax Rates

Specification	**Total elasticity,** γ^{CG}	**Policy elasticity,** $\gamma^{R}=\gamma^{CG}-\gamma^{N}$	**Laffer rate,** $\tau^{*}=\frac{-1}{\gamma^{R}}$	**Elasticity with respect to tax,** $\varepsilon^{tax}=\gamma^{R}\cdot\frac{-0.22}{1-0.22}$	χ^2 **test:** $\varepsilon^{tax}=-1$
Baseline					
0-10 years	-5.53	-2.89	0.35	-0.64	1.81
	(1.35)	(1.23)	(0.15)	(0.27)	(0.18)
0-2 years	-5.23	-3.21	0.31	-0.71	1.12
	(1.32)	(1.26)	(0.12)	(0.28)	(0.29)
3-5 years	-7.36	-3.34	0.30	-0.74	0.94
	(1.49)	(1.24)	(0.11)	(0.27)	(0.33)
6-8 years	-6.59	-3.05	0.33	-0.67	1.25
	(1.70)	(1.33)	(0.14)	(0.29)	(0.26)
6-10 years	-6.04	-2.39	0.42	-0.53	2.38
	(1.81)	(1.40)	(0.24)	(0.31)	(0.12)
Big changes only					
0-10 years	-4.80	-2.37	0.42	-0.52	3.25
	(1.34)	(1.20)	(0.21)	(0.26)	(0.07)
0-2 years	-5.55	-3.74	0.27	-0.82	0.35
	(1.33)	(1.36)	(0.10)	(0.30)	(0.55)
3-5 years	-7.62	-3.49	0.29	-0.77	0.68
	(1.48)	(1.28)	(0.11)	(0.28)	(0.41)
6-8 years	-6.27	-2.67	0.37	-0.59	1.98
	(1.68)	(1.33)	(0.19)	(0.29)	(0.16)
6-10 years	-5.01	-1.78	0.56	-0.39	3.66
	(1.87)	(1.44)	(0.45)	(0.32)	(0.06)
Control for other taxes					
0-10 years	-4.02	-1.61	0.62	-0.35	3.18
	(1.81)	(1.65)	(0.64)	(0.36)	(0.07)
0-2 years	-3.88	-1.90	0.53	-0.42	2.62
	(1.63)	(1.63)	(0.45)	(0.36)	(0.11)
3-5 years	-5.68	-2.35	0.42	-0.52	2.24
	(1.72)	(1.46)	(0.26)	(0.32)	(0.13)
6-8 years	-5.66	-2.28	0.44	-0.50	1.94
	(2.02)	(1.63)	(0.31)	(0.36)	(0.16)
6-10 years	-5.24	-2.00	0.50	-0.44	2.28
	(2.20)	(1.69)	(0.42)	(0.37)	(0.13)

Notes: This table corresponds to Table 2 in the main text, but uses a specification in which the right-hand side variable of interest is the change in the tax rate, rather than in the log net-of-tax rate. Specifically, we use the exact estimation method described in section 2.2, with the exception that in equation (2), we replace the variable $\Delta_3 \log(1-\tau_{s,t})$ with $\Delta_3 \tau_{s,t}$, and correspondingly, in equation (3), $\Delta_{11} \log(1-\tau_{s,t})$ is replaced with $\Delta_{11}\tau_{s,t}$. Similarly, the vector of controls for reforms in surrounding years, $\mathbf{X}_{s,t}$, is also specified using the tax rate in levels rather than the log net-of-tax rate. With this change of right-hand-side variables, columns 1 and 2 estimate semi-elasticities in a way completely analogously to how we estimate the corresponding elasticities in Table 2. In column 3, we calculate the revenue-maximizing tax rate given the policy-relevant semi-elasticity from column 2. In a model where the semi-elasticity γ is assumed constant, the revenue-maximizing tax rate can be found as $\tau^{*}=-\frac{1}{\gamma}$. In column 4, we convert our semi-elasticity to an elasticity with respect to the tax rate simply by multiplying by a tax rate of 0.22. More details on our calculations can be found in Appendix C. Standard errors are clustered at the state level. Values in parentheses in columns 1-4 represent standard errors; values in parentheses in column 5 (χ^2 test) represent p-values.

Table A.5: Capital Gains Elasticities and Revenue-Maximizing Tax Rates - Event Study Specification

Specification	Total elasticity, ε^{CG}	Policy elasticity, $\varepsilon^{R} = \varepsilon^{CG} - \varepsilon^{N}$	Laffer rate, $\tau^{*} = \frac{1-\bar{\tau}_S}{1+\varepsilon^R}$	Elasticity with respect to tax, $\varepsilon^{tax} = \varepsilon^{R} \cdot \frac{-0.22}{1-0.22}$	χ^2 test: $\varepsilon^{tax} = -1$
Baseline					
0-10 years	3.35	1.85	0.33	-0.52	5.26
	(0.90)	(0.74)	(0.08)	(0.21)	(0.02)
0-2 years	3.13	2.14	0.30	-0.60	2.65
	(0.97)	(0.86)	(0.08)	(0.24)	(0.10)
3-5 years	4.45	2.28	0.29	-0.64	2.05
	(1.09)	(0.89)	(0.08)	(0.25)	(0.15)
6-8 years	3.39	1.91	0.32	-0.54	3.50
	(1.04)	(0.87)	(0.10)	(0.25)	(0.06)
6-10 years	3.00	1.41	0.39	-0.40	6.34
	(1.01)	(0.85)	(0.14)	(0.24)	(0.01)
Big changes only					
0-10 years	2.68	1.57	0.37	-0.44	7.22
	(0.94)	(0.74)	(0.10)	(0.21)	(0.01)
0-2 years	3.48	2.72	0.25	-0.77	0.72
	(0.99)	(0.97)	(0.07)	(0.27)	(0.40)
3-5 years	4.84	2.75	0.25	-0.78	0.68
	(1.15)	(0.97)	(0.06)	(0.27)	(0.41)
6-8 years	3.38	2.00	0.31	-0.57	2.86
	(1.05)	(0.91)	(0.09)	(0.26)	(0.09)
6-10 years	2.44	1.30	0.41	-0.37	6.38
	(1.04)	(0.89)	(0.16)	(0.25)	(0.01)
Control for other taxes					
0-10 years	2.70	1.35	0.40	-0.38	6.27
	(0.96)	(0.88)	(0.15)	(0.25)	(0.01)
0-2 years	2.31	1.27	0.41	-0.36	4.57
	(1.08)	(1.07)	(0.19)	(0.30)	(0.03)
3-5 years	3.47	1.69	0.35	-0.48	4.03
	(1.10)	(0.92)	(0.12)	(0.26)	(0.04)
6-8 years	3.01	1.61	0.36	-0.45	3.67
	(1.12)	(1.01)	(0.14)	(0.29)	(0.06)
6-10 years	2.60	1.25	0.42	-0.35	5.23
	(1.10)	(1.01)	(0.19)	(0.28)	(0.02)

Notes: This table corresponds to Table 2 in the main text, but uses an event study specification where elasticities at different horizons are estimated jointly within the same regression model rather than using separate regressions for each coefficient as in the direct projections case. Specifically, for the three-year bins, instead of equation (2), we run a single regression of the form $y_{s,t} = \beta_{-9}\Delta_3 \log(1-\tau_{s,t+9}) + \beta_{-6}\Delta_3 \log(1-\tau_{s,t+6}) + \cdots + \beta_9 \Delta_3 \log(1-\tau_{s,t-9}) + \gamma_s + \phi_t + \varepsilon_{s,t}$. Using capital gains realizations as the outcome variable, we then provide elasticity estimates as the difference between the coefficients $\beta_t - \beta{-3}$ from this regression. Migration elasticities are calculated correspondingly, using our migration variable from the main text as the outcome variable. For the estimates in the 0-10 year and 6-10 year rows, we run separate regressions. For the 0-10 year bin, we run the regression $y_{s,t} = \tilde{\beta}_{-9}\Delta_3 \log(1-\tau_{s,t+9}) + \tilde{\beta}_{-6}\Delta_3 \log(1-\tau_{s,t+6}) + \tilde{\beta}_{-3}\Delta_3 \log(1-\tau_{s,t+3}) + \tilde{\beta}_0 \Delta_{11} \log(1-\tau_{s,t}) + \tilde{\gamma}_s + \tilde{\phi}_t + \tilde{\varepsilon}_{s,t}$ and estimate the 0-10 year elasticity as the difference $\tilde{\beta}_0 - \tilde{\beta}_{-3}$. Similarly, for the 6-10 year bin, we run the regression $y_{s,t} = \check{\beta}_{-9}\Delta_3 \log(1-\tau_{s,t+9}) + \cdots + \check{\beta}_0 \Delta_3 \log(1-\tau_{s,t}) + \check{\beta}_3 \Delta_3 \log(1-\tau_{s,t-3}) + \check{\beta}_6 \Delta_5 \log(1-\tau_{s,t-6}) + \check{\gamma}_s + \check{\phi}_t + \check{\varepsilon}_{s,t}$ and identify the 6-10 year elasticity as $\check{\beta}_6 - \check{\beta}_0$. In the specification that controls for other taxes, we include as variables in the regressions changes in state labor and corporate tax rates over the same year bins as for capital gains taxes. In the "big changes only" specification, like in Table 2, we replace the $\Delta_q \log(1-\tau_{s,t-r})$-variables with two variables that each sum changes that are smaller and larger than 1 pp, respectively, over the relevant time horizon. See the figure notes to Table 2 for details on this. After estimating the total capital gains and migration elasticities in this way, all other calculations follow exactly as in Table 2. Standard errors are clustered at the state level. Values in parentheses in columns 1-4 represent standard errors; values in parentheses in column 5 (χ^2 test) represent p-values.

Table A.6: Capital Gains Elasticities and Revenue-Maximizing Tax Rates with Controls for Unemployment

Specification	Total elasticity, ε^{CG}	Policy elasticity, $\varepsilon^{R} = \varepsilon^{CG} - \varepsilon^{N}$	Laffer rate, $\tau^{*} = \frac{1-\bar{\tau}_S}{1+\varepsilon^R}$	Elasticity with respect to tax, $\varepsilon^{tax} = \varepsilon^{R} \cdot \frac{-0.22}{1-0.22}$	χ^2 test: $\varepsilon^{tax} = -1$
Baseline					
0-10 years	3.39	1.87	0.33	-0.53	3.38
	(1.01)	(0.91)	(0.10)	(0.26)	(0.07)
0-2 years	3.32	2.09	0.30	-0.59	2.58
	(0.97)	(0.91)	(0.09)	(0.26)	(0.11)
3-5 years	4.78	2.28	0.29	-0.64	2.05
	(1.10)	(0.88)	(0.08)	(0.25)	(0.15)
6-8 years	4.07	1.94	0.32	-0.55	3.02
	(1.20)	(0.92)	(0.10)	(0.26)	(0.08)
6-10 years	3.66	1.47	0.38	-0.41	4.54
	(1.27)	(0.97)	(0.15)	(0.27)	(0.03)
Control for unemployment					
0-10 years	3.24	1.79	0.34	-0.51	3.87
	(0.98)	(0.89)	(0.11)	(0.25)	(0.05)
0-2 years	3.36	2.03	0.31	-0.57	2.74
	(0.98)	(0.92)	(0.09)	(0.26)	(0.10)
3-5 years	4.71	2.15	0.30	-0.61	2.80
	(1.14)	(0.84)	(0.08)	(0.24)	(0.09)
6-8 years	3.87	1.76	0.34	-0.50	4.24
	(1.26)	(0.87)	(0.11)	(0.24)	(0.04)
6-10 years	3.45	1.39	0.39	-0.39	5.10
	(1.22)	(0.96)	(0.16)	(0.27)	(0.02)
Control for unemployment growth					
0-10 years	3.04	1.94	0.32	-0.55	3.20
	(0.94)	(0.90)	(0.10)	(0.25)	(0.07)
0-2 years	3.02	2.17	0.30	-0.61	2.14
	(0.94)	(0.94)	(0.09)	(0.27)	(0.14)
3-5 years	4.56	2.37	0.28	-0.67	1.91
	(1.07)	(0.85)	(0.07)	(0.24)	(0.17)
6-8 years	3.92	1.93	0.32	-0.54	2.89
	(1.24)	(0.95)	(0.10)	(0.27)	(0.09)
6-10 years	3.59	1.63	0.36	-0.46	3.99
	(1.18)	(0.96)	(0.13)	(0.27)	(0.05)

Notes: This table provides additional alternative specifications to our main estimation, beyond those shown in Table 2 in the main text. The top panel of this table, labelled "Baseline", corresponds exactly to the Baseline panel in Table 2. The next two panels add controls for unemployment in two different ways. The middle panel includes a linear control for the state's unemployment rate prior to the capital gains tax reform in question. The bottom panel instead controls for a set of dummies interacting unemployment growth tertiles and years, where the unemployment growth tertile is determined separately in each year by grouping states according to unemployment growth over three years prior to the reform. Standard errors are clustered at the state level. Values in parentheses in columns 1-4 represent standard errors; values in parentheses in column 5 (χ^2 test) represent p-values.

Table A.7: Capital Gains Elasticities and Revenue-Maximizing Tax Rates with Controls for Other Taxes and Unemployment

Specification	**Total elasticity,** ε^{CG}	**Policy elasticity,** $\varepsilon^{R}=\varepsilon^{CG}-\varepsilon^{N}$	**Laffer rate,** $\tau^{*}=\frac{1-\bar{\tau}_S}{1+\varepsilon^R}$	**Elasticity with respect to tax,** $\varepsilon^{tax}=\varepsilon^{R}\cdot\frac{-0.22}{1-0.22}$	χ^2 **test:** $\varepsilon^{tax}=-1$
Control for other taxes					
0-10 years	2.28	1.01	0.47	-0.29	4.64
	(1.32)	(1.18)	(0.27)	(0.33)	(0.03)
0-2 years	2.38	1.25	0.42	-0.35	3.88
	(1.19)	(1.16)	(0.21)	(0.33)	(0.05)
3-5 years	3.58	1.64	0.36	-0.46	3.54
	(1.24)	(1.01)	(0.14)	(0.29)	(0.06)
6-8 years	3.32	1.40	0.39	-0.39	3.57
	(1.43)	(1.14)	(0.19)	(0.32)	(0.06)
6-10 years	2.98	1.18	0.43	-0.33	3.96
	(1.54)	(1.19)	(0.24)	(0.34)	(0.05)
Control for taxes, unemployment					
0-10 years	2.22	0.96	0.48	-0.27	4.83
	(1.30)	(1.18)	(0.29)	(0.33)	(0.03)
0-2 years	2.35	1.20	0.43	-0.34	3.92
	(1.23)	(1.18)	(0.23)	(0.33)	(0.05)
3-5 years	3.51	1.57	0.36	-0.44	3.84
	(1.33)	(1.01)	(0.14)	(0.28)	(0.05)
6-8 years	3.18	1.31	0.41	-0.37	4.11
	(1.47)	(1.10)	(0.19)	(0.31)	(0.04)
6-10 years	2.94	1.13	0.44	-0.32	4.23
	(1.48)	(1.18)	(0.24)	(0.33)	(0.04)
Control for taxes, unemployment growth					
0-10 years	2.21	1.06	0.45	-0.30	4.67
	(1.20)	(1.15)	(0.25)	(0.32)	(0.03)
0-2 years	2.31	1.31	0.41	-0.37	3.68
	(1.12)	(1.16)	(0.20)	(0.33)	(0.05)
3-5 years	3.55	1.70	0.35	-0.48	3.68
	(1.20)	(0.96)	(0.12)	(0.27)	(0.05)
6-8 years	3.38	1.38	0.39	-0.39	4.01
	(1.41)	(1.08)	(0.18)	(0.30)	(0.05)
6-10 years	3.08	1.25	0.42	-0.35	4.23
	(1.45)	(1.12)	(0.21)	(0.31)	(0.04)

Notes: This table provides additional alternative specifications to our main estimation, beyond those shown in Table 2 in the main text. The top panel of this table, labelled "Control for other taxes", controls for changes in state labor and corporate taxes, and corresponds exactly to the bottom panel in Table 2 – see the notes to Table 2 for further details on how this is specified. The next two panels in this table include the same controls for other state tax changes, but also control for unemployment in two different ways. The middle panel includes a linear control for the state's unemployment rate prior to the capital gains tax reform in question. The bottom panel instead controls for a set of dummies interacting unemployment growth tertiles and years, where the unemployment growth tertile is determined separately in each year by grouping states according to unemployment growth over three years prior to the reform. Standard errors are clustered at the state level. Values in parentheses in columns 1-4 represent standard errors; values in parentheses in column 5 (χ^2 test) represent p-values.

B Data Appendix

This appendix covers our data sources in more detail and clarifies adjustments and assumptions that have been made in cleaning and processing the data.

Tax rates

- Maximum federal, state, and total tax rates on long-term capital gains for the years 1977 to 2017 are obtained from NBER TAXSIM data. These data are calculated by simulating the effect of a change in income for a hypothetical high earner in the TAXSIM model, and thus incorporate statutory state tax rates as well as phaseouts of exemptions and itemized deductions. In some specifications, we control for changes in the maximum state income tax and corporate tax rates, which we also obtain from this dataset.[1]

- Table 1 shows maximum federal long-term capital gains tax rates, which we obtain from the US Department of the Treasury.[2] As of the time of writing, the Treasury data starts in 1954, but unfortunately only goes to 2014. Knowing that the maximum statutory tax rate on capital gains did not change between 2014 and 2017, we manually extend the data forwards, assuming a tax range that is unchanged from its 2014 level. Since the data also includes the effects of other minor provisions on maximum tax rates, it is possible that we are leaving out smaller changes in the maximum tax rate through our extrapolation. However, we expect any such discrepancies to be small, as the maximum effective tax rate is very close to the maximum statutory rate for recent years. In the data, certain years contain two different tax rates. In these cases, the capital gains tax rate changed at some point during the year, and different tax rates applied for gains that were realized in different parts of the years. Since our data on realized capital gains are at the year level, we are unable to apply these different tax rates over the year. Therefore, for these few years, we assume the relevant tax rate to be the midpoint between the two tax rates that applied over the year.

- Data on UK tax rates comes from HM Revenue and Customs.[3] Note that for some of the years in question, the UK had different tax rates for individuals and trusts. For the purposes of our analysis, we ignore trusts, which account for a comparatively small and stable amount of capital gains across the years we study.

Realized capital gains

- Data on realized capital gains at the federal level are obtained from the appendix tables of Piketty, Saez and Zucman (2018).[4] Specifically, the numbers we use can be found in column 21 of Table C1. These numbers were calculated by Piketty, Saez and Zucman (2018) as aggregates of the NBER microfiles samples of tax returns and correspond to the *fikgi* variable.[5] Note that these are net long-term plus short-term capital gains, i.e., any capital losses are subtracted from the total in each year.[6]

- Data on realized capital gains at the state level are taken from Smith, Zidar and Zwick (2020). The series that we use comes from a state-year collapse of the *fikgi* variable in the IRS SOI sample files. We also use data from the same source on the number of residents by state within the top 1 and 10% of the national wealth distribution.

[1] Further background information and the dataset itself are available at `https://users.nber.org/~taxsim/state-rates/`.

[2] These data are currently available in excel format at `https://www.treasury.gov/resource-center/tax-policy/tax-analysis/Documents/Taxes-Paid-on-Capital-Gains-for-Returns-with-Positive-Net-Capital-Gains.xlsx`.

[3] Specifically, it can be found at `https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/764247/Table_A1.pdf`. Note that we do not currently use these data directly in our analysis, except to verify that the UK did not change its capital gains tax rate at any time during the periods in which we use it as a control group to the US. Capital gains were treated as part of regular income throughout all of the years in our UK sample. The maximum income tax rate throughout this period was 40 percent.

[4] Currently, these can be found under `http://gabriel-zucman.eu/files/PSZ2017AppendixTablesI(Macro).xlsx`

[5] See the Piketty, Saez and Zucman (2018) codebook here `http://gabriel-zucman.eu/files/PSZCodebook.pdf`.

[6] In future work, it would be valuable to consider gains and losses separately and test where the inclusion of net short term gains and losses and netting of loss carryovers from past years have different effects.

- UK data on realized net capital gains comes from HM Revenue and Customs.[7] These data are given separately for individuals and trusts, which are taxed at different rates over the period that we study. We only use the data for individuals, who are taxed at a 40 percent rate throughout all the years that we study. For specific types of trusts, the tax rate did change slightly over the period that we study. Our choice to only use realized capital gains by individuals is therefore based on an assumption that any spillover effects between the two tax bases resulting from changes in the trust tax rate are negligible. We view this as a reasonable assumption since capital gains by trusts is a small and relatively stable share of total capital gains, since only certain types of trusts (i.e, interest in possession trusts and personal representative) were subject to tax changes over the period we study, and since the tax changes were very small, changing by only 3 percentage points over the period.

Other variables

- In some specifications, we control for state GDP numbers obtained from the Bureau of Economic Analysis.[8]
- Other specifications control for unemployment, which we obtain from the Bureau of Labor Statistics.[9]
- To generate variables in per capita terms, we use annual estimates of US state populations from the US Census Bureau, obtained through the St. Louis Fed.[10]
- We convert dollar amounts into real values using the CPI for urban consumers (CPI-U), obtained from the US Bureau of Labor Statistics.[11]
- Nominal values from the UK are deflated using the Retail Price Index, avalable from the Office for National Statistics. [12]

[7] They can be found at https://www.gov.uk/government/statistics/capital-gains-tax-statistical-tables

[8] These can be found using the Regional Economic Accounts download tool at https://apps.bea.gov/regional/downloadzip.cfm.

[9] Available at https://www.bls.gov/lau/#data.

[10] These can be obtained as a single zip file by using the download tool at https://research.stlouisfed.org/pdl/628/download.

[11] Available at https://www.bls.gov/cpi/data.htm.

[12] https://www.ons.gov.uk/economy/inflationandpriceindices/datasets/consumerpriceindices.

C On Elasticities and Semi-Elasticities

Our approach in equation (1) relates log capital gains realizations to the log net-of-tax rate, which is a standard approach in much of the recent literature on the elasticity of taxable income (e.g., Gruber and Saez, 2002; Saez, Slemrod and Giertz, 2012; Kleven and Schultz, 2014; Doerrenberg, Peichl and Siegloch, 2017), where the log net-of-tax rate (or changes in the log net-of-tax rate) is often used as the primary explanatory variable. One reason for this formulation is that the net-of-tax price is often the relevant price governing behavior in standard economic models.[13] However, most of the previous literature on capital gains taxes (e.g., Bogart and Gentry, 1995; Bakija and Gentry, 2014; Dowd, McClelland and Muthitacharoen, 2015) has related log capital gains to the linear tax rate or net-of-tax rate, fitting specifications of the semi-log form:

$$\log CG_t = \gamma \cdot \tau_t. \tag{C.1}$$

In a model of this form, the coefficient γ corresponds to a semi-elasticity of capital gains realizations with respect to the tax rate. Empirically, given the variation we observe in tax rates, it is hard to determine whether our baseline model in equation (1) fits the data better than a model of this type.[14] However, the two models generate different predictions about how behavioral responses scale with tax rates. Whereas our baseline model would imply that a 1 percentage point change in the tax rate induces larger realizations responses when the tax rate is higher, the model in (C.1) implies that a 1 percentage point change in tax rates would always generate the same percentage change in realizations. As we illustrate in Appendix Figure A.6, the difference between the predictions of these models grows larger when the tax rate is extrapolated further from the rate at which both semi-elasticity and net-of-tax rate elasticity are calculated. This difference can be important, for instance, when using these models to calculate the implied revenue-maximizing tax rate.

We use the model in equation (1) as our baseline model because it is standard in the broader taxable elasticity literature and may generate more realistic predictions when considering implied behavioral responses at large tax rates. For example, the model in (C.1) implies that the percentage change in realizations would be the same whether tax rates were increased from 20 to 21 percent or from 99 to 100 percent, which seems less accurate given standard predictions about distortions growing with the square of the tax rate. Our model, in contrast, would predict much larger responses when tax rates are high.

C.1 Empirical Estimates Using a Semi-Log Specification

We provide results estimation using semi-log specifications to facilitate comparisons to the prior literature and to assess the robustness of our estimates. We report these semi-log results in Table A.4, which has the same structure as Table 2 with our binned multi-year estimates from the main text, but with various changes as outlined below.

In the first column of Table A.4, we estimate the empirical semi-elasticity, which we label γ^{CG}. We do so using the same procedure described in Section 2.2 in the main text, but with the right hand-side variable of interest changed. For instance, instead of equation (2), we estimate:

$$y_{s,t+h} = \tilde{\theta}_h \Delta_3 \tau_{s,t} + \mathbf{X}'_{s,t}\tilde{\mathbf{\Lambda}}_h + \tilde{\mu}_{s,h} + \tilde{\phi}_{t,h} + \tilde{\varepsilon}_{s,t,h}. \tag{C.2}$$

Just as we do for the elasticities in the main text, we calculate the semi-elasticity based on these estimates as the difference between post- and pre-reform point estimates. For example, the 0-2 year semi-elasticity is calculated as $\tilde{\gamma}_0 \equiv \tilde{\theta}_0 - \tilde{\theta}_{-3}$, the 3-5 year semi-elasticity as $\tilde{\gamma}_3 \equiv \tilde{\theta}_3 - \tilde{\theta}_{-3}$, and so on. Also note that in this specification, the vector of controls for reforms in surrounding years, $\mathbf{X}_{s,t}$, is also specified in terms of the tax rate in levels, i.e., it contains the variables $\Delta_3 \tau_{s,t+r}$ for $r = -9, -6, -3, 3, 6, 9$.

In the second column of Table A.4, we obtain a semi-elasticity that differences out the migration effect by subtracting the point estimates of γ^N from a specification like (C.1) with $\theta_s \ln N_{s,t}^{P99-P100} + (1-\theta_s) \ln N_{s,t}^{P90-P100}$

[13] For example, labor supply decisions depend on the net-of-tax wage, i.e., $(1-\tau)w$, in standard models of labor supply.

[14] Figure A.5 shows that there is little difference in how strongly changes in log realized capital gains correlate with changes in net-of-tax rates and log net-of-tax rates, respectively.

as the outcome variable. This step is completely analogous to what we do in Table 2 for our main estimates.[15] We then go on to calculate the revenue-maximizing tax rate implied by the estimated policy-relevant semi-elasticities. As in Appendix E, this is the tax rate that solves the federal government's revenue maximization problem,

$$\begin{aligned}\tau_F^* &= \arg\max_{\tau_F} \tau_F \cdot CG \\ &= \arg\max_{\tau_F} \log \tau_F + \log CG\end{aligned}$$

Taking the first order condition for maximization with respect to τ_F in the second line, we get:

$$0 = \frac{1}{\tau_F} + \frac{\mathrm{d}\log CG}{\mathrm{d}\tau_F},$$

which rearranges to

$$\tau_F^* = -\frac{1}{\gamma},$$

where $\gamma \equiv \frac{\mathrm{d}CG}{\mathrm{d}\tau_F} \cdot \frac{1}{CG} = \frac{\mathrm{d}\log CG}{\mathrm{d}\tau_F}$ is the policy-relevant semi-elasticity at a national level. Note that unlike in our main analysis, where we find the formula for the revenue-maximizing tax rate in equation (6), we do not adjust for the average state taxes here. That is because in a model with a constant semi-elasticity, state taxes are irrelevant for the federal tax; differences in the baseline tax rate do not affect the magnitude of behavioral responses. In other words, in this model, if the semi-elasticity is -4, the revenue-maximizing federal tax rate is 25%, regardless of whether average state taxes are 0 or 50%.

Finally, in the fourth column of Table A.4, we convert the estimated policy-relevant semi-elasticity to an elasticity with respect to the tax rate, evaluated at 22% to facilitate comparison to Table 2 and the prior literature as referenced in Gravelle (2020). Since the semi-elasticity is given by $\gamma = \frac{\mathrm{d}CG}{\mathrm{d}\tau} \cdot \frac{1}{CG}$, it can be converted into a tax elasticity at any given tax rate τ by simply multiplying it by τ.

Our results in Table A.4 are broadly consistent with what we find in Table 2. While the first two columns are not directly comparable, we find that the semi-log specification delivers tax elasticities that are slightly larger than those in our main specification. However, despite differences in how revenue-maximizing tax rates are calculated in the two models, we get similar estimates of the revenue-maximizing tax rate across our various specifications.

[15] One small difference is that unlike in Table 2, we do not multiply by the minor adjustment factor that we describe in Appendix E. This adjustment is not needed in a model where semi-elasticities are assumed constant for all tax rates. We can see this point by repeating the simplification from equation (E.4) in the context of a semi-elasticity model. Specifically, let $\gamma \equiv \frac{\mathrm{d}CG}{\mathrm{d}\tau} \cdot \frac{1}{CG}$ be the policy-relevant semi-elasticity at a national level (corresponding to ε in (E.4)), and let $\gamma^R \equiv \frac{\mathrm{d}\log R_s}{\mathrm{d}\tau} = \frac{\mathrm{d}R_s}{\mathrm{d}\tau} \cdot \frac{1}{R_s}$ be the realizations semi-elasticity at the state level. We then find:

$$\begin{aligned}\gamma &= \frac{\mathrm{d}CG}{\mathrm{d}\tau} \cdot \frac{1}{CG} \\ &= \left[\sum_{s\in S} N_s \frac{\mathrm{d}R_s}{\mathrm{d}\tau}\right] \cdot \frac{1}{\sum_{s\in S} N_s R_s} \\ &= \left[\sum_{s\in S} N_s \gamma^R \cdot R_s\right] \cdot \frac{1}{\sum_{s\in S} N_s R_s} \\ &= \gamma^R \left[\sum_{s\in S} N_s R_s\right] \cdot \frac{1}{\sum_{s\in S} N_s R_s} \\ &= \gamma^R.\end{aligned}$$

D Estimation Using Simulated Data

This section presents the results of two simulation exercises that aim to examine whether our estimation methods are biased when estimating the empirical elasticity of capital gains with respect to the net-of-tax rate. We use our actual empirical data on the maximum combined state and federal capital gains tax rate, but rather than use empirical data on realized capital gains as the outcome variable, we simulate this variable in such a way that we know the true empirical elasticity for this simulated variable with respect to the net-of-tax rate. We start with a simulation that features an elasticity that is constant across all time horizons, before moving on to the more complex case of a time-varying elasticity.

D.1 Simulation with constant elasticity

First, we generate the simulated log capital gains variable according to the following formula:

$$\log CG_{s,t}^{sim} = 10 + 1 \cdot fips_s + 2 \cdot t + 2 \cdot \log(1 - \tau_{s,t}) + \eta_{s,t}. \tag{D.1}$$

From this data-generating process, it is clear to see that the "true" empirical elasticity of capital gains with respect to the net-of-tax rate will be $\varepsilon^{CG} = \frac{\partial \log CG_{s,t}^{sim}}{\partial \log(1-\tau_{s,t})} = 2$. The constant 10 and the terms $1 \cdot fips_s + 2 \cdot t$ are chosen arbitrarily—they are simply there to generate a time trend and some variation across states which will be absorbed by state and year fixed effects in our estimation anyway—mimicking structural time trends and differences across states which are unrelated to the tax rate.[16] The term $\eta_{s,t}$ is a random variable with mean 0 and standard deviation 0.001. In reality, the short-term and long-term elasticities likely differ, which we explore in more detail in subsection D.2. Here, we have here simplified matters and assumed a single permanent elasticity of 2, which holds for both the short and the long term. This is for expositional purposes, since it will make any bias in the different estimation methods easier to see visually.

Having generated this simulated capital gains realizations variable, we now estimate empirically the effect of capital gains tax reforms on it, using various methods. The results of these estimations are shown in Appendix Figure A.14. First, in panel (a), we use our main specification—the baseline direct projections specification from equation (1), which includes a set of controls for other capital gains reforms in the 10 years before and after each reform that enters our regressions. This figure is thus analogous to Figure 2(a) in the main text, but with simulated outcome data. If our estimation method is accurate, the figure should display a completely flat trend in the pre-and post-periods, with a single upward jump of size 2 from year -1 to 0. The results show we accurately identify the true elasticity of 2 in the simulated data. There is a clear jump from time -1 to time 0, the pre-trend is flat, and the trend in the post-period is almost entirely flat as well, with just a very slight upward trend.[17]

Panel (b) of Figure A.14 uses the same estimation method, but omits our controls for capital gains reforms at different horizons. We see that not controlling for other capital gains tax changes performs worse. While the jump at time 0 is still exactly 2, we now have a clear downward trend both before and after the reform year. This pattern reflects the fact that tax reforms in our data tend to be somewhat mean-reverting, as we show in Appendix Figure A.4 and discuss briefly in section 2. Because of this mean-reversion, the difference between tax rates at time 0 and -1 will tend to be an overestimate of the difference between rates at time h and -1 for $h > 0$, and because we are overestimating the size of the tax change, we will correspondingly underestimate the magnitude of the elasticity at these longer horizons.

Finally, panel (c) of Figure A.14 uses an event study method. We use the following specification:

$$\log CG_{s,t}^{sim} = \sum_{h=-10}^{10} \beta_h \Delta \log(1 - \tau_{s,t-h}) + \gamma_s + \delta_t + \varepsilon_{s,t}, \tag{D.2}$$

and the figure plots the point estimates that are normalized relative to period -1, i.e. it shows $\beta_{-10} - \beta_{-1}, \beta_{-9} - \beta_{-1}, \ldots, \beta_{10} - \beta_{-1}$. This differs from our baseline direct projections specification from equation (1) in that all

[16] $fips_s$ is literally just the FIPS code corresponding to state s, which is included as a crude way to ensure that the mean of $\log CG^{sim}$ will vary across states.

[17] An alternative specification that is similar to equation (1), but using $y_{s,t+h} - y_{s,t-1}$ as the outcome variable, would in fact remove this very slight bias. However, we have opted not to use this specification for our empirical analysis, as it would not extend naturally to our long multi-year binned specifications, and therefore we do not present it here either.

the point estimates are generated within the same regression. We see that this method performs better than the direct projections method without controls, but worse than the direct projections with controls, since there is still somewhat of a downward trend. This result is likely because given the specification that we use, we are unable to bin tax reforms that occur beyond the endpoints of our window of 10 leads and lags around the realization year.[18]

Overall, these results show that our main direct projections method with controls is accurately identifying the true elasticity in the longer run. In the next subsection, we extend the simulation exercise to show that our estimation methods also accurately identify true elasticities when they differ across time horizons.

D.2 Simulation with time-varying elasticity

To simulate a log realized capital gains variable with a varying net-of-tax elasticity over time, we slightly alter the simulated variable we introduced in equation (D.1). It now becomes:

$$\begin{aligned} \log CG_{s,t}^{sim} =& 10 + 1 \cdot fips_s + 2 \cdot t + 2 \cdot \log(1-\tau_{s,t}) \\ &+ 1 \cdot [\Delta \log(1-\tau_{s,t}) + \Delta \log(1-\tau_{s,t-1}) + \Delta \log(1-\tau_{s,t-2})] \\ &- 1 \cdot [\Delta \log(1-\tau_{s,t-3}) + \Delta \log(1-\tau_{s,t-4}) + \Delta \log(1-\tau_{s,t-5})] \\ &+ \eta_{s,t}. \end{aligned} \tag{D.3}$$

In this specification, the long-run elasticity of capital gains with respect to the net-of-tax rate is still 2, but the added terms modify this elasticity in the short and medium run. The first bracketed term increases the impact of the change in the net-of-tax rate on realizations by 1 for reforms that happened 0, 1 or 2 years ago, which means that the elasticity in these three years will now be 3. Similarly, the second bracketed term decreases the impact of a reform that happened 3, 4 or 5 years ago on capital gains realizations, lowering the elasticity in each of these three years to 1.

We now estimate our baseline specification from equation (1) with this new outcome variable. The result is shown in panel (a) of Figure A.15. We clearly see that our estimation method accurately picks up on the time-varying elasticity across different years, which confirms that this specification also does a good job of capturing the dynamics of the empirical capital gains elasticity around a tax reform.

Panel (b) of Figure A.15 estimates the impact of capital gains reforms on the same simulated outcome variable using the binned specifications in equations (2) and (3). We see that the 3-year binned specification also captures the dynamics of the elasticity, and the long 0-10-year specification captures the average elasticity across time (the three short-run years with an elasticity of 3 and the three medium-run years with an elasticity of 1 average out to an elasticity of 2 across these six years). Overall, these results confirm that our empirical methods are well-suited to capture the magnitude and evolution of empirical capital gains elasticities over time.

[18] Specifiying the right-hand side variables in the event study specification in levels rather than first differences could help deal with this problem, but would also make our empirical estimates harder to compare directly with those from the direct projections specification.

E Full Model

This section contains further details and derivations for the model outlined in section 4.1 of the main text. We first show the derivations of the formula for the revenue-maximizing tax rate provided in the text. Consider the revenue maximization problem of the national government.[19] Let $\bar{\tau}_S$ denote the average state tax rate.[20] The government sets τ_F to maximize revenue:

$$\max_{\tau_F} \tau_F \cdot CG, \tag{E.1}$$

where $CG = \sum_{s\in S} CG_s = \sum_{s\in S} N_s\left(1-\tau_F-\tau_s, \boldsymbol{\tau_{-s}}\right) R_s\left(1-\tau_F-\tau_s\right)$. Taking logs in (E.1), we get the first order condition

$$\frac{1}{\tau_F} = -\frac{\mathrm{d}\log CG}{\mathrm{d}\tau_F},$$

which is equivalent to

$$\begin{aligned}
\frac{1}{\tau_F} &= \frac{\mathrm{d}\log CG}{\mathrm{d}\left(1-\tau_F-\bar{\tau}_S\right)} \\
&= \frac{\mathrm{d}\log CG}{\mathrm{d}\log\left(1-\tau_F-\bar{\tau}_S\right)} \cdot \frac{\mathrm{d}\log\left(1-\tau_F-\bar{\tau}_S\right)}{\mathrm{d}\left(1-\tau_F-\bar{\tau}_S\right)} \\
&= \frac{\mathrm{d}\log CG}{\mathrm{d}\log\left(1-\tau_F-\bar{\tau}_S\right)} \cdot \frac{1}{1-\tau_F-\bar{\tau}_S}.
\end{aligned}$$

We can rewrite this expression to find that the revenue-maximizing tax rate is

$$\tau_F^* = \frac{1-\bar{\tau}_S}{1+\varepsilon}, \tag{E.2}$$

where

$$\varepsilon = \frac{\mathrm{d}\log CG}{\mathrm{d}\log\left(1-\tau_F-\bar{\tau}_S\right)} = \frac{\mathrm{d}CG}{\mathrm{d}\left(1-\tau_F-\bar{\tau}_S\right)} \cdot \frac{\left(1-\tau_F-\bar{\tau}_S\right)}{CG}. \tag{E.3}$$

We call this elasticity the *policy-relevant elasticity* since it is a sufficient statistic for determining revenue-maximizing rates at the federal level. We would like to express this elasticity in terms of the realization elasticities ε^R that we described in equation (5), since they are what we can empirically estimate. To simplify the expression in (E.3), we impose two fairly reasonable assumptions.

Assumption 1: In every region, n_s is unaffected by the federal tax rate. Mathematically, this means that

$$\frac{\mathrm{d}n_s\left(1-\tau_F-\tau_1, 1-\tau_F-\tau_2, \ldots, 1-\tau_F-\tau_s, \ldots\right)}{\mathrm{d}\tau_F} = 0 \quad \text{for all } s \in S.$$

In reality, it might be hard to find a function for which this is indeed exactly true everywhere on its domain. However, within the range of usual tax rates that we consider, it seems like a reasonable first degree approximation that a change in national tax rates wouldn't directly cause internal migration between regions.

Assumption 2: Realization elasticities are homogenous across regions, $\varepsilon_s^R = \varepsilon^R$ for all $s \in S$.

[19] Changes in the capital gains rate may affect other types of income (e.g., dividends, wage and salary income, etc.). This formula does not account for spillovers to other parts of the tax base, so we may actually be underestimating the revenue maximizing capital gains rate. Estimating these fiscal spillovers precisely is difficult empirically. Another relevant issue is the negative vertical fiscal externality between federal and state governments—maximizing federal revenues is different from maximizing federal plus state revenues.

[20] This average is weighted by state populations N_s, so

$$\bar{\tau}_S = \frac{\sum_{s\in S} N_s \tau_s}{\sum_{s\in S} N_s}.$$

Given these two assumptions, we can simplify the expression in (E.3):

$$
\begin{aligned}
\varepsilon &= \frac{\mathrm{d}CG}{\mathrm{d}\left(1-\tau_F-\bar{\tau}_S\right)} \cdot \frac{\left(1-\tau_F-\bar{\tau}_S\right)}{CG} \\
&= \left[\sum_{s\in S} N_s \frac{\mathrm{d}R_s}{\mathrm{d}\left(1-\tau_F-\tau_s\right)}\right] \cdot \frac{\left(1-\tau_F-\bar{\tau}_S\right)}{\sum_{s\in S} N_s R_s} \\
&= \left[\sum_{s\in S} N_s \varepsilon^R \cdot \frac{R_s}{\left(1-\tau_F-\tau_s\right)}\right] \cdot \frac{\left(1-\tau_F-\bar{\tau}_S\right)}{\sum_{s\in S} N_s R_s} \\
&= \varepsilon^R \left[\sum_{s\in S} N_s \frac{R_s}{\left(1-\tau_F-\tau_s\right)}\right] \cdot \frac{\left(1-\tau_F-\bar{\tau}_S\right)}{\sum_{s\in S} N_s R_s} \\
&= \varepsilon^R \left[\sum_{s\in S} n_s \frac{R_s}{\left(1-\tau_F-\tau_s\right)}\right] \cdot \frac{\left[\sum_{s\in S} n_s \cdot \left(1-\tau_F-\tau_s\right)\right]}{\left[\sum_{s\in S} n_s R_s\right]},
\end{aligned}
\tag{E.4}
$$

where n_s is the population of the state expressed as a share of the national population.[21] This expression now gives us the policy-relevant national elasticity as a function of the local realizations elasticity, ε^R, times an adjustment term which is somewhat difficult to interpret but deals with weighting among states. Essentially, it corrects for the fact that an elasticity measured at the aggregate level is not necessarily exactly equal to the mean of elasticities measured at a more granular level. Note that in our empirical setting, in every single year for which we have data, the adjustment factor is very close to 1 – its minimum value across all years is 0.993, and its maximum is 1.004. For this reason, ε and ε^R are in practice almost identical, which is why we present equation (6) for the revenue-maximzing tax rate in the main text with an ε^R, although it should be an ε to be completely precise, as in equation (E.2). We use the 2016 value, which is 1.0025, to adjust our empirical estimates when estimating ε^R and the revenue-maximizing tax rates in section 4.3.

Equations (E.2) and (E.4) together tell us directly how to get an estimate of the revenue-maximizing tax rate from local elasticities. Since our empirically estimated elasticities at the state level give us $\varepsilon^{CG} = \varepsilon^N + \varepsilon^S$, we need an estimate of ε^N to get the realizations elasticity. We do this in section 4 of the paper by running a version of our direct projections with the outcome variable being a weighted combination of the log number of state residents that belong to the top 10% and the top 1% of the national wealth distribution, respectively. This can be thought of as applying our outlined model only to the top of the wealth distribution. Capital gains tax reforms are likely to have a limited impact on migration of individuals outside the top 10%, and even if there is a migration effect for these individuals, it will not substantially affect overall capital gains realizations in the state, since individuals outside the top 10% only account for a very small share of capital gains realizations.

Two-region example

To make the above derivations a little more concrete, we present the following simple numerical example. Suppose the country consists of two regions: California (c) and everywhere else (e). Assume the following

[21] Formally, this is defined as

$$n_s = \frac{N_s}{\sum_{q\in S} N_q}.$$

values:[22]

$$\begin{aligned}
N_c &= 20 \\
N_e &= 80 \\
\kappa_c &= 25 \\
\kappa_e &= 22 \\
\tau_c &= 0.14 \\
\tau_e &= 0.05 \\
\tau_F &= 0.25
\end{aligned}$$

Suppose we estimate a total elasticity of capital gains $\hat{\varepsilon}^{CG} = 3$ and a migration elasticity $\hat{\varepsilon}^{N} = 1.5$.[23] This implies a realization elasticity of $\hat{\varepsilon}^{R} = 1.5$.
The average population-weighted state tax rate is $\bar{\tau} = 0.2 \cdot 0.14 + 0.8 \cdot 0.05 = 0.068$. Using equation (E.4) above, we thus find the policy-relevant elasticity ε above to be

$$\begin{aligned}
\varepsilon &= \varepsilon^{\kappa} \left[\sum_{s \in S} n_s \frac{R_s}{(1 - \tau_F - \tau_s)} \right] \cdot \frac{\left[\sum_{s \in S} n_s \left(1 - \tau_F - \tau_s\right) \right]}{\left[\sum_{s \in S} n_s R_s \right]} \\
&= 1.5 \cdot \left[\frac{0.2 \cdot 25}{0.61} + \frac{0.8 \cdot 22}{0.7} \right] \cdot \frac{0.2 \cdot 0.61 + 0.8 \cdot 0.7}{0.2 \cdot 25 + 0.8 \cdot 22} \\
&= 1.5 \cdot 1.006 \\
&= 1.509.
\end{aligned}$$

The revenue-maximizing national capital gains tax rate implied by this elasticity is thus

$$\tau_F^{*} = \frac{1 - \bar{\tau}_S}{1 + \varepsilon} = \frac{1 - 0.068}{1 + 1.509} = 0.371.$$

[22]These values are roughly consistent with actual numbers for people in the top 10% of the wealth distribution in the US in 2016, with the population rebased to 100 individuals and the realized capital gains per capita given in thousands of dollars.
[23]These values are close to what we find in our specification using big tax changes only.

References

Bakija, Jon M, and William M Gentry. 2014. "Capital gains taxes and realizations: Evidence from a long panel of state-level data." *Unpublished Manuscript, Williams College.*

Bogart, William T, and William M Gentry. 1995. "Capital gains taxes and realizations: Evidence from interstate comparisons." *The Review of Economics and Statistics*, 267–282.

Doerrenberg, Phillipp, Andreas Peichl, and Sebastian Siegloch. 2017. "The elasticity of taxable income in the presence of deduction possibilities." *Journal of Public Economics*, 151: 41–55.

Dowd, Tim, Robert McClelland, and Athiphat Muthitacharoen. 2015. "New evidence on the tax elasticity of capital gains." *National Tax Journal*, 68(3): 511.

Gravelle, Jane G. 2020. "Capital Gains Tax Options: Behavioral Responses and Revenues." Vol. 41364.

Gruber, Jon, and Emmanuel Saez. 2002. "The elasticity of taxable income: evidence and implications." *Journal of Public Economics*, 84: 1–32.

Kleven, Henrik, and Esben Schultz. 2014. "Estimating Taxable Income Responses Using Danish Tax Reforms." *American Economic Journal: Economic Policy*, 6: 271–301.

Piketty, Thomas, Emmanuel Saez, and Gabriel Zucman. 2018. "Distributional national accounts: methods and estimates for the United States." *Quarterly Journal of Economics*, 133(2): 553–609.

Saez, Emmanuel, Joel Slemrod, and Seth H. Giertz. 2012. "The Elasticity of Taxable Income with Respect to Marginal Tax Rates: A Critical Review." *Journal of Economic Literature*, 50(1): 3–50.

Smith, Matthew, Owen M Zidar, and Eric Zwick. 2020. "Top Wealth in America: New Estimates and Implications." Working Paper.