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NEW YORK UNIVERSITY
SCHOOL OF LAW

“The Tax Elasticity of Capital Gains and Revenue-Maximizing
Rates.”

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Via Zoom
Time: 2:00 – 3:50 p.m. EST
Week 11

SCHEDULE FOR FALL 2020 NYU TAX POLICY COLLOQUIUM

(All sessions meet online on Tuesdays, from 2:00 to 3:50 pm EST)

1. Tuesday, August 25 – Steven Dean, NYU Law School. “A Constitutional Moment in Cross-Border Taxation.”
2. Tuesday, September 1 – Clinton Wallace, University of South Carolina School of Law. “Democratic Justice in Tax Policymaking.”
3. Tuesday, September 8 – Natasha Sarin, University of Pennsylvania Law School. “Understanding the Revenue Potential of Tax Compliance Investments.”
4. Tuesday, September 15 – Adam Kern, Princeton Politics Department and NYU Law School. “Illusions of Justice in International Taxation.”
5. Tuesday, September 22 – Henrik Kleven, Princeton Economics Department. “The EITC and the Extensive Margin: A Reappraisal.”
6. Tuesday, September 29 – Leandra Lederman, Indiana University Maurer School of Law. “Of Risks and Remedies: Best Practices in Tax Rulings Transparency.”
7. Tuesday, October 6 – Daniel Shaviro, NYU Law School. “What Are Minimum Taxes, and Why Might One Favor or Disfavor Them?”
8. Tuesday, October 13 – Gabriel Zucman, University of California, Berkeley. “The Rise of Income and Wealth Inequality in America: Evidence from Distributional Macroeconomic Accounts.”
9. Tuesday, October 20 – Michelle Layser, University of Illinois College of Law. “How Place-Based Tax Incentives Can Reduce Economic Inequality.”
10. Tuesday, October 27 – Steve Rosenthal and Theo Burke, Urban-Brookings Tax Policy Center. “Who’s Left to Tax? US Taxation of Corporations and their Shareholders.”
11. Tuesday, November 10 – Owen Zidar, Princeton Economics Department. “The Tax Elasticity of Capital Gains and Revenue-Maximizing Rates.”
12. Tuesday, November 17 – Abdoulaye Ndiaye, NYU Stern Business School. “Redistribution With Performance Pay.”
13. Tuesday, November 24 – Lilian Faulhaber, Georgetown Law School. “Searching for Coherence: The Overuse of Excess Returns and Excess Profits.”
14. Tuesday, December 1 – Erin Scharff, Arizona State Sandra Day O’Connor College of Law. “Revisiting Local Income Taxes.”

The Tax Elasticity of Capital Gains and Revenue-Maximizing Rates*

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Abstract

This paper estimates the effect of capital gains taxation on realizations and explores the implications for revenue-maximizing rates. We use new data and an event study approach to estimate elasticities at the state level, and then develop a framework for determining revenue-maximizing rates at the federal level. We find that the elasticity of revenues with respect to the tax rate over a ten-year period is -0.5 to -0.3. These estimates correspond to revenue-maximizing rates of 33 and 47 percent and imply that a 5 percentage point rate increase would yield \$18 to \$30 billion in annual federal tax revenue.

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1 Introduction

The tax elasticity of capital gains realizations features centrally in U.S. fiscal policy debates. In the 1990s “capital gains tax wars,” U.S. Treasury and economic officials argued that the responsiveness of realizations to capital gains tax rates was large enough that capital gains tax cuts would pay for themselves (Auten and Cordes, 1991). Others (e.g., Gravelle, 1991) asserted that the true responsiveness was much lower, so capital tax cuts would generate substantial fiscal cost. This issue has re-emerged in every presidential administration since 1990 and plays a key role in ongoing tax reform plans. For instance, this elasticity is the central parameter governing the revenue scores of Vice President Biden’s plan to increase capital gains rates as well as President Trump’s proposal reducing capital gains taxes.

Informing these policy debates is difficult because there is a wide range of existing estimates. Feldstein, Slemrod and Yitzhaki (1980), for example, estimate an elasticity with respect to the capital gains tax rate of -3.8, whereas the estimate of Burman and Randolph (1994) is -0.22. Moreover, there is limited empirical evidence in recent decades when there has been lower inflation and a bigger role of pass-through firms, which have accounted for nearly half of capital gains realizations in recent years (Smith, Yagan, Zidar and Zwick, 2019).

This paper estimates the effect of capital gains taxes on tax revenues and quantifies the implications for revenue-maximizing tax rates in the United States. We use an event-study approach and new state-level panel data on capital gains realizations and the migration of the wealthy to estimate the effects of state capital gains tax changes on realizations and location decisions. Our data, which range from 1980 to 2016, allow us to characterize responsiveness in a more recent period than most of the literature, and our event-study approach enables us to estimate effects over different time horizons and test for dynamic effects. We then build a simple framework to relate these state-level effects to a policy-relevant elasticity at the national level, which is the state-level realization response after removing migration effects and accounting for average state taxes and a minor aggregation adjustment term. We find that this policy-relevant elasticity of realizations with respect to capital gains tax rates over a ten year period is approximately -0.3 to -0.5 depending on the specification, and that the estimates are modestly larger in absolute value in the short and medium run than in the long run.

We highlight three implications of these elasticity estimates. First, these estimates are well below an elasticity of one in absolute value, which indicates that capital gains tax cuts do not pay for themselves. We formally test and reject the null of an elasticity of -1.0. Second, our elasticity estimates of approximately -0.5 and -0.3 correspond to point estimates for the revenue-maximizing capital gains tax rates of 33 and 47 percent, respectively. Third, these estimates suggest that raising capital gains tax rates by 5 percentage points (in the current regime with unlimited deferral and step-up-basis at death) would yield 18 to 30 billion in annual tax revenue, which is roughly twice the amount suggested based on recent estimates from the Joint Committee on Taxation (JCT), which according to Gravelle (2020) currently uses an elasticity of -0.7 to score proposals.¹

¹Gravelle (2020) also notes that Treasury had used an estimate of -1.0 previously, but has since moved closer to the JCT’s estimate. In addition, Dowd, McClelland and Muthitacharoen (2015), whose paper first appeared as a technical working paper (JCX-56-12) of joint work of the staff of the JCT and CBO, estimate an elasticity of -0.72. Appendix Figure A.1 plots elasticity estimates by publication year and approach, which were compiled by Gravelle (2020).

Using state-level panel data provides evidence from substantially more reforms and closer comparison groups than time-series analysis at the federal level. At the federal level, there are not only fewer reforms but also many confounding factors. Figure 1 plots realizations and the maximum long-run capital gains tax rate since 1980. It shows that some capital gains tax changes are associated with sizable movements in realizations, but the responses are quite unequal across reforms. It is also quite difficult to separate these movements from unrelated macroeconomic trends and asset price fluctuations. One approach is to difference out macroeconomic trends by comparing the realization series in one county with that of a similar country. In panels (b) and (c) of Figure 1, we implement this approach, using the realization series of the U.K. around cuts to the U.S. capital gains tax rate in 1997 and 2003. Our analysis yields unstable elasticity estimates that exhibit large variance in non-tax-related country-year shocks and also inherit the limitations of cross-country regressions.

Our state-level approach complements prior work by [Bogart and Gentry \(1995\)](#), who use state panel data from 1979 to 1990 to estimate the effect of capital gains tax rates on on state-level realizations per tax return, and ongoing work by [Bakija and Gentry \(2014\)](#), who use a similar approach for a longer panel from 1950-2007. Relative to this valuable work, our paper uses a different empirical approach and new data to provide new policy-relevant elasticity estimates based on a more recent sample that is closer to current conditions in terms of inflation, pass-through prevalence, and tax code. In addition, by having a better measure of location decisions of the wealthy, our approach also provides a more accurate accounting for migration effects, and thus policy-relevant realization effects, which difference out migration responses. Moreover, we use an event study approach that contributes new graphical evidence on the dynamics of realizations around tax changes. Scoring capital gains tax changes requires estimating how realizations evolve over a ten-year period around the tax change, which, to the best of our knowledge, has not been done in prior work. Much of the literature on capital gains in the 1990s and 2000s (e.g., [Burman and Randolph, 1994](#); [Auerbach and Siegel, 2000](#); [Poterba, 2002](#); [Auten and Joulfaian, 2004](#)) has focused on the distinction between temporary and permanent effects, and used individual-level data to estimate these effects. The interpretation of these individual-level results, however, is complicated by factors such as strategic loss-harvesting, observations with zero realizations, and movement in and out of top income brackets depending on the timing of big realizations. While standard approaches exist for addressing these concerns (e.g., selection corrections ([Heckman, 1979](#)) to account for realization decisions and instruments for tax rates), aggregating within a state-year cell avoids these complexities and also provides a longer panel than many existing individual-level studies. In addition, mapping estimates of micro-level responses, which are often person-weighted rather than dollar-weighted, into policy-relevant macro effects on tax revenues can be difficult.² Indeed, [Joint Committee on Taxation \(1990\)](#) highlighted similar concerns when evaluating the available literature to score reforms during the capital tax wars. Some recent promising work using bunching approaches (e.g., [Dowd, McClelland and Mortenson, 2019](#); [Buhlmann, Doerrenberg, Loos and Voget, 2020](#)) also faces the challenge of mapping bunching responses into policy-relevant elasticities. Our state-level approach has the benefit of estimating aggregate responses, while also providing considerable variation over a long panel.

²For example, choosing the weights (especially for those with losses) and accounting for heterogeneous responses introduces difficulties when aggregating from micro to macro.

2 Data on Capital Gains Taxation and Realizations

Our primary outcome variable is realized capital gains by state and year from [Smith, Zidar and Zwick \(2020\)](#), which is available from 1980 to 2016. We inflate nominal data using CPI-U from the Bureau of Labor Statistics to measure realizations in 2018 USD. We also use data from 1980 to 2016 on the number of wealthy individuals by state and year from [Smith, Zidar and Zwick \(2020\)](#). Specifically, we focus on the number of individuals in the top 10% and top 1% of the national wealth distribution. Finally, some specifications use population and output data from the US Census Bureau and the Bureau of Economic Analysis.

We relate these state-level outcomes to the net-of-capital-gains-tax rate in state s in year t , which is $(1 - \tau_{s,t}) \equiv 1 - \tau_t^{fed} - \tau_{s,t}^{state}$, where τ_t^{fed} and $\tau_{s,t}^{state}$ are the maximum marginal federal and state tax rates, respectively. We use maximum long-term capital gains tax rates from NBER TAXSIM. This measure incorporates the deductibility of state and local taxes, the phase out of deductions, and other state-year-specific features of the tax code.³

The tax rate data are available from 1977 to 2017, which is a slightly longer range of years than the realizations and count data. We use these extra years when estimating longer-term effects. For example, although we cannot use a state tax reform in 1978 to identify the short-term impact on realizations, it can still contribute to the identification of longer-term effects.

Table 1 provides summary statistics. On average, state capital gains tax rates are 4 percent, but they range from 0 to 15 percent in our sample. Figure 1 plots the maximum federal tax rate over time. The current maximum capital gains tax rate is 23.8 percent. Combining both tax rates and accounting for interactions and phase-outs results in an effective keep rate of 75 percent on average, indicating that a dollar of realized capital gains amounts to 75 cents after taxes.

Our identifying variation comes from changes in the combined state and federal tax rate. Since our approach compares states before and after tax changes, most of the variation comes from state policy changes; that is, federal policy changes largely cancel out since their influence is similar across states. We find a total of 584 changes in state capital gains tax rates throughout our panel. Most of these changes are fairly small, which reflects the fact that our tax rate measure includes the effect of deductions and other minor provisions of state tax codes, so any changes to these can cause the capital gains tax rate to change by a very small amount. The largest changes, however, are in excess of 4 percentage points (Table A.1). In total, we have 128 state tax changes that exceed 1 percentage point in absolute value. In Appendix Figure A.2, we provide a histogram of all changes. As we show below, our results are robust to using variation only from these larger tax changes.

We examine whether economic and policy variables are associated with changes in state capital gains tax rates in Appendix Table A.2. Specifically, we regress indicators for capital gains tax increases and decreases on lags of state unemployment rates, GDP per capita, and state tax rates on personal and corporate income.⁴ Most

³Note that from a theoretical point of view, the appropriate tax rate to use for the explanatory variable would be the average marginal tax rate, since the marginal tax rate governs individual decision-making. However, such a measure is not available at the state level, and would also be endogenous as the marginal tax rate itself depends on individual decisions. However, because most capital gains are realized by individuals in the top tax bracket, the maximum tax rate is a good approximation of the average marginal tax rate and avoids endogeneity problems.

⁴Appendix Table A.3 also shows that changes in state capital gains tax rates are often accompanied by changes in state

coefficients are insignificant and small, though notably, higher unemployment in the previous year is associated with a higher probability of increasing the capital gains tax rate. In our main analysis, we include specifications that condition on unemployment prior to tax reforms and do not find evidence that this relationship affects our estimates.

3 Methods

3.1 Estimating the Annual Effects of Capital Gains Tax Changes

We investigate the effects of log net-of-tax rates on log realized capital gains and on log counts of wealthy residents. We run direct projections regressions for different time horizons $h \in \{-10, -9, \dots, 9, 10\}$:

$$y_{s,t+h} = \beta_h \Delta \log(1 - \tau_{s,t}) + \mathbf{X}'_{s,t} \mathbf{\Lambda}_h + \gamma_{s,h} + \phi_{t,h} + \varepsilon_{s,t,h} \quad (1)$$

where s and t indexes state and calendar years, $y_{s,t+h}$ is the outcome variable in year $t+h$ (log realized capital gains in our main specification), $\gamma_{s,h}$ and $\phi_{t,h}$ are horizon-specific state and year fixed effects, and $\mathbf{X}_{s,t}$ is a vector of controls. The main parameters of interest are the sequence of $\{\beta_h\}_{h=-10}^{10}$, which describe the path of realized capital gains around the tax change. The variable $\Delta \log(1 - \tau_{s,t})$ is the right-hand side variable of interest and represents a one-year change in the log net-of-tax rate. To express the results as elasticities at different horizons, we normalize the coefficients to be relative to the coefficient in the year before the tax change, i.e., we define elasticities $\delta_h \equiv \beta_h - \beta_{-1}$. For example, $\delta_5 = \beta_5 - \beta_{-1}$ measures the elasticity of realized capital gains 5 years after the reform⁵ with respect to the capital gains net-of-tax rate, where the change in realizations is relative to the year before the tax event. We plot the δ_h estimates in our main figures.

In our baseline specification, we control for the vector $\mathbf{X}_{s,t}$ of leads and lags of changes in the log net-of-tax rate, i.e., $\mathbf{X}'_{s,t} \mathbf{\Lambda}_h = \sum_{r=-10, r \neq 0}^{10} \lambda_r^h \Delta \log(1 - \tau_{s,t+r})$. Controlling for these other leads and lags of capital gains tax changes isolates the effect of a given tax reform. Without these controls, estimates would reflect the effect of not just the tax reform of interest, but also any other reforms occurring within the event window. If the timing and direction of reforms were randomly assigned, this would not be a problem, but if there is any type of autocorrelation of tax reforms, estimates might be biased. For instance, if tax changes have a tendency to be mean reverting – such that tax cuts are often followed by tax increases over the subsequent years and vice versa – our longer run estimates would be biased towards zero. The point estimate for year 10, for example, would not only reflect the effect of the reform 10 years prior, but also the effect of any reforms in the meantime, which would tend to push the estimate in the opposite direction.⁶ As a robustness check,

personal income tax rates. As described below, we include in our main table specifications that do (as well as those that do not) control for leads and lags of changes in state tax rates on personal and corporate income.

⁵We generally use the terms “reform” and “tax change” interchangeably to indicate any non-zero value of $\Delta \log(1 - \tau_{s,t})$.

⁶We do indeed see evidence of mean reversion in our data. Controlling for state and year fixed effects, we find that 10 years after an increase (decrease) in the net-of-tax rate, the average net-of-tax rate is 17% (s.e. 10%) lower (higher) than in the year immediately following the reform. This effect can be seen graphically in Figure A.3 in the Online Appendix. This result shows that state tax reforms do exhibit some degree of mean reversion, making our controls for other reforms appropriate. Neverthe-

we also run specifications featuring additional controls in $\mathbf{X}_{s,t}$, including GDP in pre-reform year $t - 1$, GDP-growth-bin-by-year dummies, state unemployment in pre-reform year $t - 1$, and changes in state corporate and personal income taxes. Finally, we include a specification which interacts the tax change with indicators based on the size of the tax change, and report estimates for β_h coming only from larger tax reforms that exceed 1 percentage point in absolute value.⁷

We provide additional analysis of this empirical specification in Appendix C to show that our approach accurately recovers the main elasticities of interest in a simulation that specifies a data generating process and compares the performance of our approach to alternative specifications.

Comparison to prior approaches that estimate 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. 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 form:

$$\log CG_t = \gamma \cdot \tau_t. \quad (2)$$

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.⁸ However, the two models generate somewhat 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 (2) 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.5, the difference between the predictions of these models grows larger when the tax rate is extrapolated further out of sample. 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) 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 (2) implies that the percentage change in realizations would

less, in the Appendix, we do show the results of a direct projections specification that excludes the vector of controls for other reforms. We also show a classic event study specification which includes all the leads and lags of the tax reform variable within the same regression. In both cases, we find fairly similar results.

⁷In particular, we modify the baseline specification by estimating separate coefficients for large and small tax changes, i.e., we fit $y_{s,t+h} = \beta_h^{big} \times \mathbf{1}(|\Delta(1 - \tau_{s,t})| \geq 0.01) \times \Delta \log(1 - \tau_{s,t}) + \beta_h^{small} \times \mathbf{1}(|\Delta(1 - \tau_{s,t})| < 0.01) \times \Delta \log(1 - \tau_{s,t}) + \mathbf{X}'_{s,t} \mathbf{\Lambda}_h + \gamma_{s,h} + \phi_{t,h} + \varepsilon_{s,t,h}$, where $\mathbf{1}(|\Delta(1 - \tau_{s,t})| \geq 0.01)$ is an indicator for large tax reforms, $\mathbf{1}(|\Delta(1 - \tau_{s,t})| < 0.01)$ is an indicator for small tax reforms, and β_h^{big} and β_h^{small} are the corresponding tax-change-size-specific coefficients. We report the results based on the β_h^{big} coefficients for this large tax change specification.

⁸Appendix Figure A.4 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.

be the same whether tax rates were increased from 20 to 21 percent or from 99 to 100 percent, which seems unrealistic 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.

3.2 Estimating effects over multiple years

We extend the method in equation (1) to estimate the elasticity of capital gains realizations over longer time horizons. First, we consider a direct projections specification that estimates the effect of tax reforms on realizations in three-year bins, yielding estimates of the elasticity in the short (0-2 years), medium (3-5 years) and longer run (6-8 years):

$$y_{s,t+h} = \tilde{\beta}_h \Delta_3 \log(1 - \tau_{s,t}) + \mathbf{X}'_{s,t} \tilde{\Lambda}_h + \tilde{\gamma}_{s,h} + \tilde{\phi}_{t,h} + \tilde{\varepsilon}_{s,t,h}, \quad (3)$$

where $\Delta_3 \log(1 - \tau_{s,t})$ represents the three-year change in the log net-of-tax rate (i.e., $\Delta_3 \log(1 - \tau_{s,t}) = \log(1 - \tau_{s,t}) - \log(1 - \tau_{s,t-3})$). For each value of $h \in -9, -6, \dots, 6, 9$, we estimate a separate instance of this regression across s and t . The controls for other reforms in this regression are also specified in 3-year bins: the vector of controls $\mathbf{X}_{s,t}$ now contains the variables $\Delta_3 \log(1 - \tau_{s,t+r})$ for $r = -9, -6, -3, 3, 6, 9$. We use the notation $\tilde{\beta}$, $\tilde{\Lambda}$, etc, to distinguish the parameters in equation (3) from their analogues in equation (1).

To understand why this specification correctly identifies the average elasticity over the specified three-year periods, it is helpful to consider a simple example. Suppose there is a state that changes its capital gains tax rate exactly once within our panel, in year 2000. In this simple case, $\Delta_3 \log(1 - \tau_{s,t})$ takes a value of zero for this state in every year except three: $t = 2000, 2001, 2002$. Now consider the regression above for $h = 0$. The variable $\Delta_3 \log(1 - \tau_{s,t})$ is non-zero whenever the left-hand side variable is $y_{s,2000}, y_{s,2001}$ or $y_{s,2002}$. Therefore, the coefficient $\tilde{\beta}_0$ will capture the average effect of the tax reform on capital gains in these three years. Suppose now instead $h = -3$. In this case, our left-hand side variable of $y_{s,t+h}$ becomes $y_{s,t-3}$. Since $\Delta_3 \log(1 - \tau_{s,t})$ is still zero for all t except 2000, 2001, and 2002, $\tilde{\beta}_{-3}$ captures the effect of the tax reform on $y_{s,1997}, y_{s,1998}$ and $y_{s,1999}$ (the only $y_{s,t-3}$ such that $t \in 2000, 2001, 2002$). Now, define $\tilde{\delta}_0 \equiv \tilde{\beta}_0 - \tilde{\beta}_{-3}$. $\tilde{\delta}_0$ here captures the difference in realizations in the periods immediately after and before the reform. In our example, $\tilde{\delta}_0$ represents the difference between average realizations in post-reform years 2000-2002 and average realizations in pre-reform years 1997-1999. In other words, $\tilde{\delta}_0$ identifies the average elasticity over a 0-2 year horizon relative to the reform year. Similarly, $\tilde{\delta}_3 \equiv \tilde{\beta}_3 - \tilde{\beta}_{-3}$ would identify the impact of the reform on the difference between average realizations in 2003-2005 and 1997-1999, thus giving us an average elasticity over a 3-5 year horizon, and so on.

Finally, to get a single estimate of the effect of capital gains tax reforms on realizations in the decade following the reform, we use the following specification:

$$y_{s,t} = \beta_\ell \Delta_{11} \log(1 - \tau_{s,t}) + \mathbf{X}'_{s,t} \hat{\Lambda}_h + \hat{\gamma}_{s,h} + \hat{\phi}_{t,h} + \hat{\varepsilon}_{s,t,h}, \quad (4)$$

where $\Delta_{11} \log(1 - \tau_{s,t}) = \log(1 - \tau_{s,t}) - \log(1 - \tau_{s,t-11})$.⁹ To estimate the elasticity for the 0-10-year estimate, we take the point estimate β_ℓ from this regression and subtract off the point estimate $\tilde{\beta}_{-3}$ from (3).¹⁰

Some readers might wonder why we use the specifications above to estimate multi-year effects. Another approach would be to estimate average outcomes for different time horizons around tax change events. However, this event-study style approach is not easily implemented since many states have multiple reforms during our sample, which complicates characterizing event time for specific calendar years by state. An alternative approach would create a panel with duplicated observations, which would create a separate set of pre-reform and post-reform observations for each reform present in the data. We decided against this approach since it would weigh observations in states with many capital gains reforms too heavily relative to observations in states with few reforms. While there are ways to implement this duplicated observation approach empirically, we use the approach described above because it performs well in simulations in terms of recovering elasticities at different horizons, which we verify and describe in Appendix C.2.

4 Capital Gains Tax Changes and Realizations at the State-Level

Figure 2 shows the results of our baseline specification from equation (1). The figure illustrates how capital gains realizations evolve before and after a change in the capital gains net-of-tax rate, controlling for other state capital tax reforms. We see no clear pre-trend: in each of the ten pre-reform years, capital gains realizations tend to be stable. We then see a jump soon after the reform, after which the point estimates decline modestly throughout the post-period. Unlike the 1986 and 2012 national reforms shown in Figure 1, we do not see evidence of anticipation effects preceding state capital gains tax reforms. Before some federal reforms, individuals have rushed to realize capital gains after the announcement of a tax hike but before it takes effect, or conversely, to avoid realizing gains just ahead of a tax cut. If such an effect were present at the state level, it would have manifested itself as a downward spike at year -1 relative to the point estimates in the prior years.

On average across all post-reform years, the point estimates directly provide an elasticity estimate of capital gains realizations with respect to the net-of-tax rate of around 3.18, with a modest decline over time. Expressed as an elasticity with respect to the tax rate, as has been common in the previous literature (Gravelle, 2020) which uses a 22% baseline tax rate, this estimate implies an elasticity with respect to the tax rate of around -0.9 ($= 3.18 \times \frac{-.22}{1-.22}$).¹¹

The dynamics of this response are also of interest. In Figure 2, there is a modest downward trend over

⁹In this specification, the vector of controls $\mathbf{X}_{s,t}$ contains variables that are still 3-year binned versions before and after the long bin: $\Delta_3 \log(1 - \tau_{s,t+r})$ for $r = -17, -14, -11, 3, 6, 9$.

¹⁰In table 2, we report outcomes from two alternative specifications. In the specification which controls for state income and corporate tax changes, these controls are “binned” in the exact same way and over the same years as we describe for the capital gains tax variable in this section. In the specification that uses big effects only, we replace the right-hand side variable of interest – for instance, $\Delta_3 \log(1 - \tau_{s,t})$ – with two variables: $\Delta_3^{big} \log(1 - \tau_{s,t}) \equiv \sum_{k=0}^2 \Delta \log(1 - \tau_{s,t-k}) \times \mathbf{1}(|\Delta(1 - \tau_{s,t-k})| \geq 0.01)$, which sums all the tax changes greater than 1 percentage point in magnitude over the past year, and a corresponding variable that sums all tax changes smaller than 1 percentage point. We then report estimates for the variable that sums the big changes. For the 0-10 year version of the estimate, we proceed analogously, constructing variables that sum changes greater (smaller) than 1 percentage point over the preceding 11 years.

¹¹Note that the sum of the effective federal tax rate of 17.79% and the average state capital gains tax rate is approximately 22% in 2018.

the post-period. Combining some of our individual year point estimates, the estimated short-run elasticity $\frac{1}{3} \sum_{h=1}^3 \hat{\delta}_h$ is 3.61 (s.e. 1.22), whereas the longer run estimate $\frac{1}{3} \sum_{h=8}^{10} \hat{\delta}_h$ is somewhat lower at 2.59 (s.e. 1.42). However, we cannot reject the null that these effects are the same.

We explore the robustness of these results in a several ways in Panel (b) of Figure 2, and in the Appendix (Figures A.6-A.11). Figure 2(b) shows the point estimates from five different robustness tests: (1) controlling for pre-event state GDP, (2) controlling for pre-event state GDP growth, (3) controlling for pre-event state unemployment rates, (4) only using large reforms that change the capital gains tax rate by at least 1 percentage point, and (5) controlling for changes in state income and corporate tax rates. The results are remarkably similar. We also provide a range of other checks in the appendix that control for other state tax changes, focus on small versus large states, use different specifications, and exclude controls for leads and lags of state capital tax changes.

State capital gains tax rates often move in the same direction as state income tax rates (see Appendix Table A.3 for detailed tabulations). Many states treat capital gains as regular income for tax purposes, in which case the capital gains tax rate will be identical to the income tax rate. For this reason, we might worry that part of the response we observe could come from taxpayers reacting to income tax changes rather than capital gains tax changes. For instance, part of the changes in realized capital gains might be a secondary spillover effect due to reduced wage earnings and savings. To account for this possibility, we use a specification that controls for changes in personal income and corporate taxes, and Panel (b) of Figure 2 illustrates that the elasticity estimates from this specification are very similar to the baseline (if not perhaps slightly lower, indicating slightly less responsiveness on average and thus lower elasticities in absolute value than the baseline specification without these additional controls).

5 Federal Revenue-Maximizing Rates

In this section, we present a framework that shows how to use the estimates from above to infer the policy-relevant elasticity at the national level. We then derive an estimate for the revenue-maximizing tax rate and calculate revenue effects of a hypothetical five percentage point tax rate increase.

5.1 A Simple Model of State-Level Capital Gains Realizations

Consider a country with a number of states $s \in S$. There is a federal capital gains tax rate τ_F as well as ones set by individual states, τ_s . Any individual residing in state s will retain a share $(1 - \tau_F - \tau_s)$ of their realized capital gains.

We can decompose total realized capital gains in state s into two terms:

$$CG_s = N_s (1 - \tau_F - \tau_s, \tau_{-s}) R_s (1 - \tau_F - \tau_s), \quad (5)$$

where $N_s(1 - \tau_F - \tau_s, \tau_{-s})$ represents the number of residents in state s ,¹² and $R_s(1 - \tau_F - \tau_s)$ represents realized capital gains per resident *conditional* on residing in state s .

Using equation (5), we can decompose the empirical elasticity of capital gains with respect to the net-of-tax rate:

$$\varepsilon^{CG} = \frac{\partial \log CG_s}{\partial \log(1 - \tau_F - \tau_s)} = \frac{\partial \log N_s}{\partial \log(1 - \tau_F - \tau_s)} + \frac{d \log R_s}{d \log(1 - \tau_F - \tau_s)} = \varepsilon^N + \varepsilon^R. \quad (6)$$

In this framework, ε_s^{CG} is the sum of two elasticities: a migration elasticity ε^N and a realization elasticity ε^R , which is the main object of interest and represents the “pure” per capita response of capital gains realizations to the net-of-tax rate.

5.2 From State-Level Realizations to the Federal Revenue-Maximizing Tax Rate

Given an estimate of ε^R , we show in Online Appendix Section D that we can compute the federal capital gains tax rate that maximizes federal tax revenue as follows:

$$\tau_F^* = \frac{1 - \bar{\tau}_S}{1 + \varepsilon^R}. \quad (7)$$

This formula resembles familiar optimal tax models (Saez, 2001; Diamond and Saez, 2011), but has an additional aggregation adjustment term $\bar{\tau}_S$ that denotes the average population-weighted state tax rate. The presence of this term reflects the fact that taxpayers face both state and federal taxes, and that their behavioral response takes the combined tax rate into account.¹³ Therefore, the policy-relevant elasticity at the federal level is $\varepsilon^R = \varepsilon^{CG} - \varepsilon^N$, our estimate of the elasticity of capital gains realizations at the state level less the migration elasticity.

5.3 Estimating the Federal Revenue-Maximizing Tax Rate

In the previous subsection, we showed that deriving the policy-relevant elasticity depends on an estimate of the migration elasticity ε^N . Although the model assumes homogenous individuals, capital gains are concentrated among the wealthiest individuals in practice (Smith, Zidar and Zwick, 2020). The importance of this group for the capital gains tax base motivates estimating ε^N based on the responses of those at the top of the national wealth distribution. To do this, we use our framework from equation (1), with the outcome variable being the share of the state population that belong to either the top 10% or the top 1% of the national wealth distribution.

Panels (a) and (b) of Figure 3 show the outcome of this specification for the top 10% and top 1% groups,

¹² $N_s(1 - \tau_F - \tau_s, \tau_{-s})$ is a function of tax rates in all states as migration decisions may depend on the difference in tax rates across states.

¹³In fact, for equation (7) to be exact, the parameter ε^R must be multiplied by an adjustment factor to account for the fact that an elasticity measured at the aggregate level is not necessarily exactly equal to the mean of elasticities at a more granular level. The adjustment factor is a function of state populations, state net-of-tax rates, and per capita capital gains realizations in a given year, but it is very close to 1 in every year in the sample. The value in 2016, for example, is 1.0025. We use this value to adjust our empirical estimates when calculating revenue-maximizing tax rates in section 5.3. Because this adjustment factor is so close to 1 that it is almost negligible, we do not go into detail here, but refer to Online Appendix Section D for further details.

respectively. We see fairly stable pre-trends, though somewhat noisy in the earliest pre-periods for the top 1% group. Following an increase in the net-of-tax rate, the share of residents in each of the top groups grows, and the magnitude of the response is larger for the top 1% group. Connecting these migration responses to the theory requires weighing the following tradeoff. Focusing on the top 10% delivers a less noisy estimate, but risks putting too little weight on the responsiveness of those at the top who have substantial capital gains realizations in dollar terms.

Due to these considerations, our preferred measure of migration is a combination of the two measures above. Specifically, we define the outcome variable as: $\theta_s \ln N_{s,t}^{P99-P100} + (1 - \theta_s) \ln N_{s,t}^{P90-P100}$, which is a dollar-weighted convex combination of the two groups, with θ_s representing the state's wealth share of the top 1% relative to the top 10%.¹⁴ We adopt this approach because the ensuing regression coefficients will represent a weighted average of the migration elasticities of the top 1% and top 10%, with the former group weighted more heavily in states where they own a larger wealth share and therefore have a bigger impact on capital gains realizations.

To estimate ε^R , we first estimate ε^{CG} and ε^N using our binned specifications described in section 3.2, with log capital gains and our migration measure from above as outcome variables. We perform this estimation at various time horizons: A main estimate covering years 0-10 after each reform, as well as three-year bins of 0-2 years, 3-5 years, and 6-8 years. We then calculate $\hat{\varepsilon}_h^R = \hat{\varepsilon}_h^{CG} - \hat{\varepsilon}_h^N$ at each time horizon.

Panel (c) of Figure 3 shows the estimates from these binned regressions graphically. The grey series shows estimates of $\hat{\varepsilon}_h^{CG}$ at different horizons h , the dark blue series shows $\hat{\varepsilon}_h^R$, and the light blue shows the average policy-relevant elasticity over a decade following each reform, $\hat{\varepsilon}_{0-10}^R$.

Table 2 also provides estimates of our elasticities at various time horizons. In addition to the estimates of ε^R , we also translate our net-of-tax elasticity estimates into an elasticity with respect to the tax rate to facilitate comparisons to prior work. Table 2 also includes estimates from two alternative specifications: one in which we identify all elasticities from state tax reforms of at least 1 percentage point, and a second in which we control for all reforms to state income tax and corporate tax rates in a 21-year window around the capital gains tax reform in question.

Overall, our baseline estimate at a 0-10 year horizon gives an elasticity with respect to the net-of-tax-rate of approximately 1.87, which translates into an elasticity of -0.53 with respect to the tax rate. The specification using only large tax changes yields an elasticity with respect to the tax rate of -0.42 and the specification controlling for other state tax changes yields an elasticity with respect to the tax rate of -0.29. While these point estimates are somewhat noisy, the point estimates are notably smaller in absolute value than the conventional elasticities used by tax analysts. Moreover, we can definitively test and reject the null hypothesis that this elasticity with respect to the tax rate equals 1 in absolute value. The p-values for the

¹⁴ θ_s is defined as

$$\theta_s = \sum_t \frac{W_{s,t}^{P99-P100}}{W_{s,t}^{P90-P100}},$$

that is, it represents the average wealth share in state s of the top 1% within the top 10% across all years in our sample. Across all states in the sample, the mean of θ_s is 0.39. The minimum value is 0.28 (Iowa), while the maximum is 0.56 (District of Columbia), with Wyoming, Nevada and New York also having values above 0.5.

baseline, big-change-only, and other-tax-control specifications are 0.066, 0.021, and 0.31, respectively. This finding provides important evidence suggesting that capital gains tax cuts do not pay for themselves, which has been a prominent proposition in this literature (Joint Committee on Taxation, 1990; Auten and Cordes, 1991; Gravelle, 1991; Burman, 2010; Gravelle, 2020).

As in Figure 2, the results in Table 2 across all specifications show an elasticity which is somewhat bigger in absolute value in the short to medium run, and then declines in the longer run. This pattern could potentially reflect some transitory effects that are present in the short run but disappear over time. For instance, a tax cut may in the shorter run spur some individuals to realize accumulated gains to take advantage of the lower tax rate, particularly if they expect a possible reversal of the tax cut in the future. However, once many of these accumulated gains have been realized, the potential for realization of further gains is limited, and so the magnitude of the behavioral effect declines in the longer run.¹⁵

5.4 Policy Implications

These elasticity results have policy implications for revenue-maximizing tax rates and the revenue effects of capital gains tax reforms. Table 2 provides the corresponding estimates of the revenue-maximizing tax rate, $\hat{\tau}_F^*$, for each of our three main specifications by time-horizon. As shown in the table, our baseline elasticity estimate for the full 10-year period implies a revenue-maximizing rate around 33%, and the analogous estimates for the big-changes-only and control-for-other-tax-changes specifications are 38% and 47%, respectively. Thus, over a ten year budget window, these results suggest that a capital gains tax rate of around 40% would maximize federal capital gains tax revenues though the specific maximum estimate varies across specifications.

In terms of tax revenues, our elasticity estimates from Table 2 imply that annual federal tax revenues would increase by between \$18 billion and \$30 billion if the capital gains tax rate were increased by 5 percentage points.

To compute these revenue effects, we use our estimates of $\hat{\epsilon}^R$ which vary a bit across our three main specifications. By the definition of these elasticities, we can estimate how realizations and thus tax revenues change given an elasticity estimate and a tax rate change. In 2017, the most recent year that our state and federal tax data covers, the average combined maximum state and federal tax rate was 27.82%.¹⁶ We calculate behavioral effects of a tax increase using this rate as an approximation to the average marginal tax rate. An increase of 5 percentage points in the tax rate implies that the net-of-tax rate decreases by $\frac{0.05}{1-0.2782} = 6.93\%$. At our baseline 0-10 year policy-relevant elasticity of 1.87 (from Table 2), this implies that at this counterfactual tax rate, realizations would have been $6.93 \cdot 1.87 = 13$ percent lower, for a total of \$754.3 billion in realizations. Now, to calculate counterfactual tax revenue given this realizations amount, we need to use the *average* tax rate, which differs from the marginal. In 2018, the most recent year for which we have data on federal tax

¹⁵This possibility seems consistent with the graphical evidence that we find when we examine the behavioral effects following tax increases and tax decreases separately, which are shown in Appendix Figure A.9. Following a tax cut, we see a striking and immediate upward jump in realizations, and the effect grows even larger over the following 3-4 years. However, after this initial jump, the trend reverses, and the behavioral effect 7-9 years after a tax cut is much more modest. In contrast, the effect on realizations following a tax increase is much smaller and more stable over time.

¹⁶Note that the Tax Cuts and Jobs Act of 2017 did not make any substantial changes to federal capital gains taxation.

revenue, total capital gains realizations were \$890.6 billion (from [Piketty, Saez and Zucman, 2018](#)), and federal capital gains tax revenue was \$158.4 billion, yielding an average federal tax rate of $\frac{158.4}{890.6} = 17.79\%$. We assume that the 5 percentage points tax increase also applies to this number, for a counterfactual average tax rate of $17.79 + 5 = 22.79\%$.¹⁷ Applying this average tax rate to the counterfactual realizations amount yields tax revenue of $0.2279 \cdot 754.3 = \$176.6$ billion, an increase of 18.2 billion relative to the actual 2018 tax revenue. Repeating these steps but using the net-of-tax elasticity estimate of 1.01 from our specification with controls for other taxes would result in an increase of \$30.3 billion in tax revenues. Absent any behavioral response, which corresponds to an elasticity of zero, tax revenues from this 5 percentage point tax increase would increase revenues by \$44.5 billion. Thus, depending on the specification, our estimates indicate that at 22% effective tax rates, the behavioral response amounts to between a third and just over half of the mechanical revenue gains.

Our central elasticity estimate is lower than those in most existing studies, and our estimated revenue-maximizing tax rate is correspondingly higher. In particular, it is interesting to compare our estimated elasticity to that used by the JCT to evaluate the budgetary impacts of tax reforms. They currently assume an elasticity with respect to the tax rate of 0.68 ([Gravelle, 2020](#)), substantially higher than our estimate. This elasticity would imply a revenue gain from a 5 percentage point tax increase of only \$10.6 billion, or that about three-quarters of mechanical revenue gains are lost due to behavioral effects. Appendix Figure [A.1](#) provides an overview of our elasticity estimate, implied revenue-maximizing tax rate and revenue impact from a tax increase compared with what would be implied by previous studies. Note that all of these estimates apply to the current capital taxation regime with unlimited deferral and step-up-basis at death.

6 Conclusion

This paper estimates the effect of state capital gains tax changes on realizations at the state-level. These estimates reflect the responsiveness of both capital gains realizations as well as the migration of the wealthy. These overall effects at the state-level are of interest in their own right as many states consider revenue-raising options to address budgetary pressures. We hope that estimates of how state-level realizations evolve around state capital gains tax changes may serve as useful inputs into this process, as well as to the literature on state taxes, capital gains behavior, and migration.

We also provide policy-relevant elasticities at the federal level, which use a new framework to account for migration responses on the wealthy and other aggregation adjustments. Our main estimate is an elasticity of realizations with respect to the tax rate of -0.5 to -0.3 depending on the specification.

These main elasticity estimates are notably smaller than estimates used by official analysts to score federal tax reforms ([Gravelle, 2020](#)). These elasticity estimates, as well as their implications for revenue-maximizing rates and tax revenue effects, will hopefully be considered when evaluating reforms to capital gains taxation. Our bottom-line finding is that raising capital gains tax rates has sizable revenue-raising potential, and that

¹⁷In reality, marginal and average tax rates do not necessarily change by the same amount, depending on the structure of the tax reform. Here, we assume that they do.

cutting capital gains tax rates has substantial fiscal cost.

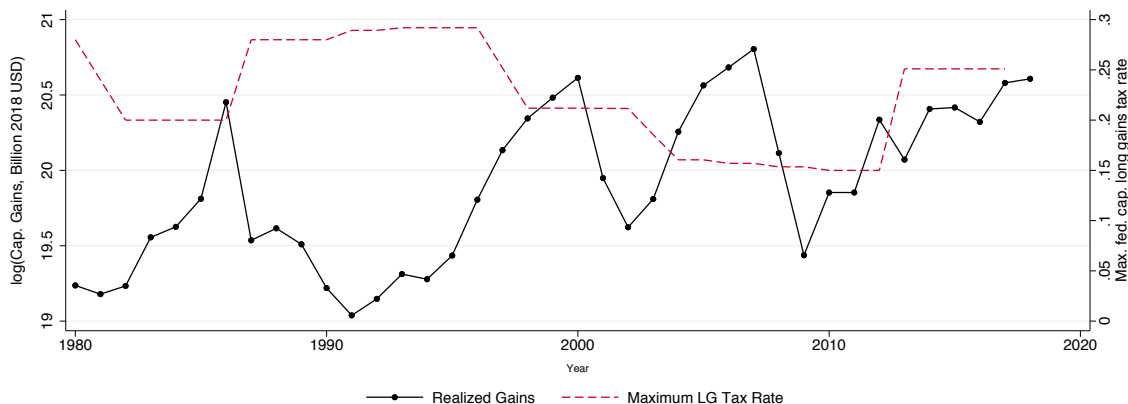
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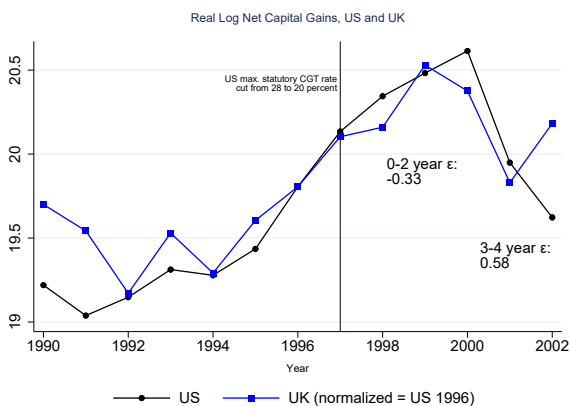
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Figure 1: Capital Gains Realizations and Tax Rates in the United States

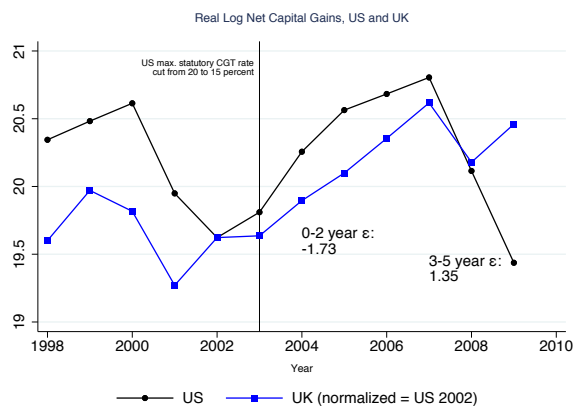
(a) Time-Series Evidence



(b) US vs. UK: 1997 Reform

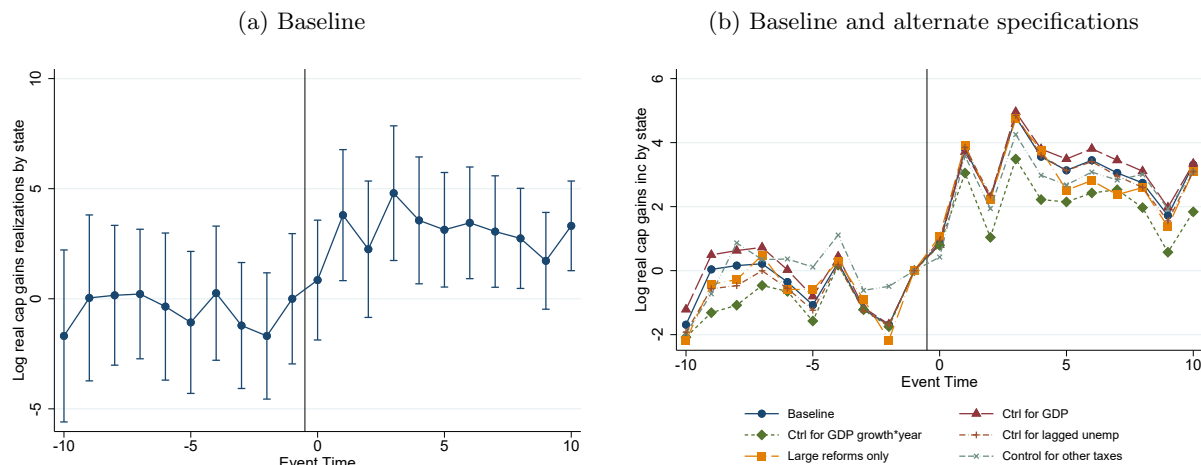


(c) US vs. UK: 2003 Reform



Notes: Panel (a) shows the evolution of realized capital gains and the maximum federal long-term capital gains tax rate from 1980 to 2018. Panels (b) and (c) compare realized capital gains in the US to those in the UK around the time of US reforms. In both of the panels, the UK capital gains tax rate was constant throughout the period shown. The UK series has been normalized to equal the US series in the year prior to the reform. We calculate the short-term (0-2 years) and medium-term (3-4 or 3-5 years) tax elasticities provided in panels (b) and (c) by normalizing the UK series in the year before reform, calculating the average difference between the normalized UK series and the US series during the period, and dividing that difference by the difference in US log net-of-tax rates before and after the reform. This calculation gives us elasticities with respect to the net-of-tax rate, which we then multiply by $\frac{-0.22}{1-0.22}$ to convert them into elasticities with respect to the tax rate, at a tax rate of 22%. We use this tax rate to facilitate comparisons between these numbers and those given in Table 2, where we also use a rate of 22% to calculate tax elasticities given net-of-tax elasticities. If instead we had calculated the tax elasticities in panels (b) and (c) using the prevailing US federal tax rates prior to each reform, we would have obtained tax elasticities in panel (b) of -0.48 in the short run and 0.85 in the medium run, and in panel (c) of -1.64 in the short run and 1.28 in the medium run. We do not include the fifth year post-reform in the medium-term analysis of panel (b) because this fifth year coincides with the 2003 tax reform shown in panel (c).

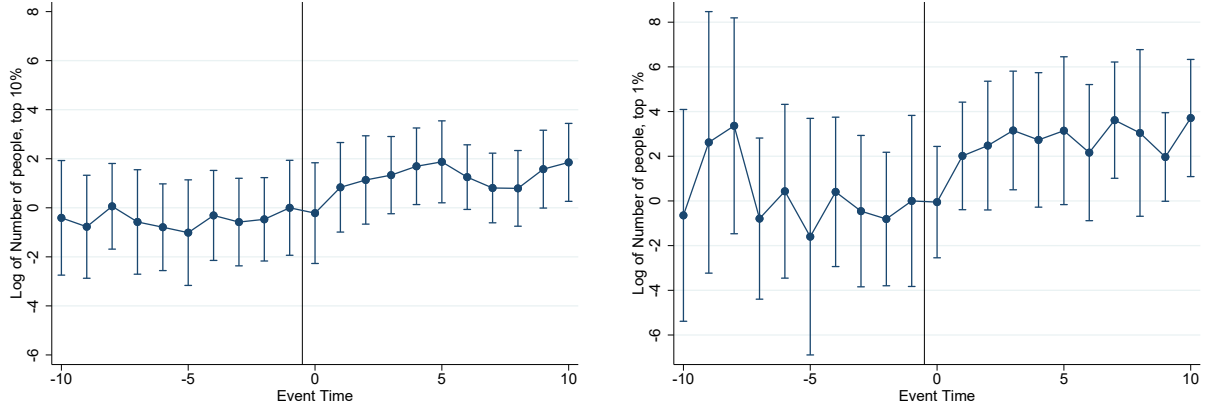
Figure 2: The Effect of Net-of-Tax Rate Changes on Capital Gains Realizations



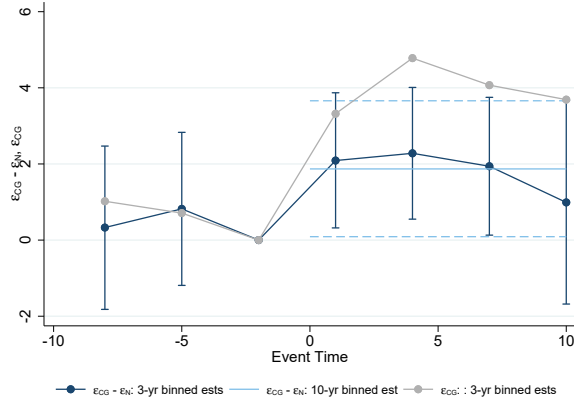
Notes: This figure presents our main results of the impact of state capital tax rate changes on capital gains realizations. The points plotted are the estimated coefficients from equation (1) for the impact of a one-period change in the total (federal and state) log net-of-tax capital gains tax rate on log capital gains realizations. The alternate specifications include the following: (1) controlling linearly for GDP in the year before the reform; (2) controlling for a set of dummies interacting prior GDP growth tertiles and years, where the prior GDP growth tertile is determined using GDP growth over the most recent three years; (3) interacting the tax change variable with indicators for reforms greater or smaller than 1 percentage point, and reporting the coefficients corresponding to large changes, (4) controlling for other state personal and corporate income tax changes, and (5) controlling for prior unemployment rates. In all series, capital gains are in real terms, and the estimated coefficients are normalized to equal 0 at time -1, i.e., we plot $\hat{\delta}_h$ as described in section 3.1. Standard errors are clustered at the state level.

Figure 3: Migration Effects of State Capital Gains Taxes and Policy-Relevant Elasticity Estimates

(a) Residents in top 10% of national wealth distribution (b) Residents in top 1% of national wealth distribution



(c) Binned estimates of empirical and policy-relevant elasticities



Notes: Panels (a) and (b) of this figure show the impact of state capital gains tax reforms on migration of high-net worth residents, using the specification in equation (1). The outcome in panel (a) is the log of the share of residents belonging to the top 10 percent of the national wealth distribution, and in panel (b) it is the log share in the top 1 percent. The points plotted are 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 these outcome variables. In panel (c), we estimate the empirical capital gains elasticity using a specification analogous to that in equation (1), but using three-year bins (see section 3.2 for details). This estimate is represented by the grey point estimates. The dark blue point estimates represent our estimates of the policy-relevant elasticity $\hat{\epsilon}^R = \hat{\epsilon}^{CG} - \hat{\epsilon}^N$ for each period. As described in section 3.2, $\hat{\epsilon}^N$ is estimated using a state-year specific dollar-weighted average of the migration responses of the top 1% and top 10%. The horizontal light-blue line is our estimate of the policy-relevant elasticity using a binned specification for post-reform years 0-10 (see equation 4). All specifications include state and year fixed effects and controls for tax reforms in years surrounding the reform. The estimated coefficients are normalized to equal 0 at time -1, and standard errors are clustered at the state level.

Table 1: Summary Statistics on State Capital Gains Realizations and Tax Rates

	N	Mean	SD	Min	Max
Capital gains realizations					
Capital gains income (\$ B)	1887	9.33	16.50	0.19	176.12
Log capital gains income	1887	15.25	1.22	12.14	18.99
Per capita capital gains income (\$ 1000s)	1887	1.58	1.21	0.18	20.12
Tax variables					
State capital gains tax rate (τ_{st}^{state})	2091	0.04	0.03	0.00	0.15
Keep rate ($1 - \tau_t^{fed} - \tau_{st}^{state}$)	2091	0.75	0.05	0.63	0.85
Log keep rate	2091	-0.29	0.07	-0.46	-0.16
Indicator for $\Delta\tau_{st}^{state} \neq 0$	2040	0.29	0.45	0.00	1.00
$\Delta\tau_{st}^{state}$ if $\Delta\tau_{st}^{state} \neq 0$	584	0.00	0.01	-0.08	0.09
Indicator for $\Delta\tau_{st}^{state} \geq 0.01$	2040	0.04	0.19	0.00	1.00
$\Delta\tau_{st}^{state}$ if $\Delta\tau_{st}^{state} \geq 0.01$	75	0.03	0.02	0.01	0.09
Indicator for $\Delta\tau_{st}^{state} \leq -0.01$	2040	0.03	0.16	0.00	1.00
$\Delta\tau_{st}^{state}$ if $\Delta\tau_{st}^{state} \leq -0.01$	53	-0.02	0.01	-0.08	-0.01

Notes: This table summarizes capital gains and tax variables used in our analysis, which are observed at the state-year level. We report counts and magnitudes for changes in state capital gains tax changes in three bins: non-zero changes, increases of one percentage point or more, and decreases of one percentage point or more. The sample ranges from 1980 to 2016 for realizations, and from 1977 to 2017 for tax rates. All dollar values are in 2018 dollars. We use capital gains income data from Smith, Zidar and Zwick (2020); data on state and federal capital gains tax rates from NBER TAXSIM; and data on state population from the Census Bureau via FRED. See data appendix B for additional details.

Table 2: Capital Gains Elasticities and Revenue-Maximizing Tax Rates

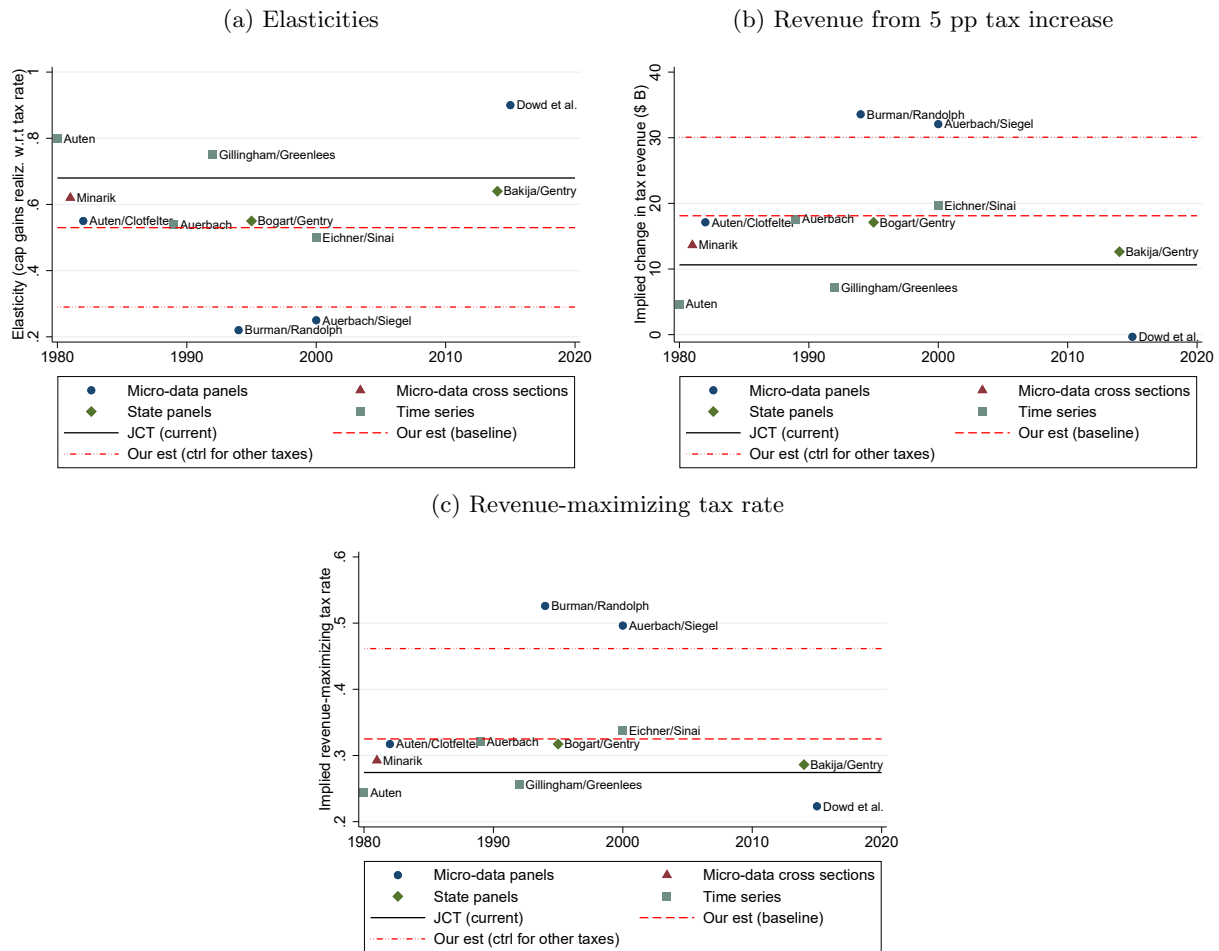
Time Horizon	Baseline				Big changes only				Control for other taxes			
	0-10	0-2	3-5	6-8	0-10	0-2	3-5	6-8	0-10	0-2	3-5	6-8
Empirical elasticity ε^{CG}	3.39*** (1.01)	3.32*** (.97)	4.78*** (1.1)	4.07*** (1.2)	2.81*** (1.02)	3.54*** (.97)	4.96*** (1.1)	3.77*** (1.19)	2.28* (1.32)	2.38** (1.19)	3.58*** (1.24)	3.32** (1.43)
Policy-relevant elasticity $\varepsilon^R = \varepsilon^{CG} - \varepsilon^N$	1.87** (.91)	2.09** (.91)	2.28*** (.88)	1.94** (.92)	1.48* (.89)	2.5** (.98)	2.4*** (.92)	1.65* (.91)	1.01 (1.18)	1.25 (1.16)	1.64 (1.01)	1.4 (1.14)
Laffer rate $\tau^* = \frac{1-\bar{\tau}_S}{1+\varepsilon^R}$.33*** (.1)	.3*** (.09)	.29*** (.08)	.32*** (.1)	.38*** (.14)	.27*** (.07)	.28*** (.07)	.35*** (.12)	.47* (.27)	.42** (.21)	.36** (.14)	.39** (.19)
Elasticity w.r.t. tax $\varepsilon^{tax} = \varepsilon^R \cdot \frac{-0.22}{1-0.22}$	-.53** (.26)	-.59** (.26)	-.64*** (.25)	-.55** (.26)	-.42* (.25)	-.71** (.28)	-.68*** (.26)	-.46* (.26)	-.29 (.33)	-.35 (.33)	-.46 (.29)	-.39 (.32)
χ^2 test: $\varepsilon^{tax} = -1$	3.38	2.58	2.05	3.02	5.31	1.14	1.54	4.35	4.64	3.88	3.54	3.57
p-value	(.066)	(.108)	(.152)	(.082)	(.021)	(.286)	(.214)	(.037)	(.031)	(.049)	(.06)	(.059)

Notes: This table shows estimates of main elasticities and the associated revenue-maximizing rate for different specifications of equation (3). The columns labelled “0-2”, “3-5” and “6-8” use 3-year bins, while the one labelled “0-10” uses a single bin for the full 11-year post-period as described by equation (4). The empirical elasticities ε^{CG} are calculated as the difference between the point estimate corresponding to the period for the column in question, and the point estimate for the $[-3, -1]$ -year bin. We use an analogous method to estimate ε^N and report the difference $\varepsilon^R = \varepsilon^{CG} - \varepsilon^N$ in the following row. Revenue-maximizing tax rates are estimated using the formula in equation (7), which is derived in Online Appendix Section D. The term $\bar{\tau}_S$ adjusts for average wealth-weighted state tax rates, which were 6.27% in 2016, the year that we use for this calculation. All specifications control for reforms in the capital gains tax rate in three 3-year bins before and after the reform in question, and include state and year fixed effects. The columns labelled “Big changes only” use a specification in which the right hand side variable of interest—the 3-year (or 11-year) change in the log net of tax rate—is replaced by two variables: one which sums the changes that are greater than 1 percentage point each given year, leaving out smaller changes, and one which sums the changes from year to year that are smaller than 1 percentage point. We then report the coefficients from the bigger changes. We provide more details on this big-change-only specification in footnote 10 on page 8. Finally, the columns for the “Control for other taxes” specification report results from a specification that include controls for changes in state income and corporate tax rates. We control for the change in other tax rates over the same 3-year (or 11-year) bins that we use to identify our main point estimate in each regression (to control for contemporaneous reforms to these other tax rates) as well as three 3-year bins before and after the main period (to control for reforms to other taxes in surrounding years). Standard errors are clustered at the state level.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix For Online Publication

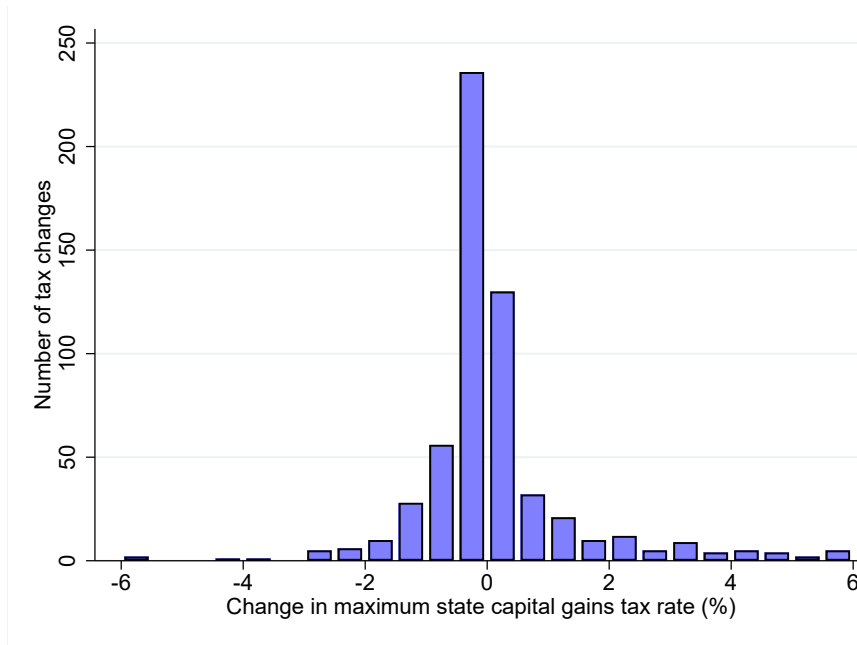
A Appendix Figures

Figure A.1: Estimates from the Capital Gains Literature



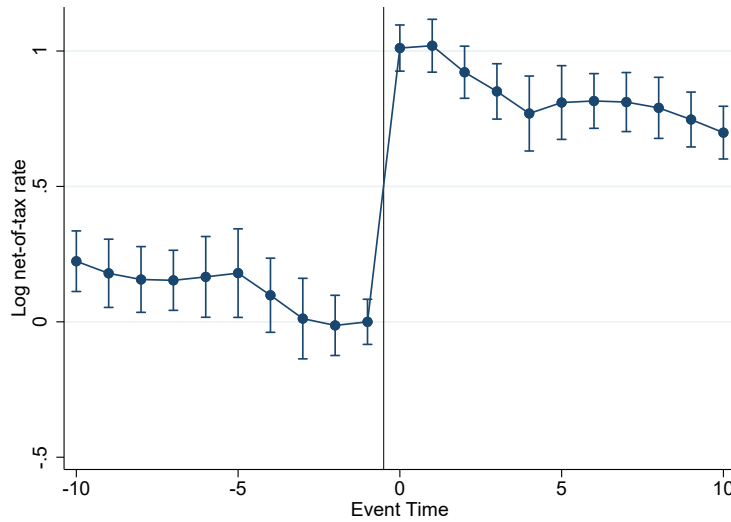
Notes: This figure compares our results with those from the previous literature on capital gains. The elasticities reported in panel (a) are with respect to a tax rate of 22% and taken from Tables 1 and B-1 from [Gravelle \(2020\)](#). The tax increase analyzed in panel (b) is a 5 percentage point increase, 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 (7) 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



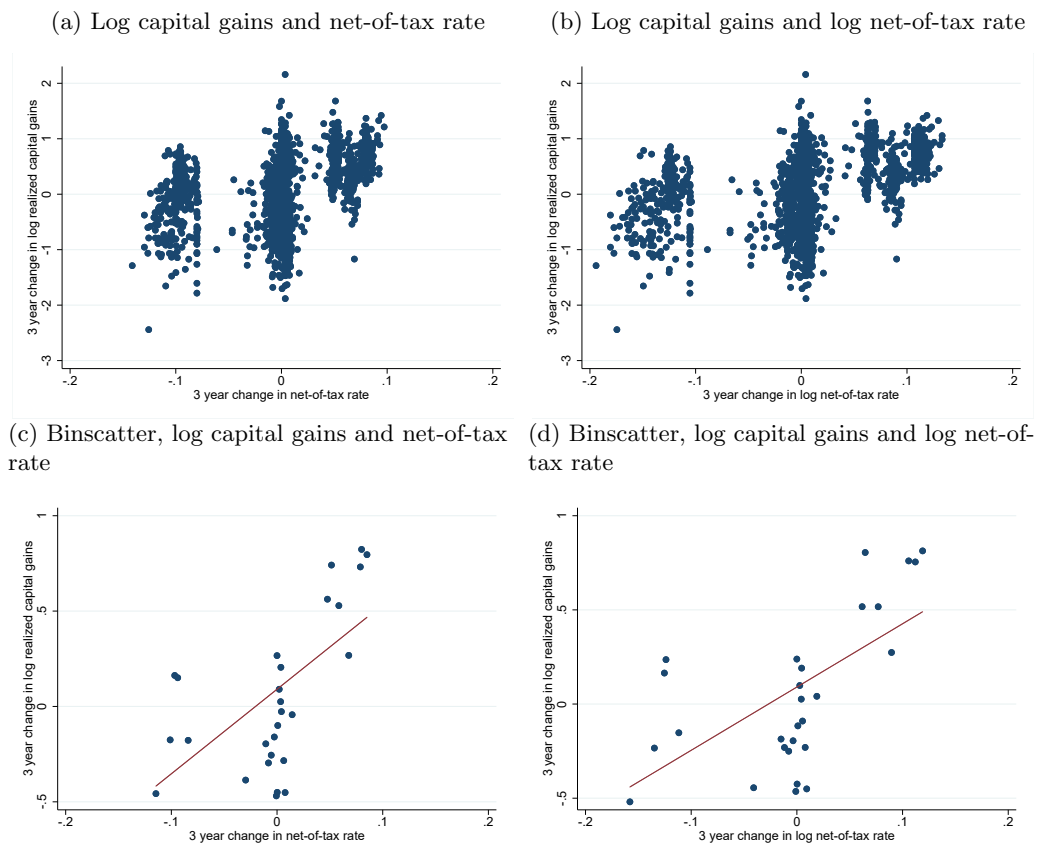
Notes: This figure shows the distribution of the size of changes in the top state capital gains tax rate throughout our panel, including changes to the statutory tax rate as well as deductibility and other minor provisions of the tax code. It has been censored at 6%, so tax changes of more than 6 percentage 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: The Effect of Net-of-Tax Rate Changes on the Net-of-Tax Rate over Time



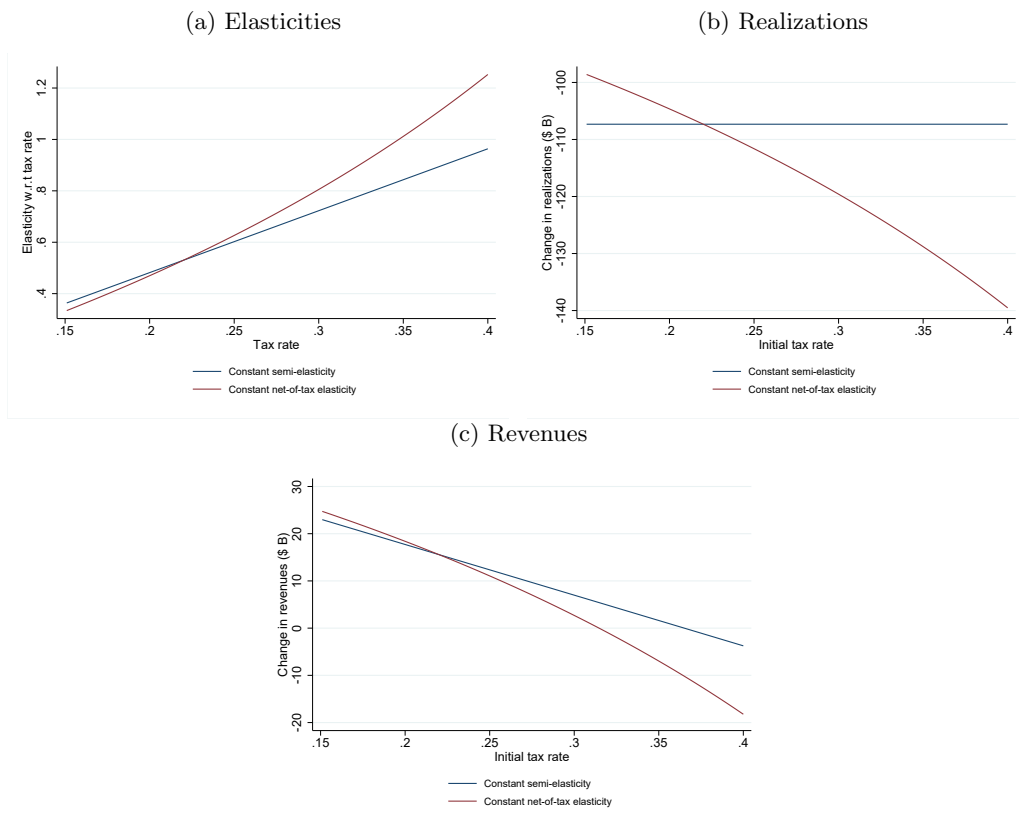
Notes: This figure uses our direct projections framework from equation (1), but with the outcome variable being the net-of-tax rate itself, and excluding the controls for capital gains tax reforms in other years. This creates a specification where the treatment effect from time -1 to time 0 is 1 by construction, 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.4: Scatterplots, 3-year Changes in Log Capital Gains, Net-of-Tax Rate, and Log Net-of-Tax Rate



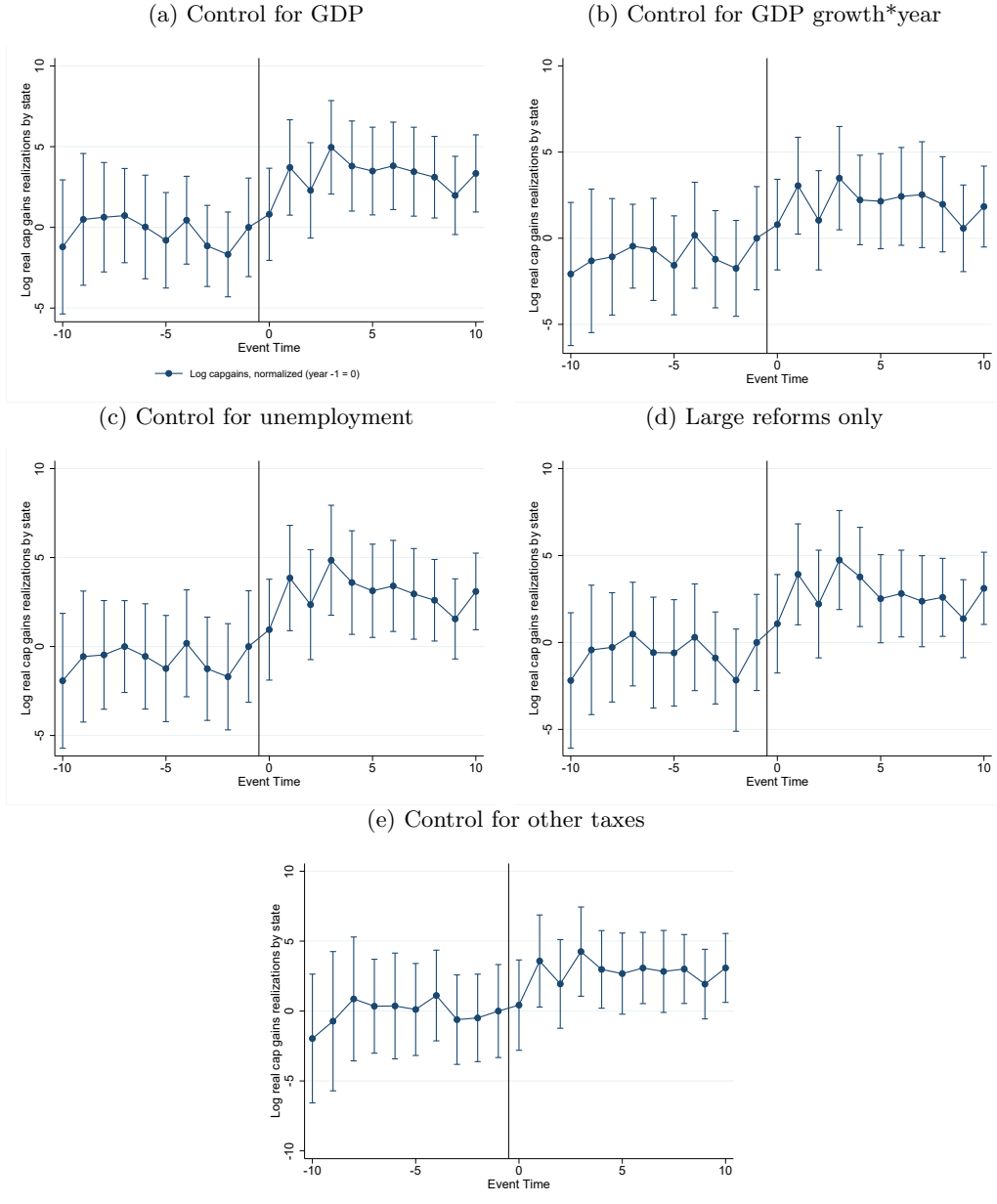
Notes: This figure shows two scatterplots of our state-year data on tax rates and realized capital gains, as well as corresponding binned scatterplots. In all plots, the variable on the vertical axis is the three-year change in log realized capital gains (2018 dollars). In the plots on the left, the 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.5: Comparing Elasticity Assumptions



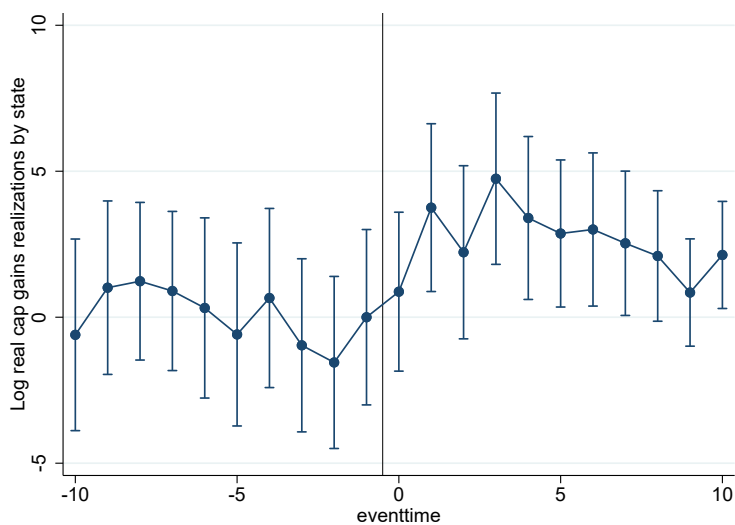
Notes: This figure supplements the discussion in section 3.1 of models of capital gains realizations that either assume a constant semi-elasticity (models of the form $\log CG_t = \gamma \cdot \tau_t$), or a constant net-of-tax elasticity (of the form $\log CG_t = \delta \cdot \log(1 - \tau_t)$). We 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.6: The Effect of Net-of-Tax Rate Changes on Capital Gains Realizations, by Specification



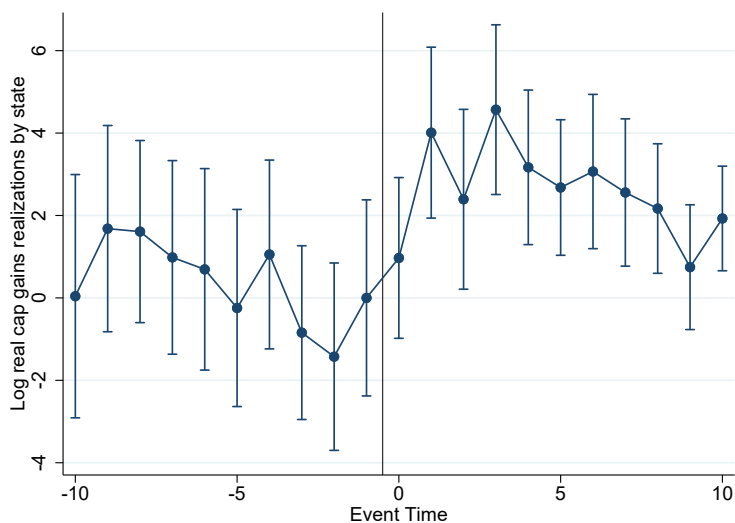
Notes: This figure shows the five series from panel (b) of Figure 2 individually. Panel (a) in this figure controls linearly for GDP in the year before the reform; panel (b) controls for a set of dummies interacting GDP growth tertiles and years, where the GDP growth tertile is determined separately in each year using GDP growth over the most recent three years; 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 identified 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.7: Baseline Specification as Event Study



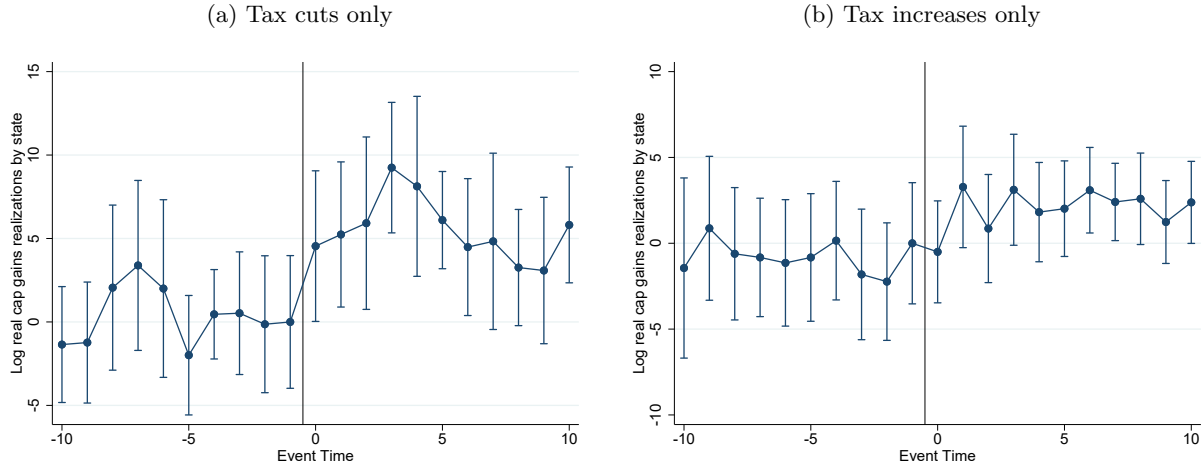
Notes: This figure shows a variation of our baseline graph in Figure 2, but using a classic event study specification in which all plotted coefficients are estimated within the same single regression rather than the direct projections approach. The specification used is $y_{s,t} = \sum_{h=-10}^{10} \beta_h \Delta \log(1 - \tau_{s,t-h}) + \gamma_s + \phi_t + \varepsilon_{s,t}$ (where Δ indicates a one-period change), and the figure plots the point estimates for $\beta_{-10}, \beta_{-9}, \dots, \beta_{10}$. 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.8: The Effect of Net-of-Tax Rate Changes on Capital Gains Realizations – No Controls for Other Capital Gains Tax Reforms



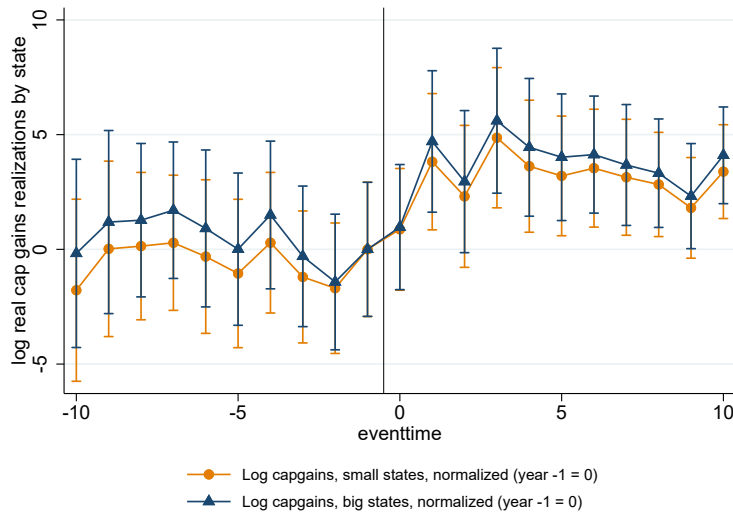
Notes: This figure is analogous to panel (a) of Figure 2, but without controls for other changes in the capital gains tax rate before and after the reform of interest. Realized capital gains are in real terms, and the estimated coefficients are normalized to equal 0 at time -1. Standard errors are clustered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

Figure A.9: The Effect of Net-of-Tax Rate Changes on Capital Gains Realizations – Tax Cuts and Increases



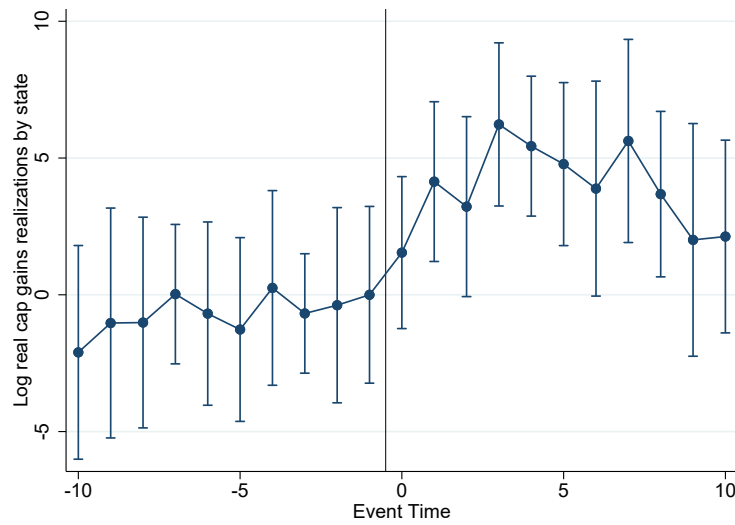
Notes: This figure is analogous to panel (a) of Figure 2, but shows the effects of tax cuts and tax increases separately. Specifically, we modify the baseline specification in equation (1) by estimating separate coefficients for tax increases and decreases, i.e., we use the specification $y_{s,t+h} = \beta_h^{cut} \times \mathbf{1}(\Delta\tau_{s,t} < 0) \times \Delta \log(1 - \tau_{s,t}) + \beta_h^{inc} \times \mathbf{1}(\Delta\tau_{s,t} > 0) \times \Delta \log(1 - \tau_{s,t}) + \mathbf{X}'_{s,t} \boldsymbol{\Lambda}_h + \gamma_{s,h} + \phi_{t,h} + \varepsilon_{s,t,h}$, 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 coefficients $\{\beta_h^{cut}\}_{h=-10}^{10}$, 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.10: The Effect of Net-of-Tax Rate Changes on Capital Gains Realizations – 10 most pop. states v. 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.

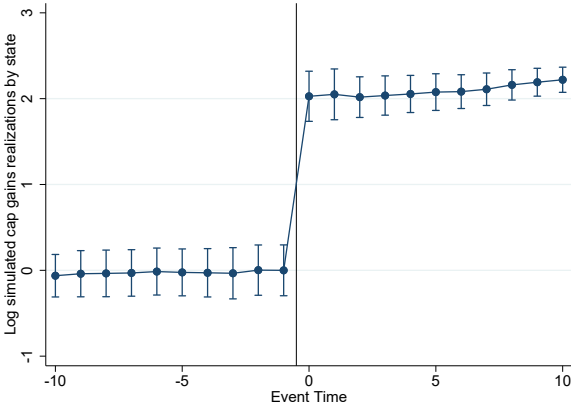
Figure A.11: The Effect of Net-of-Tax Rate Changes on Capital Gains Realizations – After 1990



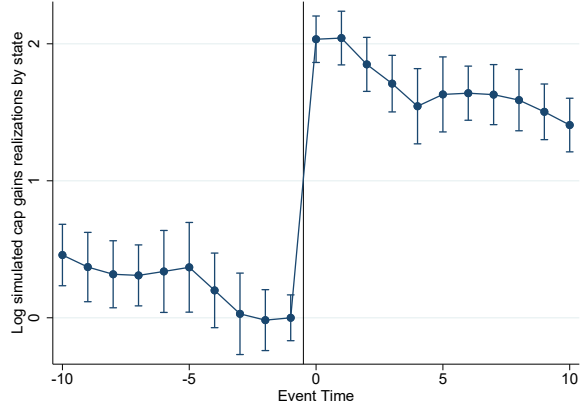
Notes: This figure is analogous to panel (a) of Figure 2, but restricts the specification to only estimate the effects of reforms after 1990. We do use realizations data from prior to 1990 to estimate the pre-trend, and we also include reforms from before 1990 when in our set of controls for capital 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.12: Estimating Effects of Simulated Tax Changes – Constant Elasticity

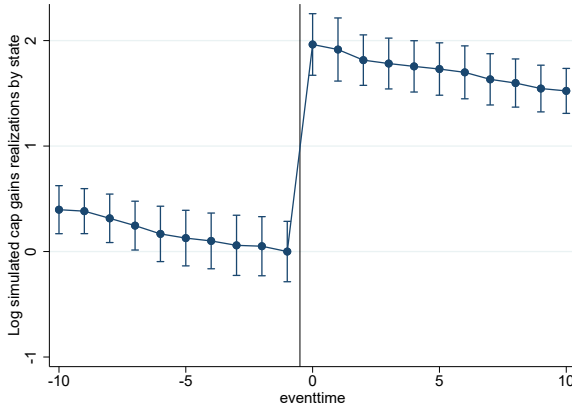
(a) Direct projection, control for reforms in surrounding years



(b) Direct projection, no controls for other reforms



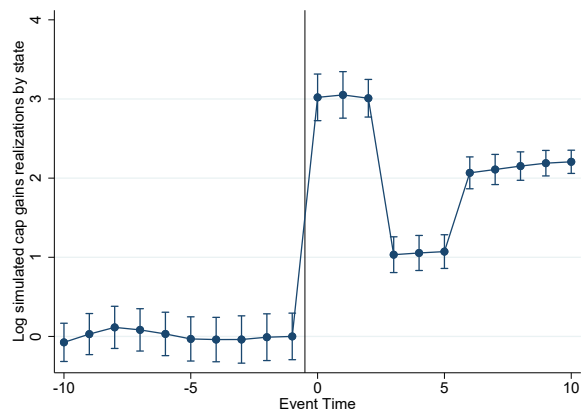
(c) Event study



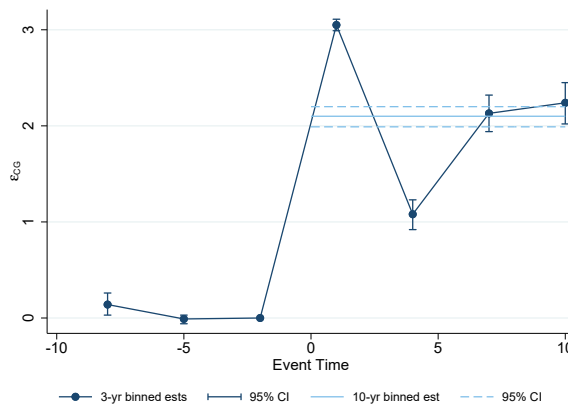
Notes: This figure shows the outcome of the simulation exercise detailed in Appendix Section C. We simulate a log capital gains realizations variable which is generated in such a way that it has a true empirical elasticity of 2 with respect to the net-of-tax rate, constant across all horizons. The figures 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 C for further details.

Figure A.13: Estimating Effects of Simulated Tax Changes – 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 C. Unlike Figure A.12, 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 when binned specifications as outlined in section 3.2. We include state and year fixed effects. See Appendix Section C for further details.

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

	Year	$\Delta\tau_{s,t}^{CG}$	Post- change $\tau_{s,t}^{CG}$	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	Std. Error	Estimate	Std. Error
Unemployment (t-1)	1.23716***	.40092	.79592	.55813
Unemployment (t-4)	.23517	.45368	-.68742	.55174
GDP per capita, USD 1000 (t-1)	0	.00199	.00801*	.00437
GDP per capita, USD 1000 (t-4)	-.0014	.00203	-.00769*	.00444
Max. state income tax (t-1)	.92045*	.49282	1.92046**	.74553
State corporate tax (t-1)	.63029**	.27915	-.01416	.359
State in middle CGT tertile (t-1)	.01189	.02683	.04249	.03778
State in highest CGT tertile (t-1)	.00181	.03387	.04401	.04836
Constant	.00356	.04744	-.01318	.04516

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)	.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)	.9% (13)	67.4% (161)	10.2% (213)
Total	100% (345)	100% (1507)	100% (239)	100% (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

Time Horizon	Baseline				Big changes only				Control for other taxes			
	0-10	0-2	3-5	6-8	0-10	0-2	3-5	6-8	0-10	0-2	3-5	6-8
Empirical semi-elasticity γ^{CG}	-5.53*** (1.35)	-5.23*** (1.32)	-7.36*** (1.49)	-6.59*** (1.7)	-4.8*** (1.34)	-5.55*** (1.33)	-7.62*** (1.48)	-6.27*** (1.68)	-4.02** (1.81)	-3.88** (1.63)	-5.68*** (1.72)	-5.66*** (2.02)
Policy-relevant semi-elasticity $\gamma^R = \gamma^{CG} - \gamma^N$	-2.89** (1.23)	-3.21** (1.26)	-3.34*** (1.24)	-3.05** (1.33)	-2.37** (1.2)	-3.74*** (1.36)	-3.49*** (1.28)	-2.67** (1.33)	-1.61 (1.65)	-1.9 (1.63)	-2.35 (1.46)	-2.28 (1.63)
Laffer rate $\tau^* = -\frac{1}{\gamma^R}$.35** (.15)	.31*** (.12)	.3*** (.11)	.33** (.14)	.42** (.21)	.27*** (.1)	.29*** (.11)	.37* (.19)	.62 (.64)	.53 (.45)	.42 (.26)	.44 (.31)
Elasticity w.r.t. tax $\gamma^{tax} = \gamma^R \cdot 0.22$	-.64** (.27)	-.71** (.28)	-.74*** (.27)	-.67** (.29)	-.52** (.26)	-.82*** (.3)	-.77*** (.28)	-.59** (.29)	-.35 (.36)	-.42 (.36)	-.52 (.32)	-.5 (.36)
χ^2 test: $\varepsilon^{tax} = -1$	1.81	1.12	.94	1.25	3.25	.35	.68	1.98	3.18	2.62	2.24	1.94
p-value	(.178)	(.29)	(.333)	(.263)	(.071)	(.552)	(.408)	(.159)	(.075)	(.105)	(.134)	(.164)

Notes: This table corresponds to Table 2 in the main text, but uses a semi-log specification. [More details here]

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

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 combined federal and state capital gains tax rates 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 both 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.¹⁸
- Table 1 shows maximum federal long-term capital gains tax rates, which we obtain from the US Department of the Treasury.¹⁹ 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 rate 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 actual 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.²⁰ 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 \(2018\)](#).²¹ 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 micro-files samples of tax returns. Note that these are net capital gains, i.e. any capital losses are subtracted from the total in each year.
- Data on realized capital gains at the state level are taken from [Smith, Zidar and Zwick \(2020\)](#). 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.
- UK data on realized net capital gains comes from HM Revenue and Customs.²² 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

¹⁸Further background information and the dataset itself are available at <https://users.nber.org/~taxsim/state-rates/>.

¹⁹This is 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>.

²⁰Specifically, 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. Throughout all of the years from which we actually use UK data on realized capital gains amounts, capital gains were treated as part of regular income. The maximum income tax rate throughout this period was 40 percent.

²¹Currently, these can be found under [http://gabriel-zucman.eu/files/PSZ2017AppendixTablesI\(Macro\).xlsx](http://gabriel-zucman.eu/files/PSZ2017AppendixTablesI(Macro).xlsx)

²²They can be found at <https://www.gov.uk/government/statistics/capital-gains-tax-statistical-tables>

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 trusts²³ 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.²⁴
- Other specifications control for unemployment, which we obtain from the Bureau of Labor Statistics.²⁵
- 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.²⁶
- We convert dollar amounts into real values using the CPI for urban consumers (CPI-U), obtained from the US Bureau of Labor Statistics.²⁷
- Nominal values from the UK are deflated using the Retail Price Index, available from the Office for National Statistics.²⁸

²³Specifically, interest in possession trusts and personal representatives

²⁴These can be found using the Regional Economic Accounts download tool at <https://apps.bea.gov/regional/downloadzip.cfm>.

²⁵Available at <https://www.bls.gov/lau/#data>.

²⁶These can be obtained as a single zip file by using the download tool at <https://research.stlouisfed.org/pdl/628/download>.

²⁷Available at <https://www.bls.gov/cpi/data.htm>.

²⁸<https://www.ons.gov.uk/economy/inflationandpriceindices/datasets/consumerpriceindices>.

C 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 which is constant across all time horizons, before moving on to the more complex case of a time-varying elasticity.

C.1 Simulation with constant elasticity

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

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

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.²⁹ 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 C.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.12. 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.

Panel (b) of Figure A.12 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.3 and discuss briefly in section 3. 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.12 uses an event study method. We use the following specification:

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

and the figure plots the point estimates that are normalized relative to period -1, i.e. it shows $\beta_{-10} - \beta_{-1}, \beta_{-9} - \beta_{-1}, \dots, \beta_{10} - \beta_{-1}$. This differs from our baseline direct projections specification from equation (1) in that all 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 the controls in equation (C.2) are balanced

²⁹ $fips_s$ is literally just the fips number corresponding to state s , which is included as a crude way to ensure that the mean of $\log CG_{s,t}^{sim}$ will vary across states.

around the time of capital gains realizations, unlike in our baseline specification, where they are balanced around the time of the reform. When estimating β_{10} , for instance, the here specification includes 20 controls for reforms years following the reform, but no controls for reforms in the periods preceding the reform. This approach can again cause downward bias if the reform in question is partially or fully a reversal of a prior tax reform.

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. This requires simulating a variable for which the elasticity varies over time.

C.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 (C.1). It now becomes:

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

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.13. 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.13 estimates the impact of capital gains reforms on the same simulated outcome variable using the binned specifications in equations (3) and (4). 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.

D Full Model

This section contains further details and derivations for the model outlined in section 5.1 of the main text. Let the setup be as described in 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. Let $\bar{\tau}_S$ denote the average state tax rate.³⁰ The government sets τ_F to maximize

$$\max_{\tau_F} \tau_F \cdot CG, \quad (\text{D.1})$$

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

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

which is equivalent to

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

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

$$\tau_F^* = \frac{1 - \bar{\tau}_S}{1 + \varepsilon}, \quad (\text{D.2})$$

where

$$\varepsilon = \frac{d \log CG}{d \log(1 - \tau_F - \bar{\tau}_S)} = \frac{d CG}{d(1 - \tau_F - \bar{\tau}_S)} \cdot \frac{(1 - \tau_F - \bar{\tau}_S)}{CG}. \quad (\text{D.3})$$

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 (6), since they are what we can empirically estimate. To simplify the expression in (D.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

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

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 $s \in S$.

³⁰This 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 (D.3):

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

where n_s is the population of the state expressed as a share of the national population.³¹ 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 (7) for the revenue-maximizing tax rate in the main text with an ε^R , although it should be an ε to be completely precise, as in equation (D.2),

Equations (D.2) and (D.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 5 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 values:³²

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

³¹Formally, this is defined as

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

³²These 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.

Suppose we estimate a total elasticity of capital gains $\hat{\varepsilon}^{CG} = 3$ and a migration elasticity $\hat{\varepsilon}^N = 1.5$.³³ 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 (D.4) above, we thus find the policy-relevant elasticity ε above to be

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

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

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

³³These values are close to what we find in our specification using big tax changes only.