How Executive Compensation Changes In Response to Personal Income Tax Shocks

(Who Pays the CEO's Income Taxes?)

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Abstract

Using staggered personal income tax changes across US states, we study the effects of taxes on executive compensation. After a tax rate increase, CEO pay increases within two years by an amount close to fully compensating the CEO for the increased tax liability. This effect is stronger in more profitable industries. The higher tax rate appears to motivate CEOs to sell firm stock for liquidity. Boards respond by increasing cash pay to replace liquidity and stock pay to replenish incentives. The effect of personal income tax shocks on compensation is asymmetric: CEOs do not experience pay cuts following tax cuts.

Keywords: Executive compensation, Personal income tax, CEO incentives, CEO equity sales

JEL codes: H24, H71, J33, M12

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1. Motivation, Literature, and Hypotheses

The level and structure of executive pay are complex and controversial concerns. Persistent interest among investors, regulators, politicians, and executives has motivated a sizable scholarly literature that addresses the determinants, economic and otherwise, of the level and incentive properties of executive pay. Per Edmans, Gabaix, and Jenter (2017), in their survey of the theories and empirical evidence on managerial compensation, the various empirical designs arise from at least three, non-mutually-exclusive perspectives: shareholder value maximization; rent extraction by executives; and institutional forces, including taxation.

The focus in the literature has been on the first two perspectives.

> Most recent analyses of executive compensation have focused on efficient-contracting or managerial-power rationales for pay, while ignoring or downplaying the causes and consequences of disclosure requirements, **tax policies**, accounting rules, legislation, and the general political climate. (Murphy, 2013; emphasis added)

We emphasize the third line of inquiry to assess the effects of tax policy on executive compensation. In particular, we investigate how exogenous changes in personal income tax rates affect the level, composition, and incentive properties of CEO compensation in listed US firms.

There are at least two reasons why a change in personal tax rate would affect the **level** of executive pay. First, higher income taxes can directly reduce executives' after-tax income, thereby shifting the supply curve for executive input upward. If the demand curve for top executive talent is relatively inelastic, which likely is the case in a thin market for suppliers of high-level managerial input, then the firm will respond to a shift in the manager's supply curve with

meaningful additional pay, with the incidence of the tax falling on other stakeholders of the firm. Second, if an executive is entrenched or otherwise has the ability to extract rents from the firm, perhaps because the board of directors is co-opted (Coles, Daniel, and Naveen, 2014) or not truly independent (Weisbach, 1988), then the manager potentially can wrest higher pay from the employer to cover the increased tax liability. Either way, raising executive pay in response to a tax rate increase likely means paying at least some of the executive's tax bill with shareholder money. We thus expect the level of CEO pay to increase in response to a tax rate increase.

A change in income taxes should also affect the **composition**, in terms of the mix of cash, stock, and options, of both annual pay and the executive's portfolio of accumulated past awards net of dispositions. The reasons include (a) executive incentive alignment and (b) the need of the taxpayer for cash as the means to satisfy their tax obligation. To illustrate the latter, in 2012 California raised its maximum personal income tax rate from 10.3% to 13.3%. Consider Mr. Lawrence J. Ellison, the CEO of Oracle, headquartered in California, with reported compensation of US$96.16M in 2012.[1] For simplicity, in the presence of a flat state tax schedule, assuming no state and local tax (SALT) deduction at the federal level, and supposing that the figure is immediately taxable, the 3% increase in the state income tax rate would decrease his after-tax pay and increase his state and overall tax liability by US$ 2.88M.[2] An increase in the state tax rate likely creates some additional preference on the part of executives for cash in the compensation package.

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[1] https://www.sec.gov/Archives/edgar/data/1341439/000119312512399999/d399484ddef14a.htm#toc399484_20.

[2] In 2012 the SALT deduction was not yet capped. The increase in tax for Mr. Ellison, assuming a 35% federal income tax rate, would have been $1.86M = $96.16M × 0.03 × [1-0.35]. As of 2018, the SALT deduction has been capped at $10,000. More generally, in 2012 average CEO compensation in S&P 500 firms was $10.6M. Absent the SALT deduction, a 3% tax increase increases the average CEO's tax payment by $318K.

This argument for an increased preference for cash requires frictions. To satisfy the increased state tax bill the executive could sell accumulated shares or options or exercise options to sell stock. But suppose stock or option markets are imperfect with nontrivial transactions costs, or, more likely, a sale or exercise and sale triggers tax on realized gains. In addition, sales of stock by a top executive require disclosure and can draw unwelcome attention to the executive and firm from investors, the media, and regulators. In the presence of such frictions, an increase in tax rate would strengthen the preference of the executive for cash as a component of compensation.

Note as well that for some time there has been a tax friction in place gravitating against the use of cash in executive pay. Starting in 1994 the US limited the deductibility of pay for top-five executives of public firms to $1 million per executive per year (IRS Section 162(m)), with incentive pay exempt from that limit,[3] at which time firms shifted towards compensating top executives with stock and options (Perry and Zenner, 2001). This move away from awarding cash further obliges the executive to liquidate shares or options to cover a larger tax bill. Following a tax rate increase, we expect executives to sell equity-based instruments so long as the transaction costs discussed above are not prohibitive.

In terms of executive incentives, such sales of stock and options reduce the manager's firm-related wealth, dampen the sensitivity of CEO wealth to performance, and diminish the incentive of the executive to act in the interest of shareholders. We expect firms to replace those lost equity incentives with larger stock grants. In addition, the change in tax rate affects managerial incentive alignment, even if the stock and option holdings of the manager remain unchanged. A standard

[3] In 2018 (IRS iNotice 2018-68, arising from the Tax Cuts and Jobs Act of 2017), the incentive pay exemption was eliminated and the scope of coverage of 162(m) was extended from the CEO to include CFOs and the three other highest-paid employees,

measure of incentive alignment is delta, the sensitivity of CEO wealth to stock price arising from the accumulation of stock and options net of dispositions (Jensen and Murphy, 1990; Core and Guay, 2002). Higher delta can mean that managers will work harder or more effectively because managers share gains and losses with shareholders. If pre-tax delta is given by δ, and the appropriate state and federal tax rates on stock and option payouts as compensation are τ_s and τ_f, then *after-tax delta* is $\delta_{AT} = (1 - \tau_s - \tau_f)\delta$. It is likely that it is after-tax delta that matters for the incentives of the manager, so an increase in τ_s or τ_f requires an increase in pre-tax δ, through additional awards of stock for example, to return post-tax δ_{AT} to the pre-tax-change level. That is, in addition to replacing liquidated stock and options, returning post-tax incentives to the prior level requires further adjustment in the pre-tax effective CEO ownership of the firm.

We use staggered state-level personal income tax changes as plausibly exogenous shocks to tax rates and apply a difference-in-differences (DiD) approach. Compared with federal tax changes, state-level changes in personal income taxes happen more frequently and do not affect all states at the same time. The staggered nature of state-level personal tax shocks provides valid control firms as a set of counterfactuals for how executive compensation would have evolved without the tax changes. Over the 1992 – 2018 period there were 347 changes in the top state personal income tax rates, of which 109 were increases and 238 were decreases. Following Heider and Ljungqvist (2015), we focus primarily, though not exclusively, on the 38 large tax rate shocks, meaning rate changes at least as large as one percentage point, including 22 tax increases and 16 tax cuts (see Fig. 1), in our sample. This approach is consistent with the possibility that large tax changes are more salient than small ones and that the bargaining and other costs associated with adjusting compensation to very small income tax rate changes are large relative to the benefits.

In our DiD analysis, the treated group includes CEOs of firms headquartered in states experiencing large increases or decreases in top personal income tax rates. The control group includes the remaining CEOs in the sample. Because states can and do experience repeated tax shocks, we define our treatment variable to indicate the appearance of each tax shock, while using the first difference of control variables on the right-hand side (see Heider and Ljunqvist, 2015). Our DiD estimates show that CEOs receive economically and statistically higher pay two years after an increase in personal income tax rates. Specifically, CEOs receive an 5.7% increase in pay following large tax increases relative to CEOs who do not experience such tax shocks, controlling for various other determinants of compensation. In stark contrast, when income tax rates decrease, we observe no significant changes in total pay, all else equal. Therefore, the reaction of CEO compensation to tax increases versus decreases is asymmetric.

The CEO responds to the state tax increase by liquidating a significant proportion of shares held. Firms respond by increasing both cash compensation and shares granted to the CEO. The extra increase in annual cash salary is 1.2%, long-term incentive plan (LTIP) cash awards increase by 15.9%, while the increase in equity pay is 12.6%, all else equal. Furthermore, the firm increases pre-tax CEO delta incentives by 2.4% after a large tax rate increase.

To further quantify the tax effects, we regress the natural logarithm of the proportional change in managerial pay on the log of the *net-of-tax ratio*, the ratio of pre-tax-change (year *t-r*) *net-of-tax rate* (*NOT*) to the post-tax-change (year *t*) net-of-tax rate: $(1-\tau_{f,t-r}-\tau_{s,t-r})/(1-\tau_{f,t}-\tau_{s,t})$.[4] An estimate of the coefficient on the log of the net-of-tax ratio equal to one would indicate

[4] This extends Frydman and Malloy (2011), who employ this ratio for federal taxes. The use of the net-of-tax rate comports with norms in the public finance literature.

that the proportional change in executive pay exactly offsets the tax increase, making the executive whole after-tax and fully shifting the incidence of the tax increase to the firm. Based on our estimate from the full sample of all state tax shocks, when the *net-of-tax ratio* increases by 1% due to a state personal income tax increase, CEO pay increases by 0.736%. When focusing on large tax rate changes only, the response in CEO pay to a 1% increase in the net-of-tax ratio is 0.943%, close to 1.0. Both estimates indicate that the demand curve for CEO services is highly inelastic.

Our analysis survives additional hurdles for credible identification. First, we investigate whether state tax changes arise from prior rapid growth in executive pay. They do not. Second, a potential concern is that both state tax changes and executive pay changes can be affected by local economic conditions, while our baseline setting includes control firms that are geographically not proximate to the corresponding treated firms. Exploiting the fact that local economic conditions tend to be similar in bordering states, we use a control group including only CEOs of firms headquartered in bordering states that do not experience any tax shock. This neighboring control group establishes the counterfactual response of CEO compensation to the unobserved local factors excluding the effects of tax changes. The effect of tax changes on CEO pay is robust to the bordering-state setting. Third, we verify that the treated and control groups have parallel trends in CEO pay changes before both positive and negative shocks to tax rates. Fourth, we assess and then discard the possibility that our results on tax increases are attenuated towards zero by CEOs who avoid a state tax increase by a change in or the original choice of domicile. In 99.3% of cases in our sample the CEO owns a residence in the state where the corporate headquarter is located.

We provide several other findings. First, named executive officers (NEO) who are not the CEO receive a much smaller pay increase of about 2.5%, about half of that of the CEO, in response to an increase in personal income tax rate. Like CEO pay, NEO pay does not decline in response to

a tax decrease. Second, when a CEO experiences a tax increase but the firm does not increase pay, the likelihood of CEO turnover is higher.[5] Firms that fail to increase CEO pay after a tax increase have lower subsequent stock and accounting (ROA) performance. Third, the responsiveness of CEO pay to tax increases is stronger in firms that operate in more profitable industries.

Our analysis contributes to three segments of the literature. First, we provide new evidence on the effect of taxes on executive compensation that builds on but differs from that in the literature. For example, we build on the prior work of Frydman and Malloy (2011). Using a sample of top executives in 50 large firms from 1946 to 2005, they find very little response in pay of executives to changes in federal tax rates on labor income. Other previous studies on the topic, in like manner relying on identification by time series variation within firms, report that changes in income tax rates have negligible effects on CEO compensation (Goolsbee, 2000; Hall and Liebman, 2000; Rose and Wolfram, 2002). Our results differ substantially. One possible reason is that federal tax shocks apply to executives across all states, in which case the tax shock does not affect the change in relative after-tax opportunity wage obtainable by a CEO willing to move to another company with employees taxable in a different domicile.[6, 7] A federal tax increase does not make the grass

[5] In practice, voluntary CEO turnover tends to be associated with a pay increase and a move to a firm in another state. In our sample period (1992 to 2018), using Execucomp data, we identify 140 CEO turnovers for which we can track the new job and domicile after the turnover. Among the departing CEOs, 95 (68%) obtained a pay increase and 104 (74%) moved to a firm in another state.

[6] Other possible reasons for the differing results, aside from the use of staggered state tax shocks for identification, include different sampling of firms and executives, the use of different fixed effects, and our inclusion of both the federal and state tax rates in the net-of-tax rate.

[7] It appears that top executives are attuned to differences in state tax rates and potentially will relocate in response. While the Covid-19 pandemic also has been a consideration, tax differentials on their own may be a significant factor (https://www.bizjournals.com/sanfrancisco/news/2020/11/17/california-exodus-roared-on-even-before-covid-hit.html). Elon Musk, the CEO of Tesla, recently announced he moved his residence from California to Texas (https://www.bbc.com/news/technology-55246148). Hewlett Packard Enterprises announced plans to relocate its headquarters from San Jose to Houston (https://www.cnn.com/2020/12/13/tech/silicon-valley-moving-to-austin-miami/index.html). California has high personal income tax rates, while Texas has no personal income tax.

relatively greener in another state. This difference in outside options, in contrast to staggered state tax rate changes, could lead to the minimal executive pay responses to federal tax changes, even though federal tax changes are usually larger in size. In our DiD analysis, we use only staggered state-level changes in personal income tax rates because a federal tax change affects all firms and no treated or control firms can be defined based on such a federal tax shock.

Second, we contribute to the broader literature on incentive compensation and governance. Our results indicate that the demand curve for managerial input is highly inelastic. Further, we introduce and emphasize the difference between pre-tax and *after-tax* delta for managerial incentive alignment. Our findings also support the idea (Murphy, 2013) that boards prioritize executive incentive alignment and managerial retention over the financial and political costs of higher executive pay. Nonetheless, CEO pay is insensitive downward to tax decreases, which suggests that CEO entrenchment and bargaining position also have some power to explain pay.

Third, our evidence has policy implications, which we illustrate in the conclusion.

2. Empirical Design

Our empirical analysis is based on staggered changes in top personal income tax rates at the state levels. As CEOs usually have very high income, we assume that the top personal income tax rates apply to them. We use a DiD approach and study the changes in CEO pay in response to changes in top personal income tax rates. We perform the analysis for all states for all changes in the top personal income tax rates. Moreover, following Heider and Ljungqvist (2015), we mainly examine the subsample of largest tax changes, specifically those changes that are greater than one percentage point up or down. In the DiD analysis, treated firms are those headquartered in states

experiencing large tax shocks (increase or decrease), while control firms are those headquartered in states without tax shocks.

In a DiD analysis based a single event, the treatment variable is usually set to one in years after the event (as illustrated in the upper panel of Internet Appendix Figure IA1). In our analysis, however, there are multiple shocks to tax rates through time and there can be repeated shocks in one state. For example, one tax increase may be followed by another tax increase or decrease in the same state in the future. In this case, a single treatment dummy equal to one after the first shock would fail to capture the subsequent shocks (lower panel of Internet Appendix Figure IA1).

One way to accommodate repeated events is to set the treatment variable as a count variable, or equivalently, use the first differences of all variables (including the treatment variable) in the DiD analysis (Heider and Ljungqvist, 2015). Accordingly, we define a dummy variable, *Tax Increase* (*Decrease*), which equals one if a large tax increase (decrease) occurs in the headquartered state in a year, and zero otherwise, where a large tax change refers to a change greater than one percentage point. This is equivalent to the first difference of a count variable and captures all large tax shocks in a state (lower panel of Internet Appendix Figure IA1). In our DiD analysis we use the first differences of variables to estimate:

$$\begin{aligned}\Delta Ln(y_{m,t}) = {} & \beta_0 + \beta_1 \cdot Tax\ Increase_{m,t-2} + \beta_2 \cdot Tax\ Increase_{m,t-1} \\ & + \beta_3 \cdot Tax\ Decrease_{m,t-2} + \beta_4 \cdot Tax\ Decrease_{m,t-1} + \Delta X_{m,t-1} \cdot \Gamma \\ & + \mu_m + \vartheta_t + \varepsilon_{m,t},\end{aligned} \tag{1}$$

where *m* is the CEO index, *t* is the year index, $Ln(\cdot)$ is the natural logarithm function, *y* is a variable to investigate, such as total compensation or its components, Δ is the first difference operator (within CEO-firm), *X* is the vector of control variables (including characteristics of the firm that employs the CEO), Γ is the coefficient vector for the control variables, μ_m is the CEO fixed effect,

ϑ_t is the year fixed effect, and $\varepsilon_{m,t}$ is the error term. The control variables in *X* can be transformed using the natural logarithm function, scaled, or not transformed at all. Here and throughout $\Delta X_{m,t-1}\Gamma + \mu_m + \vartheta_t$ is meant to capture determinants, other than tax rate changes, of the change in CEO pay. $Tax\ Increase\ (Decrease)$ is the tax shock dummy specific to the domicile of the CEO's employer as defined above. The coefficients β_1 to β_4 show the treatment effects in the DiD analysis. For example, when *y* is CEO compensation, a significantly positive β_1 would show that CEO compensation is increased significantly two years following a large increase in state personal income tax rate.

We also investigate the elasticity of compensation to personal income tax changes. To capture accurately the implications for after-tax income of changes in personal income tax rates, we consider the tax rates at both the state level and the federal level in the elasticity analysis.[8] In particular, we use the ratio of the pre-tax-change (year *t*-*r*) net-of-tax rate to the post-tax-change (year *t*) net-of-tax rate: $(1 - \tau_{f,t-r} - \tau_{s,t-r})/(1 - \tau_{f,t} - \tau_{s,t})$. As we discuss in Section 8 below, when the sum of the federal and state tax rates changes, this ratio determines the proportional change in pay that would exactly offset the tax increase, thereby making the executive whole. The ratio increases (decreases) when the sum of the federal and state tax rates increases (decreases).

3. Sample Construction

We obtain data on personal income tax rates from the official website of the Tax Policy Center (https://www.taxpolicycenter.org). As Panel A of Table 1 reports, over the period 1992 – 2018

[8] In our DiD analysis we only use state-level changes in personal income tax rates because a federal tax change affects all firms and no treated or control firms can be defined based on such a federal tax shock.

there were 1,377 (= 51 x 27) state-years (including Washington, DC) and 347 changes in the top state personal income tax rates. Of these, 109 (238) were increases (decreases), while 38 (309) were large (small) changes of at least (less than) one percentage point.

We obtain compensation data from Execucomp, corporate accounting data from Compustat, and insider trading data from Thomson Reuters. In our analysis we assume firms' executives live in the states where their offices are located.[9] We extract the information on the location of firms' executive offices directly from SEC 10K filings. To identify the relevant state for personal income tax rates, we use the "Mail Address" in 10K filings, which is the HQ address or the "Address of principal executive offices" for the firm.

Our sample reflects the merged intersection of the Execucomp and Compustat datasets. We only include CEOs who have worked in their current positions more than two years, so that their compensation in the current firms can be affected by the tax changes in the past couple of years and that CEO moves across firms do not contaminate the compensation data. Over 1992–2018, the final sample includes 38,786 CEO-firm-year observations. Panel B of Table 1 reports additional summary statistics. About 5.3% and 1.4% (5.9% and 14.0%) of CEO-year observations reflect a large (small) increase or decrease, resp., in the CEO's top personal income tax rate.

For compensation measurement, we use the method described in Coles, Daniel, and Naveen (2013). We deploy their code[10] to calculate the value and incentive properties of cash, equity, and option awards to executives and the value and incentive properties of the accumulation of those awards (net of dispositions) as they comprise the executive's portfolio. The average CEO in our

[9] In Section 4.5 we assess and then discard the possibility that our results are attenuated towards zero by CEOs who avoid a state tax increase by choice of domicile.

[10] See https://astro.temple.edu/~lnaveen/documents/deltavega_2013.sas. We thank the authors.

sample earns US$4.77M per year: $711K in salary, $339K in cash bonus; $632K in non-equity incentive pay; $1.37M in stock; $1.14M in options; and perquisites valued at $197K.

Following the existing compensation literature, we control for the book value of assets, market-to-book ratio and CEO-firm performance (ROA) in our tests. For firm-related control variables, the firm-year averages in our sample are $10.1B for book assets and 3.07 for market-to-book. In general, we include manager fixed effects, to control for time-invariant manager characteristics, and year fixed effects, to control for time-series effects common to firms and managers.

4. Results on the CEO Pay Response to Personal Income Tax Rate Changes

4.1. Do state personal income tax rate changes depend on CEO pay changes

We use state-level income tax changes as plausibly exogenous shocks to the tax rates to study the effect of taxes on executive compensation. One important assumption is that executive pay changes do not cause tax rate changes, which would lead to concerns about reverse causality. The potential issue would be that high growth in executive pay triggers regulatory intervention in the form of a higher marginal tax rate for high earners, such as top corporate executives.

To assess this possibility, we carry out regression analysis in which the dependent variable is the indicator *Tax Increase* (*Decrease*) at the state level, which equals one if a state experiences an increase (decrease) in personal income tax rate greater than one percentage point in a year and zero otherwise. We use the linear probability model and consider the effect of CEO pay growth in a state one and two years prior, controlling for state characteristics including state debt, state GDP, tax revenues, cash savings, population, government indicator (democratic governor = 1, otherwise = 0), and unemployment rate. We include state and year fixed effects. CEO pay growth is the average change in firm-level CEO pay within a state-year. Table 2 reports the results. The

coefficients on CEO pay growth in the previous two years are not statistically significantly different from zero for both tax increases and decreases. State-level personal income tax changes do not appear to be associated with prior CEO pay growth in the states, and it likely is valid to use the tax changes as exogenous shocks in our DiD analysis.

4.2. The Magnitude and Timing of the Compensation Response to Tax Shocks

For the DiD analysis, as described in Section 2, we first check the parallel trends condition. We compare CEO pay changes [Δln(TDC1)] in the treated group and the control group in years around a shock (tax increase or decrease) to a state top personal income tax rate. We investigate tax increases and tax decreases separately. Increases and decreases share the same control group of firms headquartered in states without tax changes.

Specifically, for tax increases, the treated group includes CEOs of firms headquartered in states with personal income tax rates increased by at least one percentage point. To check the parallel trends condition, we compare CEO pay changes of the treated and control groups one year and two years prior to the large tax increases. The parallel trends condition would be satisfied if the pay changes of the treated group are not statistically different from that of the control group in years prior to the tax increases, i.e. the difference between them is not statistically different from zero. In each year (relative to the event year), we first calculate the CEO pay changes at the CEO-firm-year level, which will be used as the dependent variable in our DiD regression analysis. We then take the yearly average within the treated and control groups, respectively, and calculate the difference between the two group-level yearly averages. We plot the yearly differences in Panel A of Figure 2. The blue dots represent the average yearly differences in CEO pay changes [Δln(TDC1)] between treated and control groups. The upper and lower bounds of the bars show the 90% confidence intervals. The red dashed line indicates the zero value of the y-axis. This

figure shows that in years before the event year (year 0), i.e. year -2 and year -1, the differences between treated and control groups are not statistically different from zero, which confirms that the parallel trend condition is satisfied. The figure also illustrates the pay differences a couple of years following the large tax increases. The only year in which treated and control firms have significantly different CEO pay changes is the year +2, i.e. two years after a tax increase. This suggests that CEOs in the treated group receive larger pay increases two years following a large tax increase compared with CEOs in the control group.

Panel B shows a similar figure for large tax decreases. The treated group includes CEOs of firms headquartered in states experiencing personal tax rate decreases of at least one percentage point. The figure shows that in years before the event year (year 0) the differences between treated and control groups are not statistically different from zero, which confirms that the parallel trend condition is satisfied. Interestingly, the figure also shows that in years after a tax decrease there are no significant differences between treated and control groups. It suggests that unlike large tax increases, large tax decreases do not have significant effects on CEO compensation.[11]

In our DiD regression analysis, we consider changes in CEO compensation both one and two years after shocks to top personal income tax rates. In the US, personal income taxes in year *t* usually need to be paid no later than April in year *t*+1, when the liquidity issue and equity sales of CEOs may attract the attention of the compensation committee of the board of directors to redesign compensation contracts. Benchmarking and pay-formation processes used by many listed US

[11] In the Internet Appendix Figure IA2 (Panel A), we extend the time window from three to five years after a tax increase to check if a tax increase would have an additional long-run effect on CEO pay. The figure shows that there is no significant difference between treated and control groups in years +4 and +5. The tax effect on CEO pay only appears in the second year following tax increases. Panel B of Internet Appendix Figure IA2 shows a similar figure for tax decreases with the extended time window.

firms generally include lags in data and response. The human resources director and board compensation committee, often in collaboration with a compensation consultant, set pay based on lagged pay data for size- and industry-based comparison firms and with a lag in pay determination based on those data (Murphy, 1999). The compensation consultant will collect compensation data on the various positions (CEO, CFO, SVP, Chief Legal Officer, Division Head, SVP, etc.) from those comparable companies and, as the benchmark, pick the median, mean or appropriate percentile, based on where the board determines the executive resides in effectiveness and performance relative to peer executives. An annual inflation factor, such as 5%, is applied to the lagged benchmark data for overall pay and the components of pay so as to formulate contemporaneous benchmarks for pay setting. The new compensation contracts will be effective no earlier than year t+1 or perhaps more likely one more year later, in year t+2. Accordingly, we expect a lag of at least one year and perhaps two years for a response, if any, to a change in the personal income tax rate. This prediction is also consistent with Figure 2. Our specification is equation (1) as shown in Section 2 and the dependent variable is $\Delta\ln(TDC1)$.

Panel A of Table 3 presents the results for the indicators for large tax shocks. Column 1 (2) shows the estimates of the effect on CEO compensation of tax increases (decreases) one year and two years prior. Column 3 includes indicator variables for both tax increases and decreases. The results show that CEO compensation significantly increases two years after a large tax increase. For example, controlling for other determinants of pay changes,[12] Column 1 (3) shows that CEO compensation increases by 5.5% (5.7%) two years after a state personal income tax increase. We

[12] Note that our estimate of the elasticity of pay in firm size, as measured by total assets, 0.324, is consistent with prior results. See Murphy (1999) and Edmans, Gabaix, and Jenter (2017).

observe no significant changes in compensation in the adjacent lagged year of a tax increase. On average it takes two years for CEO pay to adjust following a tax increase. One possible reason for the large increase, which we address in Section 8, is that the demand for CEO services is inelastic.

In stark contrast, there is no decrease in compensation following a tax decrease. As Columns (2) and (3) report, the estimated coefficients on the lagged and twice-lagged tax decrease indicator variables are nonnegative and insignificantly different from zero. Bargaining power in a thin market and entrenchment in the CEO position are possible explanations for the lack of downward response to tax rate decreases. In any event, the estimates indicate asymmetric effects on CEO pay of tax increases versus tax decreases, all else equal.[13]

4.3. Components of Compensation Affected by Tax Shocks

Figure 3 shows how the components of CEO compensation evolve over time, with stock pay becoming the largest component starting 2006. To examine the effects of tax changes on the components of CEO compensation following tax increases, we estimate the following model:

$$\Delta Ln(yc_{m,t}) = \beta_0 + \beta_1 \cdot Tax\ Increase_{m,t-2} + \beta_2 \cdot Tax\ Increase_{m,t-1} \\ \beta_2 \cdot Tax\ Increase_{m,t-1} \ + \Delta X_{m,t} \cdot \Gamma + \mu_m + \vartheta_t \ + \varepsilon_{m,t}, \tag{2}$$

where *m* is the CEO index, *t* is the year index, *yc* is the component of CEO pay (e.g., cash or equity pay), and other notation is the same as in Equation (1). Panel B of Table 3 presents the results.

Including controls and fixed effects, both salary cash pay (Column 1) and stock pay (Column 4) increase significantly two years following a large increase in personal tax rates. Specifically,

[13] In our sample period there are four significant federal income tax changes (exceeding one percentage point). The results of our DiD analysis are robust if we consider both federal and state personal income tax shocks (see Internet Appendix Table IA1). We also investigate the tax effects on the compensation of non-CEO named executive officers (NEO) and find that the effect on NEO pay is not statistically significant at the 10% level (please see Internet Appendix Table IA2).

two years after a large tax increase, cash pay increases by 1.2% and stock pay increases by 12.6%, all else equal. The larger adjustment of compensation in response to tax increases is to equity-based pay in the form of stock granted. Another component of CEO compensation that has significantly increased is non-equity incentive pay (15.9%) under a long-term incentive plan (LTIP), for example cash pay if a sales target is reached. We do not observe, however, a significant change in option pay. The changes in components of CEO pay suggest that boards usually increase both cash pay for the liquidity issue faced by the CEOs and incentive pay that strengthens or renews the alignment of CEO incentives with shareholder interests.

4.4. Neighboring states as control states: robustness tests

A potential concern about our identification is that local economic situations may affect both executive compensation and local tax policies. Such effects are not necessarily removed in our baseline tests in which treated and control firms can be in different states far away from each other. To address this concern, we restrict control firms to be the treated states' bordering states. Such states are more likely than distant states to share similar local economic conditions. In particular, for a treated state with a large tax shock, we include as control states only bordering states that do not experience a large shock to the personal income tax rates (as illustrated in Figure 4). This setting allows us to remove the effects of unobserved variation in local economic conditions.

Table 4 reports the results. The effects of tax increases on CEO pay remain positive and statistically significant (Columns 1 and 3), while the effects of tax decreases remain insignificant (Columns 2 and 3). These findings are consistent with the results in our baseline tests reported in Table 3. The results in Table 3 are robust to controlling further for local economic conditions.

4.5. Do the locational choices of CEOs attenuate the estimates?

Another potential concern about our use of staggered state personal income tax changes for identification is that some executives potentially work in a state that is different from their home state for tax purposes.[14] Then, *though only under some circumstances*, as we discuss below, a shock to the personal income tax rate of the state where the employer is located would not affect the CEO's after-tax pay. It also is possible that an executive would move in response to a tax change, out of (into) a state that increased (decreased) the personal income tax rate. Such locational choices potentially would attenuate our estimates of the effect of a change in a state income tax rate on CEO pay towards zero. An increase (decrease) in the state tax rate in the work state could cause a CEO to move out of (into) the work state. In the case of an increase the CEO potentially would avoid the increase by relocating and thereby reducing the need for the firm to respond with a pay increase. In the case of a decrease in tax rate, the CEO could move into the work state, thereby reducing the need for the firm to implement a pay raise the firm would otherwise provide. A CEO living elsewhere, however, potentially would anticipate such a response and would thereby have a diminished incentive to move to the work state. If these locational decisions are material, the effect on CEO pay of a change up or down in the personal income tax rate is larger than that reported in Table 3. Here we assess whether locational choices by the CEO likely to be a concern.[15]

In the U.S., personal income tax codes and rules vary across states. We discuss here two aspects of tax codes that shape the incentives for locational choices and provide four empirical checks on whether locational effects attenuate our estimates of the effect of state tax shocks on CEO pay.

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[14] Think of the home state as being the domicile or primary residence of the executive. Domicile and tax residence, however, need not be the same.

[15] We thank Carola Frydman for bringing locational concerns to our attention.

First, some neighboring states have reciprocity agreements under which the earner, the CEO or NEO in our case, incurs tax liability in their domicile and can entirely disregard the income tax code of the state in which she works. For example, if a CEO worked in Arizona but was a resident of California, Indiana, Oregon, or Virginia, then the employee could request exemption from Arizona state income tax and withholding for that income tax.[16] Then a shock to the Arizona personal income tax rate would not affect the CEO. Note, however, that the reverse is not true. If the CEO worked in California but was a resident of Arizona, California did not accord the symmetric privilege to the Arizona resident. In contrast, Illinois and Iowa each have a reciprocity agreement with the other, as did Pennsylvania and New Jersey until 2017. In 2016 Pennsylvania's top personal income tax rate was 3.07%, while New Jersey's top rate was 8.97%. A CEO living and working in New Jersey would have had the incentive to locate originally in Pennsylvania or change domicile to Pennsylvania while continuing to work in New Jersey, especially if New Jersey raised the income tax rate further. Moreover, a CEO living in New Jersey and working in Pennsylvania would also have the incentive to make Pennsylvania her domicile. Perhaps not surprisingly, the New Jersey reciprocity agreement with Pennsylvania has been terminated,[17] though the Pennsylvania agreement with New Jersey remains. Such reciprocity agreements and

[16] See https://azdor.gov/forms/withholding-forms/withholding-exemption-certificate.

[17] After nearly forty years, in September 2016 New Jersey Governor Chris Christie terminated the New Jersey agreement with Pennsylvania, effective January 1, 2017. While at the time Governor Christie's office declined to provide an estimate of the gain in tax revenue, a former State Treasurer of New Jersey estimated that ending the agreement could generate an additional $180 million annually for New Jersey (https://www.inquirer.com/philly/news/politics/20160903_Christie__seeking_revenue__ends_40-year_tax_agreement_with_Pa_.html).

the flexibility they offer are uncommon. Such are present approximately 2.51% of the time in 2016 and 2.47% after 2017.[18]

Second, it is common that earners whose residences and offices are in different states pay state income tax on the income where it is earned or "sourced."[19] The typical protection from double taxation is that the income tax paid to another state for income earned in the source state is credited by the domiciliary state up to the tax amount that would have been paid on the income had it been earned in that home state. Thus, the relevant state income tax rate is determined by the tax schedule in the state with the higher income tax rate. Let *D* (*W*) denote the domicile (work state) of the CEO and let y_w denote income sourced in the work state. Assume $D \neq W$, and let $\tau_D \neq \tau_W$ denote the state personal income tax rates in the two states. Assuming for simplicity a flat income tax, then $\tau_W y_w$ in tax revenue goes to the work state, $\min\{\tau_D, \tau_W\}\, y_w$ is credited towards personal income tax in the domiciliary state, and the CEO pays personal state income tax aggregated across jurisdictions equal to $\max\{\tau_D, \tau_W\} y_w$. When $\tau_D > \tau_W$ the earner had and continues to have the incentive to shift her domicile to be the work state. When $\tau_D < \tau_W$ the employee has the incentive to shift the source income home to state *D*, away from state *W*, and that incentive increases (decreases) if τ_W increases (decreases).

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[18] Up until the end of 2016, in 17 states, including the District of Columbia, nonresident workers who live in reciprocal states did not have to pay state taxes in the work state. See https://www.thebalance.com/state-with-reciprocal-agreements-3193329. In 2016 there were 64 ordered state pairs with a one-way reciprocity arrangement, which was 2.51% of the 2550 possible one-way arrangements among 51 jurisdictions, the 50 states and Washington, DC. Again, New Jersey terminated its reciprocity agreement with Pennsylvania as of January 1, 2017.

[19] For example, in California, absent a reciprocity agreement, non-residents are required to pay California income tax based on an effective tax rate applied to gross income and deductions derived from California sources (https://www.ftb.ca.gov/forms/misc/1100.html). A CEO who works in California but resides in another state without a reciprocity agreement pays state income tax to California on income earned in California based on the California income tax schedule.

States are fully aware of such incentives (i) to shop for a low-tax-rate tax domicile/residency and (ii) to source income in the low-tax state. Many states have introduced barriers to doing so. For example, in terms of a CEO locating her tax home, she would be a New York State resident for tax purposes if her domicile is New York State **or** (a) she maintains a permanent place of abode in New York State for substantially all of the taxable year **and** (b) she spends 184 days or more in New York State during the taxable year. Any part of a day is a day for this purpose, and the CEO does not need to be present at the permanent NY abode for the day to count as a day in New York.

Continuing with New York as an example, in terms of locating the source of earnings, if an employee does not meet the requirements to be a resident the employee still can owe New York tax as a nonresident if the employee receives income from New York sources. For example, one can owe NY State income tax when the earner's primary office is inside New York State but the earner is telecommuting or otherwise working from outside of the state if the employee is working outside of New York for the employee's own convenience rather than the convenience or necessity of the employer.[20] For example, if one is a nonresident whose primary office is in New York State, days telecommuting during the Covid-19 pandemic are considered days worked in New York unless the employer has established an employer office with certain characteristics at the remote location or unless multiple other criteria are satisfied. A factor considered by New York in applying the convenience test is whether the employee is an officer of the company.[21] If the

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[20] New York is one of several states with a "convenience of the employer" statute that specifies whether an employee working from a home office outside of the state is liable for nonresident income tax. (See https://taxnews.ey.com/news/2020-2543-new-york-issues-guidance-on-the-nonresident-income-tax-liability-to-employees-working-temporarily-outside-of-the-state-due-to-covid-19.) Under this test, nonresident income tax applies if the employee is working outside of the state for the employee's own convenience rather than the necessity of the employer and the employee spends at least one day in New York in the calendar year. Conversely, if the remote work arises from the convenience or necessity of the employer, nonresident NY income tax does not apply.

[21] https://www.tax.ny.gov/pdf/memos/income/m06_5i.pdf.

employee is the CEO or another NEO, for example, the employee is less likely to satisfy the convenience test. Under such circumstances, more expensive measures to source NEO income from the low-tax rather than the high-tax state are required. One means is for the employing firm to relocate the primary office (e.g., corporate HQ) to the domiciliary state[22] or otherwise establish a bona fide place of business in that domicile.

Given that state income tax reciprocity agreements are uncommon, and in light of the barriers states have put in place to reduce locational flexibility for tax residence and income source, we do not expect CEOs and NEOs to easily avoid state personal income tax shocks in their work state. Accordingly, we do not expect our coefficient estimates on the effect of state income tax shocks on executive pay to be contaminated (attenuated) by such locational factors.

We assess this assertion empirically. First, Duchin and Sosyura (2021) examine how remote management by CEOs affects their financial decisions and ability to create shareholder value. They define a "long-distance CEO" as one who commutes at least 50 miles each way to corporate headquarters and does not own a residence within 50 miles of headquarters. Because some corporate headquarters are farther than 50 miles from the nearest bordering state, such long-distance CEOs likely live in their work state. Thus, the set of long-distance CEOs should contain almost all CEOs who would be insulated from a state personal income tax increase in their work state, as well as other commuting CEOs who still would be subject to a state tax change. Duchin and Sosyura (2021) find 1925 long-distance CEO-firm-years among US domiciled firms listed in

[22] While costly, such moves do occur. Hewlett-Packard plans to relocate corporate HQ away from California to near Houston, Texas. In response, as reported December 1. 2020, by the *Wall Street Journal*, San Jose Mayor Sam Liccardo asserted that "The move of HPE's headquarters demonstrates how our region's high costs - including housing, taxes, and regulatory burdens - make it increasingly difficult for employers to justify hiring any but the most technologically advanced talent here." In addition to taxes, Mayor Liccardo listed traffic, housing, and quality of life as concerns. See https://www.wsj.com/articles/hewlett-packard-enterprise-to-leave-silicon-valley-for-texas-11606862026.

the US over the period 2000 – 2020. Over that period there were 105,819 US-firm-year US listings, so the percentage of firm years with a commuter CEO is 1.82%. We view this small percentage as an upper bound on the proportion of CEOs who potentially could avoid a state tax increase in their work state.[23]

Second, as did Duchin and Sosyura (2021), we obtain the CEO residential address data used by Bernile, Bhagwat, and Yonker (2018).[24] In our sample, we find that in 99.3% of CEO-year cases the CEO owns a residence located in the same state as the corporate headquarters. While it is possible that some of these CEOs reside in another abode in a different state, almost all CEOs have the option to make their work state their tax domicile as well.

Third, assuming that in general a CEO must be proximate to corporate HQ for peak performance (per Duchin and Sosyura, 2021), we interact the tax shock with the distance to the nearest state line. If that distance is large, it is less likely that the CEO is domiciled elsewhere and thus would be insulated from the state tax shock. Then the estimated coefficient on the interaction term should be positive if the sample contains a material number of CEOs who are insulated from the tax shock. We find that the interaction coefficient is not significantly different from zero (Column 1 of Appendix Table IA3).

Fourth, we restrict the sample to include observations for which the distance between a CEO's office and state border is more than 125 miles. CEOs in this subsample are unlikely to commute day by day and are more likely to be domiciled in the work state and be exposed to the state tax

[23] Moreover, as Duchin and Sosyura (2021) document, the costs to shareholders of a long-distance CEO include lower operating performance and, in some instances, material commuting costs (as disclosed in the DEF14A). Such costs and poor performance likely contribute to the low incidence of long-distance CEOs.

[24] We thank the authors of Bernile, Bhagwat, and Yonker (2018) for sharing their data on executives' home addresses.

rate shock. When excluding observations with nearby states, the estimated coefficient on the state tax shock is significantly positive (Column 2 of Appendix Table IA 3), as in Panel A of Table 3.

In summary, it appears that our coefficient estimates on the effect of state personal income tax changes on CEO pay are unlikely to be contaminated by the presence in the sample of a significant number of CEOs avoiding taxes by way of locational choices.

4.6. Additional Considerations

Several further considerations warrant brief attention. First, suppose a CEO switches firms. Such a move and the likely substantial change in compensation such a move generates (Coles, Li, and Wang, 2018) can reflect the elasticity of demand for CEO input and CEO versus firm bargaining power, though likely not CEO entrenchment.[25] Demand elasticity and relative bargaining power, as well as the location of the demand curve, potentially can vary across firms, such as the prior versus new employer. Accordingly, so as to better hold constant firm characteristics and to maintain the intersection of CEO and firm, we restrict observations on the change in compensation to include those for which the CEO stays at the same firm for the two years following the relevant change in the personal income tax rate.

Second, about 2.5% of our sample of CEO-year observations have a tax change in two consecutive years. First-differencing removes unobserved firm-specific fixed effects in the corresponding levels equation. Thus, our specification accommodates: repeated treatments (the possibility that a firm experiences a sequence of tax increases or tax cuts over its time in the panel);

[25] Fee and Hadlock (2013) confirm that CEOs who move obtain higher pay and that the compensation change can be explained in part by the equity position forfeited at the prior employer and by the prior employer's performance.

treatment reversals (a tax increase followed sometime later by a tax cut, or vice versa); manager turnover; and differences in firms' responses to tax changes. See Heider and Ljungqvist (2015).

Third, significant elements of our empirical analysis rely on the idea that changes in TDC1 (Execucomp, as adjusted per Coles, Daniel, and Naveen, 2013) reflect pay adjustments that arise in response to changes in the personal income tax rates that are applied to taxable income. To examine this notion in more detail, note that total compensation includes some or all of annual salary, annual bonus, and long-term cash bonus, as well as the grant date fair value (GDFV) estimates for stock and option awards. While annual salary and bonus are part of taxable income in the year they are paid, the grant date fair values of stock and option grants need not be. Under standard time-based vesting, the receipt of stock and options occurs in the future, with the actual taxable date and taxable value being uncertain at the time of the award.[26] Performance-vesting provisions (Bettis, Bizjak, Coles, and Kalpathy, 2010, 2018), under which the number of units of cash, stock, or options ultimately received depends on one or more accounting or market performance metrics, introduce additional uncertainty about actual taxable income.

Of course, in calculating/estimating the value of stock and option awards, compensation committees and consultants often apply standard, SEC- and FASB-sanctioned methods to capture the range and likelihood of possible outcomes (Bettis, Bizjak, Coles, and Kalpathy, 2018). The very act of generating a grant date fair value to disclose requires some understanding of these uncertainties. Thus, GDFV potentially provides a reasonable estimate of the present discounted

[26] A stock award is taxed at the ordinary rate at market value at the time it vests. If the executive holds the stock, then subsequent tax is based on the gain or loss since vesting at either the ordinary income tax rate or the favorable capital gains rate, depending on holding period since vesting. Most options are issued at the money and are taxed at exercise, with the ordinary rate applied to the difference between the market value of the stock acquired net of the exercise price. Again, if the executive continues to hold the stock, then subsequent tax is based on the gain or loss since exercise and either the ordinary income tax rate or the capital gains rate applies, depending on the holding period.

taxable value of those awards. Furthermore, even if GDFV is biased one way or another relative to the present value of taxable income, if the bias is similar from year to year then there is some hope that using the *change* in GDFV removes that bias, so that $\Delta Ln(y_{m,t}) = Ln(y_{m,t}) - Ln(y_{m,t-1})$ is a reasonable proxy for the change in the discounted value of taxable income. This reinforces the use of $\Delta Ln(y_{m,t})$ on the left-hand side of regression specifications.

5. CEO Equity Sales and Wealth-Performance Sensitivity

The consequences for CEOs and firms of personal income tax rate changes extend beyond adjustments by the firm in the level of pay. In this section, we examine the effects on equity sales by the CEO, the composition of the pay package awarded by the firm in response, and revision of the incentive properties of the CEOs accumulated portfolio of stock and options.

5.1 Equity Sales, the Tax Bill, and the Composition of Pay

A significant income tax increase is likely to affect a CEO's liquidity needs because the increased personal tax obligation is paid in cash. One potential mechanism is for the CEO to sell vested stock acquired through prior awards of shares. To test the effects of income tax shocks on CEO equity sales, we estimate the following regression model:

$$\Delta Ln(\$Shares\ Sold_{m,t}) = \beta_0 + \beta_1 \cdot Tax\ Increase_{m,t-2} + \beta_2 \cdot Tax\ Increase_{m,t-1} + \Delta X_{m,t-1} \cdot \Gamma + \mu_m + \vartheta_t + \varepsilon_{m,t}, \quad (3)$$

where \$*Shares Sold* is the dollar value of equity sold by the CEO as an insider, and the other notation is the same as above.

Table 5 reports the results. Column 1 shows that CEOs sell significantly more shares one year after a large tax increase than they do otherwise. This is consistent with the hypothesis that CEOs sell a larger amount of their firm-related equity to create the liquidity required to satisfy a larger

tax bill. Column 1 also shows that CEOs do not sell significantly more shares two years after a large tax increase. These findings are consistent with the results on the cash and equity composition of CEO pay in Panel B of Table 3. The compensation committee of the board of directors, supervised by a human resources director and potentially advised by a compensation consultant, appears to be aware of the CEO's need for liquidity and for replacement of equity incentives, both needs arising from the personal income tax increase. For example, Column 1 of Panel B in Table 3 indicates that firms award more cash to the CEO following a personal income tax increase, all else equal. Moreover, as the coefficient on the twice-lagged tax increase indicator in Column 4 (Panel B of Table 3) establishes, firms respond with even larger grants of stock, likely in part to replace prior, current, and anticipated sales of shares by the CEO.

To summarize the timing, for a tax increase in year *t* in one state, an affected CEO needs to pay the increased tax no later than April (or perhaps October) in year *t*+1, with few incentives to pay before that. In terms of covering the tax bill, income tax rate increases are associated with a large increase in CEO sales of personal holdings of their company stock in year *t*+1. Then boards respond by adjusting CEO compensation in the following year, year *t*+2.

We note that a CEO could instead be motivated to liquidate shares due to negative, private, non-public information they possess. It is unlikely, however, that increases in personal tax rates are correlated with negative firm-level information. Nonetheless, to address this concern, we test whether CEOs exercise more options. In specification (3) we replace *$Shares Sold* by *$Options Exercised*, which is defined as the number of options exercised multiplied by the exercise price per share. If CEOs sell more stock due to negative private information, we would expect that they also dispose of more options, the reason being that the value of options also is sensitive to negative information. Column 2 of Table 5 shows that the effect of tax increases on options exercised is

statistically insignificant. It appears that CEOs decrease their equity holdings due to liquidity reasons rather than based on negative non-public information.

5.2 The Incentive Properties of CEO Pay

As CEOs sell their firm's shares and thus reduce their firm-related wealth, the alignment between CEO incentives and shareholder interests erodes. As we argue in Section 1, an increase in the personal income tax rate weakens the after-tax CEO incentive to increase shareholder wealth. The board of directors should recognize this and adjust pre-tax delta upward to recover appropriate after-tax CEO incentives.

We measure wealth-performance sensitivity (WPS) by delta, which is defined as the change in the value of the CEO's accumulated portfolio of stock and options, net of dispositions, for a 1% change in stock return (e.g., Coles, Daniel, and Naveen, 2006). As reported in Table 1, the average CEO delta is \$517K. On average, a 1% increase in firm value leads to an increase in CEO firm-related wealth of \$517K. We estimate the following model.

$$\Delta Ln(delta_{m,t}) = \beta_0 + \beta_1 \cdot Tax\ Increase_{m,t-2} + \beta_2 \cdot Tax\ Increase_{m,t-1} + \Delta X_{m,t-1} \cdot \Gamma + \mu_m + \vartheta_t + \varepsilon_{m,t}. \quad (4)$$

Table 6 shows results for delta based on the large tax increase dummy. The estimates indicate that pre-tax delta of the CEO's accumulated portfolio of stock and options increases two years after a large tax increase by 2.4% to 2.9%. In both models, the coefficients on the large tax increase indicator variable are statistically significant at the 5% level.

6. The Role of Industry Profitability: Sharing a Larger Pie

Higher personal income tax rates decrease CEO after-tax pay and give the CEO reason to pursue higher before-tax pay through negotiations with the firm. It is usually relatively easier to bargain

for higher pay if the firm is more profitable. Such bargaining power arises from the argument that the CEO should be paid more for better performance and perhaps also from the notion that employees should share in a larger pie with shareholders. Thus, throughout our regression specifications have controlled for the change in profitability.

In addition, we also expect the effects of tax increases on CEO compensation to be stronger in more profitable industries. Holding own-firm performance constant, better industry performance potentially confers more bargaining power to the CEO. One reason is that other CEOs in the same industry will expect and receive pay adjustments and the CEO in the focal firm will be evaluated and benchmarked for pay relative to a more generous external benchmark Another is that a firm in a healthy industry is less likely to be financially constrained and is more able to respond to a tax increase with a pay increase for the CEO. Therefore, we split our sample into two subsamples based on industry-level median profit margin [(Sales – COGS)/Sales], where the industry classification is based on the two-digit SIC. We then analyze and compare the two subsamples using the following specification.

$$\Delta Ln(TDC1_{m,t}) = \beta_0 + \beta_1 \cdot Tax\ Increase_{m,t-2} + \beta_2 \cdot Tax\ Increase_{m,t-1} + \Delta X_{m,t-1} \cdot \Gamma + \mu_m + \vartheta_t + \varepsilon_{m,t}. \quad (5)$$

Column 1 (2) of Table 7 shows the result for the high-profit (low-profit) group. The coefficient estimate on the twice-lagged large-tax-increase dummy is significant only in the high-profit group. The estimate on the large-tax-increase dummy for firms in more profitable industries is more than double the estimate when all firms are included (Columns 1 and 3, Panel A, Table 3). The results confirm that higher industry profitability amplifies the effects of tax increases on CEO pay.

7. CEO Turnover, Firm Performance, and CEO Pay raises

7.1 CEO Turnover and CEO Pay Raises

When a CEO experiencing an increase in personal income tax rate fails to get a pay raise in the current firm, she may search for a similar or better position elsewhere. In practice, a new CEO position generally is accompanied by a signing bonus, replacement of the lost value of unvested stock and options at the prior employer, and a pay increase (Fee and Hadlock, 2013; Coles, Li, and Wang, 2018). Moreover, tax considerations potentially matter. An affected CEO can tilt her move towards an employer in the same state that adjusts pay in response to state tax changes or towards an employer in a different state where the personal income tax rate is lower.[27]

One possibility is that the affected firm "invites" the CEO to voluntarily depart by not adjusting pay in response to a tax increase. Such a strategy avoids some of the costs of involuntary turnover, such as payouts under a severance agreement, while the planned eventual departure allows the firm to search for a new CEO that is a better fit. Under this narrative, the firm benefits from the departure. In contrast, another possibility is that the firm is distressed or otherwise constrained in the extent to which it can raise pay to the prevailing after-tax market pay for a CEO. A CEO turnover under such circumstances is more likely to damage the firm. For example, an unhappy exiting CEO may be less cooperative during the transition to exit, which can have negative effects on existing long-run projects. Furthermore, non-disclosure agreements and non-compete clauses often have limited enforceability (Garmaise, 2011), in which case a departing CEO can take key information on the now-former employer to a rival firm. Finally, when a current CEO

[27] In a related investigation, we collect CEO-to-CEO transitions across firms using Execucomp data. We find that when a CEO moves to the next CEO position, in 74% of cases the CEO moves to a different state, which implies that geographical stability is unlikely to be a hard and fast job search requirement for CEOs.

unexpectedly leaves her position, the potentially urgent search for a successor likely gives outside candidates bargaining power to negotiate higher pay. To what extent is a response to increased personal income tax rates in the form of higher pay an effective means for retention?

To assess the presence of the retention motive, we divide firms with CEOs who face a large increase in personal income tax rates into two groups. One group includes CEOs who receive a pay raise two years after a large increase in state personal income tax rate. The other group contains CEOs who suffer from a large tax increase but do not receive a subsequent pay increase. We compare the likelihood of CEO turnover across these two groups.

Panel A of Table 8 reports the univariate comparison of turnover rates. We find a significant difference in the likelihood of CEO turnover between the groups with and without CEO pay raises. In the firms that do *not* give their CEOs pay raises, there are 153 turnovers that count for 10% of CEO-firm years in this group of tax-shocked CEOs. In contrast, in firms that give their CEOs pay raises, there are only 101 turnovers that only count for 4.5% of CEO-firm years in the got-a-pay-raise group. A *t*-test for the equality of turnover rates between these two groups indicates that the means are statistically different at the 1% level (p-value 0.001). The likelihood of CEO turnover in the pay-raise group is significantly lower than that in the no-pay-raise group.

One possibility is that the CEOs who get no raise are less capable. For example, bad performance in previous years might happen to drive CEOs to leave their positions and lead firms, by not responding, to encourage CEOs to depart. To address this possibility we control for prior firm performance in a regression model. For CEOs who faced an increase in personal income tax rates two years prior, we estimate the following linear probability model:

$$CEO\ Turnover_{m,t} = \beta_0 + \beta_1 \cdot PayRaise_{m,t-1} + X_{m,t-1} \cdot \Gamma + \mu_i + \vartheta_t + \varepsilon_{m,t}, \qquad (6)$$

where *CEO Turnover* is an indicator variable for CEO turnover and $PayRaise$ is the pay raise dummy (= 1 if the CEO received a pay raise within two years of the tax rate change, 0 otherwise). Control variables include ROA or stock return and other firm characteristics.

Both columns in Panel B show that the coefficients on the pay raise dummy are negative and statistically significant at the 5% level. It appears that CEOs receiving pay raises are significantly less likely to depart than those who do not receive a raise following a tax increase.[28]

7.2 Firm Performance Following CEO Pay Raises

Would higher CEO pay following an increase in income tax rates be associated with better or worse subsequent firm performance? In this section, we focus on firms whose CEOs experienced an exogenous personal income tax rate increases two years prior and again partition the sample based on whether the CEO received an increase in compensation. We measure firm performance by ROA and stock return. Panel A of Table 9 shows the univariate results. The change in ROA and stock returns from year *t-1* to *t* is higher in firms that gave raises to their CEOs in period *t-1* following a tax hike in the previous two years.

A multivariate setting provides similar results. We estimate the following model.

$$\Delta Performance_{i,t} = \beta_0 + \beta_1 \cdot PayRaise_{m,t-1} + \Delta X_{m,t-1} \cdot \Gamma + \mu_i + \vartheta_t + \varepsilon_{m,i,t} \qquad (7)$$

where *i* is the firm index, $PayRaise$ is the pay raise dummy, μ_i is the firm fixed effect, and $\varepsilon_{m,i,t}$ is the error term. A potential concern could be that CEOs that made poor or unlucky decisions do not get a raise, whereas better performing CEOs get a raise. Put differently, past performance

[28] In the robustness tests reported in the Appendix Table IA4, we focus on voluntary turnovers and find that the tax increases have a significant effect only on turnover of CEOs that do not receive a pay raise. The voluntary turnovers are the difference between the set of CEO turnovers identified from Execucomp and the forced turnover dataset provided by Peters and Wagner (2014). We thank Peters and Wagner for making the forced turnover data publicly available.

might be an omitted variable. To address such concerns, we control for firm performance in the previous one and two years. In the meantime, the dependent variable $\Delta Performance$ is measured one year forward from the period in which the CEO did or did not receive a pay increase (in response to a large tax increase two years prior). Panel B reports the results.

ROA (Column 1) and stock return (Column 2) are significantly higher for firms that increase CEO pay following a large personal income tax increase, after controlling for the firm performance in the previous years. Put differently, if a firm does not increase CEO pay after a large state tax increase, firm performance tends to be worse. These findings are consistent with the idea that boards can offset negative compensation shocks unrelated to CEO performance/quality and, by doing so, retain valuable talent to facilitate good firm performance.

8. The Elasticity of CEO Compensation in Personal Taxes

To further assess the economic significance of the responsiveness of CEO pay to personal taxes, in this section we estimate the elasticity of CEO compensation with respect to the factor that captures what is left after income taxes, the net-of-tax rate.[29] To measure the economic magnitude of tax changes more accurately, in our analysis of the elasticity we consider both federal level and state level changes in personal income tax rates, include both increases and decreases in tax rates, and include both large and small tax shocks.

8.1. Framework

[29] The income tax in the US can include three parts: federal, state, and local. In contrast to federal and state income taxes, local income taxes are low (most local income tax rates are between 1% to 3%, with a few exceptions, including the District of Columbia, with the income tax rate ranging from 4% to 8.5%. More information is available at https://taxfoundation.org/local-income-taxes-city-and-county-level-income-and-wage-taxes-continue-wane/.). Therefore, in our calculations, we approximate the income tax rate as the sum of federal and state income tax rates and ignore local income tax.

Let $y_{m,t}$ be nominal period *t* compensation of CEO *m* and let $\tau_{m,f,t}$ and $\tau_{m,s,t}$ be the federal and state tax rates applicable to CEO *m* in period *t*. Assuming a flat tax, for simplicity, after-tax, period-t pay of the CEO of the firm is $y_{m,t} \cdot (1 - \tau_{m,f,t} - \tau_{m.s,t}) = y_{m,t} \cdot NOT_{m,t}$, where $NOT_{m,t} \equiv (1 - \tau_{m,f,t} - \tau_{m,s,t})$ is the "net of tax" rate, which when applied to taxable income determines after-tax income. Let $g_{m,t}$ be the one-year labor-market equilibrium growth rate for the pay of the CEO. The rate $g_{m,t}$ could depend on the level of or changes in firm accounting or market performance, size, asset tangibility, inflation rate, performance of industry competitors, other factors, and on CEO characteristics as well.

Suppose that $(1 + g_{m,1})y_{m,0}$ is the right (equilibrium) benchmark for the CEO's pay in period 1. Let $\hat{y}_{m,1}$ denote the nominal pay of the CEO in period 1 that makes the CEO whole after-tax, holding all else constant: $\hat{y}_{m,1} \cdot \left(1 - \tau_{m,f,1} - \tau_{m,s,1}\right) = \left(1 + g_{m,1}\right) \cdot y_{m,0} \cdot (1 - \tau_{m,f,0} - \tau_{m,s,0})$, or identically, $\hat{y}_{m,1} \equiv \left(1 + g_{m,1}\right) \cdot (NOT_{m,0}/NOT_{m,1})y_{m,0}$. Dividing both sides by prior pre-tax pay, and allowing that tax rate changes can affect pay potentially with a lag, suggests the following specification to estimate the effect on CEO pay of a change in the personal income tax rate:

$$Ln\left(\frac{y_{m,t}}{y_{m,t-1}}\right) = \beta_0 + \beta_1 Ln\left(\frac{NOT_{m,t-3}}{NOT_{m,t-2}}\right) + \beta_2 Ln\left(\frac{NOT_{m,t-2}}{NOT_{m,t-1}}\right) + \Delta X_{m,t-1}\Gamma + \mu_m + \vartheta_t + \varepsilon_{m,t}, \tag{8}$$

where *m* is the CEO index, *t* is the time index, *y* is CEO compensation, $NOT_{m,t}$ is the after-tax adjustment as defined above, and other notation is defined prior. Because we expect the response, if any, to be lagged by two years, the coefficient β_1 is our focus. We expect the estimate of β_1 to be positive because an increase in tax rate(s) from $t - 3$ to $t - 2$ implies an increase in the *NOT* ratio, $NOT_{m,t-3}/NOT_{m,t-2}$. If compensation responds sooner, β_2 should be positive.

In either case, the estimated coefficient from model (8) is the **negative** of the elasticity of executive pay in the net-of-tax rate, $-\beta_1 = \varepsilon_{y,NOT} \equiv (NOT/y)(dy/dNOT)$. Restated, the estimated coefficient would be equal and opposite in sign if we perform the regression analysis based on $NOT_{m,t-2}/NOT_{m,t-3}$, the reciprocal of the after-tax ratio used in model (8).

8.2. Empirical findings on the elasticity of CEO compensation in personal income tax changes

Table 10 reports the results. Columns 1 and 2 of Panel A show the results for all tax rate changes and large tax rate changes, respectively. Our prior is that all tax rate changes, large or small, likely matter for CEO pay. Moreover, while using a discrete threshold of the size of the tax rate shock is consistent with the discrete nature of the diff-in-diff design, the continuous nature of the ratio of net-of-tax rates easily accommodates tax rate shocks of all sizes. In applying equation (8), Column 1 of Table 10 includes all personal state income tax shocks. For Column 2, which is focused on large shocks, we set $NOT_{m,t-s}/NOT_{m,t-(s-1)} = 1$ for all observations for which the rate change was less than one percentage point.

Columns 1 and 2 indicate that a 1% decrease in the net-of-tax rate due to a state personal income tax rate increase is associated with a 0.736% (p = 0.070) and 0.943% (p = 0.049) increase in total compensation two years later. An estimate of 1 would be consistent with an increase in pay that makes the CEO exactly whole in terms of after-tax pay. Both estimates indicate that the CEO is substantially compensated two years later for the increase in state personal income tax rate.

To illustrate further the economic significance of the parameter estimate, suppose the state or federal tax rate (or the sum of those rates) goes up by 0.01 from period $t-3$ to $t-2$. Assume that prior to the tax increase that the federal and state rates are the CEO-year averages in the sample, 36.4% and 5.3%, respectively, so the federal and state rates sum to 0.417 at $t-3$ and 0.427 at $t-2$. Then $Ln(NOT_{m,t-3}/NOT_{m,t-2})$ becomes 0.0173 rather than 0 (which the

logarithm of the net-of-tax ratio would be if there had been no tax rate change). Using the elasticity estimate from Column 2 implies a 1.63% (i.e. 0.943 x 0.0173) proportional increase in CEO pay. Also note, consistent with the results in Table 3, that our estimates indicate that there is very little response in the first year following the tax change ($t-2$ to $t-1$).

8.3. Discussion of the Elasticity Estimates

Both the very strong response upward in CEO pay to tax increases and the lack of responsiveness downward of CEO pay to tax decreases are provocative results that beg for additional inspection. Here we consider whether there is a combination of standard supply and demand effects that accommodate the results.

To do so we address whether the empirical estimate of β_1 is consistent with plausible demand and supply conditions for CEO "labor" as a function of "wage." Denote equilibrium executive compensation as y, the sum of the federal and state tax rates as $\tau = \tau_f + \tau_s$, and CEO pay after income tax as $y \cdot (1-\tau) = y \cdot NOT$. Denote the demand function of the firm for executive "labor" or input as $D(y)$ and the executive's supply function as $S(y \cdot NOT)$. In partial equilibrium in the executive labor market, $D(y) = S\big(y \cdot (1-\tau)\big) = S(y \cdot NOT)$ determines the equilibrium level of compensation for a given net-of-tax rate.

Suppose that there is a shock to the net-of-tax rate. The shock could be an increase (a reduction) in federal or state tax rate, in which case NOT would fall (rise). To assess the effect of the tax shock on equilibrium pay, differentiate the expression equating demand and supply in y and NOT to get $D'(y) \cdot dy = S'(y \cdot NOT)[y \cdot dNOT + NOT \cdot dy]$. Solving gives $\varepsilon_{y,NOT} = -\varepsilon_S/(\varepsilon_S - \varepsilon_D)$, where $\varepsilon_{y,NOT} \equiv (NOT/y) \cdot (dy/dNOT)$ and the supply and demand elasticities in the CEO labor market are $\varepsilon_S \equiv y \cdot NOT \cdot S'(y \cdot NOT)/\, S(y \cdot NOT)$ and $\varepsilon_D \equiv y \cdot D'(y)/\, D(y)$. If $\varepsilon_S \in [0, \infty)$ and $\varepsilon_D \in (-\infty, 0]$, then $\varepsilon_{y,NOT} = -\varepsilon_S/(\varepsilon_S - \varepsilon_D) \in [-1,0]$.

Note that both of the estimates of $\varepsilon_{y,NOT}$ from Table 10, - 0.0736 from Column 1 and - 0.943 from Column 2, fall inside his interval. The estimated value of $\varepsilon_{y,NOT}$ = - 0.943 indicates that the demand curve for CEO input is approximately one-sixteenth as elastic as the supply curve ($\varepsilon_D = -0.06045\ \varepsilon_S$). Using $\varepsilon_{y,NOT}$ = - 0.736 gives $\varepsilon_D = -0.3587\ \varepsilon_S$. For both estimates, especially the one based on large tax shocks, the demand curve appears to be highly inelastic relative to the supply curve. An inelastic demand curve for CEO input is consistent with the high responsiveness of CEO pay to state personal income tax shocks.

9. Conclusion

We study the effect of tax policies on CEO compensation. Specifically, we utilize staggered changes in state-level personal income tax rates in the US to investigate how increases and decreases in personal income tax rates affect CEO compensation. Two years after a large increase in the personal income tax rate, the CEO receives significantly higher pay that offsets much of the cost of the tax increase. In particular, our estimates indicate that a 1% decrease in the CEO's net-of-tax rate for large tax changes is associated with a 0.943% increase in total compensation two years later. This increase is close to what would have been required to make the CEO exactly whole after the increase in personal income tax. These results are consistent with a relatively inelastic demand curve for CEO input. In stark contrast, we find that income tax rate decreases have minimal effects on CEO pay. The effects on CEO pay of tax increases and decreases are decidedly asymmetric. The lack of a downside response in pay to a tax increase, controlling for other determinants of pay, suggests that CEOs possess and exercise bargaining power.

The form of the pay increase comes in both cash and awards of stock in the firm. The former is consistent with an increase in demand for liquidity by the CEO to pay the larger tax bill. The latter

is consistent with maintaining the CEO's after-tax equity incentives. Following a tax rate increase, we find that CEOs sell equity, likely for additional liquidity needed to pay income tax. Equity awards by the firm to the CEO appear to offset those lost equity incentives. Moreover, after-tax delta incentives decline when there is an increase in personal income tax rate, so firms grant equity to increase pre-tax delta to offset the effect of an increase in tax rate.

We find that the tax effect on CEO pay is stronger in more profitable industries. Furthermore, when CEOs experience increases in income taxes, a pay raise is negatively associated with the likelihood of CEO turnover and positively associated with firm performance. This evidence suggests that increases in CEO pay after personal tax increases do not damage shareholder wealth.

Edmans, Gabaix and Jenter (2017) list three perspectives as being particularly useful to understand managerial compensation: market forces and shareholder value maximization; executive bargaining power and rent extraction; and institutional forces, such as taxes. We believe our results reflect all three of those perspectives. The combination of the strong effect of personal income taxes on pay, the magnitude of the elasticity of executive pay in the net-of-tax rate, the asymmetry in the effect of tax increases versus decreases, and the effects of taxes on the incentive properties of executive compensation suggest that market forces and managerial bargaining power shape the way that CEO pay responds to personal income tax rates.

A question we are unable to address without more data is the incidence at the firm level of the shock to the supply curve of the CEO. The firm responds with higher CEO compensation, but we do not know the extent to which that cost is spread across shareholders, bondholders, other labor, other factors of production, customers, or suppliers. We leave this for future inquiry enabled by appropriate data.

Our analysis has implications for policy. For example, there are recent calls at the state and federal level to increase income tax rates on high earners, such as CEOs and other NEOs. Our analysis highlights the fact that whether changing income tax rates would reduce the inequalities in earnings between top executives and the median or rank-and-file worker depends on the elasticity of firm demand for each type of employee.[30]

[30] Supposing that a state uses a flat rate for the personal income tax, if the demand curve for CEO and other NEO input is more inelastic than the demand curve for rank-and-file employees, an increase in the flat state income tax rate likely will increase earnings inequality in the firm. Such factors also will determine the success of various other initiatives, including California Senate Bill 37, which would impose significant taxes on firms that have the largest gaps between the highest-earning and lowest-paid employees. California SB 37, the "Corporate Fair Share for California and Californians," originally proposed that large corporations that do business in California would face a tax increase of 2% to 6%, depending on the difference between what the CEO is paid and the pay of their average worker (https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201920200SB37). As of January 2020, an amended version of the bill, applying only to companies with earnings more than $10 million, would tax companies based on the gap is between the highest and lowest paid employees. California corporations would face a tax increase from 10.84% to as much as 14.84%, while California-domiciled financial institutions are looking at a possible increase from 12.82% to 16.84%. Read more in the *Sacramento Bee*, January 17, 2020 (https://www.sacbee.com/opinion/california-forum/article239287588.html#storylink=cpy) and the *California Globe*, February 24, 2020 (https://californiaglobe.com/section-2/california-businesses-could-face-higher-taxes-based-on-gap-between-highest-and-lowest-wages/).

References

Bernile, Gennario, Vineet Bhagwat, and Scott Yonker, 2018, Board diversity, firm risk, and corporate policies. *Journal of Financial Economics* 127, 588-612.

Bettis, Carr, John Bizjak, Jeffrey L. Coles, and Swaminathan Kalpathy, 2010, Stock and option grants with performance-based vesting provisions, *Review of Financial Studies* 23, 3849-3888.

Bettis, Carr, John Bizjak, Jeffrey L. Coles, and Swaminathan Kalpathy, 2018, Performance-vesting provisions in executive compensation, *Journal of Accounting and Economics* 66, 194-221.

Coles, Jeffrey L., Naveen D. Daniel, and Lalitha Naveen, 2006, Managerial incentives and risk-taking, *Journal of Financial Economics* 79, 431-468.

Coles, Jeffrey L., Naveen D. Daniel, and Lalitha Naveen, 2008, Boards: does one size fit all? *Journal of Financial Economics* 87, 329-356.

Coles, Jeffrey L., Naveen D. Daniel, and Lalitha Naveen, 2013, Calculation of compensation incentives and firm-related wealth using Execucomp: data, program, and explanation, Temple University working paper.

Coles, Jeffrey L., Naveen D. Daniel, and Lalitha Naveen, 2014, Co-opted boards," *Review of Financial Studies* 27, 1751-1796.

Coles, Jeffrey L., Zhichuan (Frank) Li, and Yan (Albert) Wang, 2018, Industry tournament incentives, *Review of Financial Studies* 31, 1418–1459.

Duchin, Ran, and Denis Sosyura, 2021, Remotely productive: The economics of long-distance CEOs. Arizona State University working paper.

Edmans A, X. Gabaix, and D. Jenter, 2017, Executive compensation: A survey of theory and evidence, in *Handbook of the Economics of Corporate Governance*, Chapter 7, 383-539.

Fee, C. E., and C. J. Hadlock, 2003, Raids, rewards, and reputations in the market for managerial talent, *Review of Financial Studies* 16, 1311–53.

Frydman, Carola, and Raven S. Molloy, 2011, Does tax policy affect executive compensation? Evidence from postwar tax reforms, *Journal of Public Economics* 95, 1425-1437.

Garmaise, Mark J, 2011, Ties that truly bind: Noncompetition agreements, executive compensation, and firm investment, *Journal of Law, Economics, & Organization* 27, 376-425.

Goolsbee, Austan, 2000, What happens when you tax the rich? Evidence from executive compensation, *Journal of Political Economy* 108, 352-378.

Hall, Brian J. and Jeffrey B. Liebman, 2000, The taxation of executive compensation, in: James Poterba (Ed.), *Tax Policy and the Economy* 14, MIT Press, Cambridge, MA.

Heider, Florian, and Alexander Ljungqvist, 2015, As certain as debt and taxes: estimating the tax sensitivity of leverage from state tax changes, *Journal of Financial Economics* 118, 684-712.

Jensen, Michael C., and Kevin J. Murphy, 1990, Performance pay and top-management incentives, *Journal of Political Economy* 98, 225-264.

Murphy, Kevin J., 1999, Executive compensation, in Orley Ashenfelter and David Card, eds.: *Handbook of Labor Economics* 3 (Elsevier, Amsterdam), 2485-2563.

Murphy, Kevin J., 2013, Executive compensation: Where we are, and how we got there, in George Constandinides, Milton Harris, and Rene Stulz: *Handbook of the Economics of Finance* 2A (Elsevier, Amsterdam), 211-356.

Perry, Tod, and Marc Zenner, 2011, Pay for performance? Government regulation and the structure of compensation contracts, *Journal of Financial Economics* 62, 453–488.

Peters, Florian S., and Alexander F. Wagner, 2014, The executive turnover risk premium, *Journal of Finance* 69, 1529-1563.

Rose, Nancy L and Catherine Wolfram, 2002, Regulating executive pay: using the tax code to influence chief executive officer compensation, *Journal of Labor Economics* 20, S138–S175.

Weisbach, Michael S, 1988, Outside directors and CEO turnover, *Journal of Financial Economics* 20, 431-460.

Appendix: Variable Definitions

Assets	total book value of assets
Cash Pay	the natural logarithm of total compensation (TDC1) less stock and option pay
Cash	cash and liquid assets held by the firm (scaled by total book assets)
Debt	short and long-term debt held by the firm (scaled by total book assets)
Democrat Gov	dummy variable equal to one if the state had a democratic governor in a particular year, zero otherwise
Delta	the change in firm-related wealth for a 1% change in the firm's stock return, calculated following Coles, Daniel and Naveen (2006)
Equity Pay	the natural logarithm of the sum of stock and option pay received
Mkt-Book	the market value of equity (shares outstanding multiplied by share price) divided by the book value of shareholder's equity
NOT	$NOT_t \equiv (1 - \tau_{f,t} - \tau_{s,t})$ means "net of tax", where $\tau_{f,t}$ ($\tau_{s,t}$) is the top marginal federal (state) tax rate at time *t*
Old CEO	a dummy variable that equals to one if a CEO is at least 65 years old in a year and zero otherwise
Pay Raise	the pay raise dummy that equals one if the CEO received a pay raise within two years of the tax rate change and zero otherwise
Population	the total state population within a specific year
ROA	net income scaled by total assets
R&D	research & development expenditures of the firm (scaled by total book assets)
SCash	the total cash of a given state in a specific year

SDebt	the total debt of a given state in a specific year
State GDP	the gross domestic product within a state-year
Stock Return	stock return over a fiscal year
Tax Increase	a dummy variable equal to one if a CEO experienced a personal income tax rate increase (greater than one percentage point (in some models), and zero otherwise
Tax Decrease	a dummy variable equal to one if a CEO experienced a personal income tax rate decrease (greater than one percentage point in some models), and zero otherwise
Tax Revenue	total tax revenue within a state-year
Turnover	dummy variable equal to one if a firm experiences a CEO turnover in a given year, zero otherwise
Unemployment	the percentage of workers that are unemployed within a state-year
Vega	the change in firm-related wealth for a 0.01 change in the firm's annualized standard deviation of daily stock return, calculated following Coles, Daniel and Naveen (2006)
$Options Exercised	the number of options exercised by the CEO multiplied by the exercise price per share, all adjusted for stock splits
$Shares Sold	the dollar value of equity sold by the CEO as an insider

Figure 1. Large State Personal Income Tax Rate Shocks Over Time

This figure shows the yearly number of large increases and decreases in state-level personal income tax rates between 1992 and 2018, where the large charges are changes exceeding one percentage point for earners in the top tax bracket. The blue (orange) bars are for increases (decreases) in tax rates.

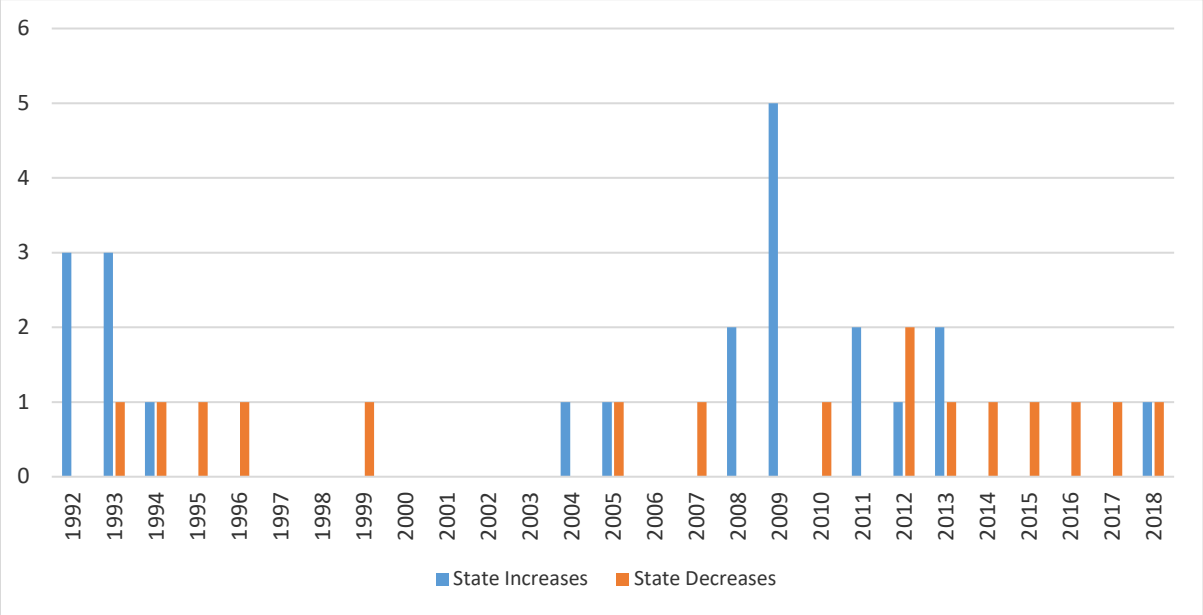


Figure 2. Differences in CEO Pay Changes Between Treated and Control Groups in Years Around the Tax Changes

This figure shows the differences in CEO pay changes between the treated group and control group. The treated group includes CEOs in firms headquartered in states experiencing large personal income tax rate changes (greater than one percentage point). The control group includes CEOs in firms headquartered in states without personal income tax changes. Panel A (B) is for tax increases (decreases). The x-axis shows the year relative to an event year (as year 0). The y-axis shows the difference in CEO pay changes [Δln(TDC1), to be used as the dependent variable in DiD analysis]. The blue dots represent the average yearly differences in Δln(TDC1) between treated and control groups. The upper and lower bounds of the bars show the 90% confidence intervals. The red dashed line indicates the zero value of the y-axis.

Panel A. Tax increases

Panel B. Tax decreases

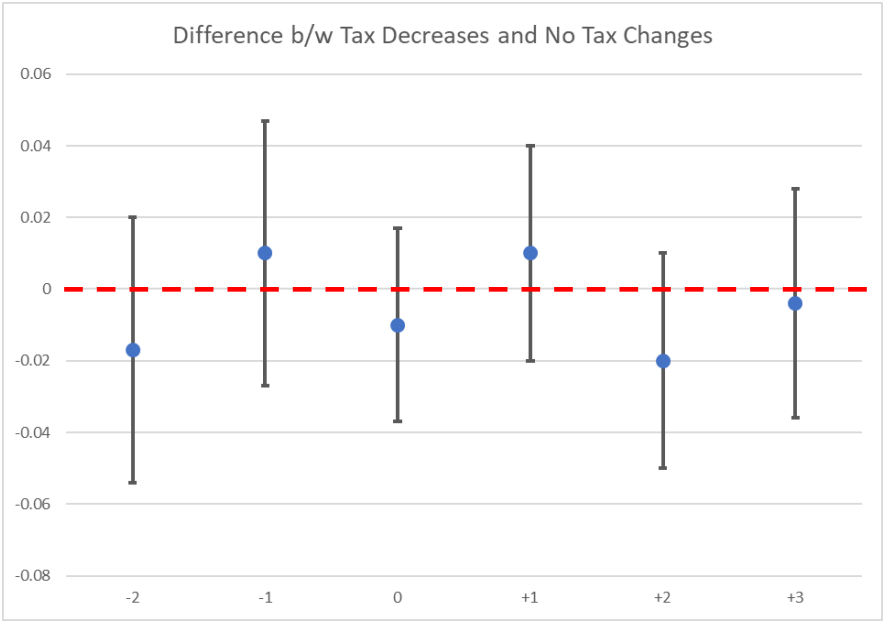


Figure 3. Components of CEO Compensation

This figure illustrates the yearly average of the value of the components of CEO compensation between 1992 and 2018 inclusive. The components include salary, bonus, non-equity incentives, stock, and options in thousands of US$. The data are from Execucomp.

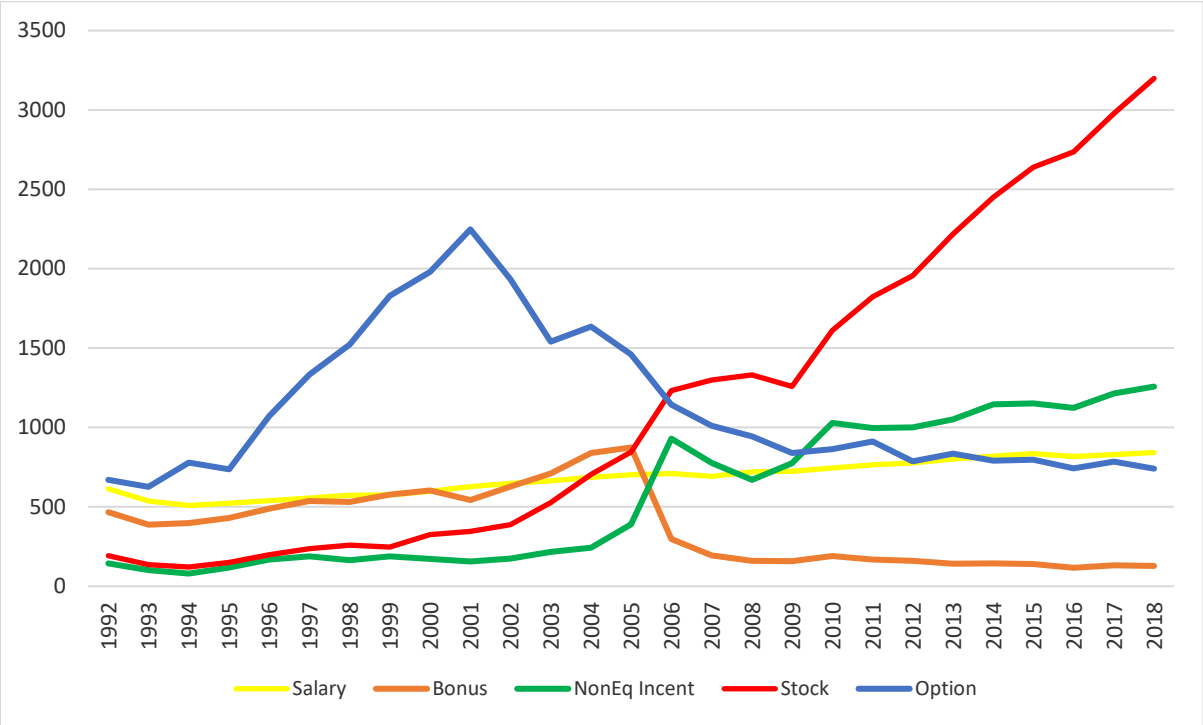


Figure 4. Examples for Neighbor States Without Tax Shocks

This figure shows examples for neighboring control states for treated states with tax increases or increases. For example, North Dakota (ND) had a tax increases [in Red]; Montana (MT) and South Dakota (SD) are neighbors without shocks [in Yellow]; Minnesota (MN) had a tax increase, so is not designated as a neighbor control state. In our sample, in total we have 15 (14) unique states with large tax increases (decreases) and correspondingly have 20 (21) unique neighboring control states without tax shocks.

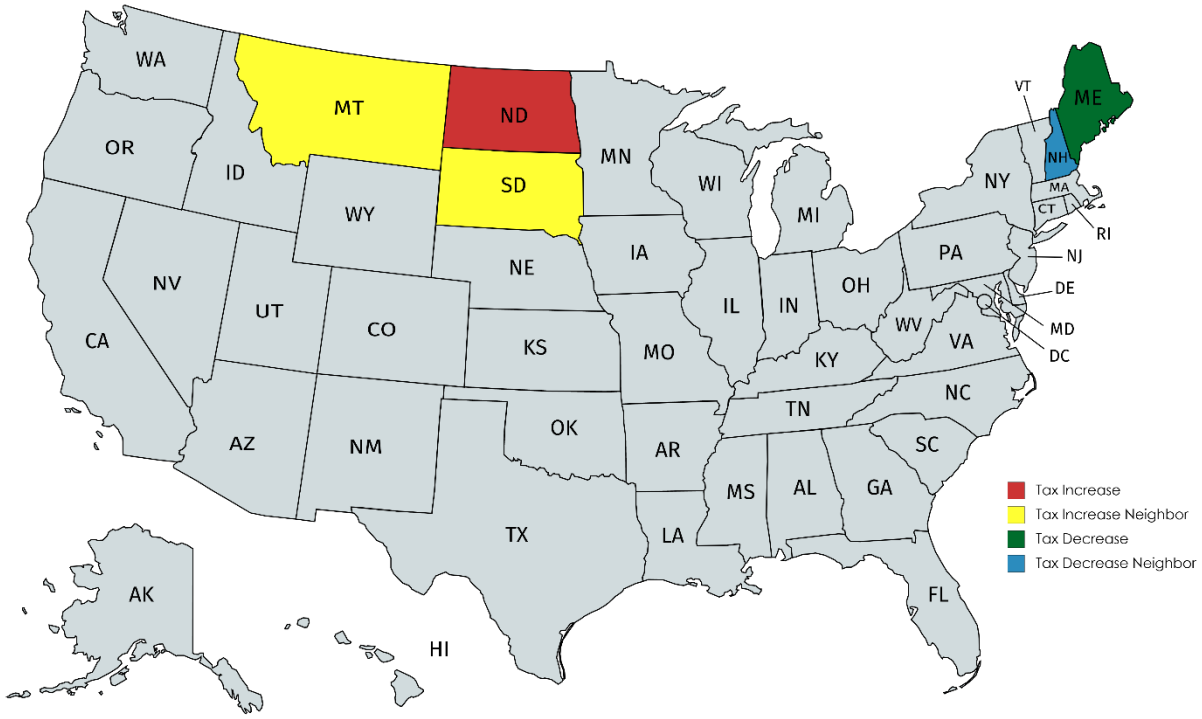


Table 1. Summary Statistics

This table presents summary statistics in Panel A for changes in the top state personal income tax rate. Panel B provides summary statistics at the level of CEO-firm-year on compensation, personal income tax rate changes and firm characteristics. The sample consists of firms in the intersection of Execucomp and Compustat for the years 1992 – 2018 inclusive. The compensation-related variables are in thousands of US dollars. Assets are in millions of dollars. All variables are winsorized at the 1st and 99th percentile values. Variable definitions are in the Appendix.

Panel A: State Personal Income Tax Rate Changes

	Mean%/Count		
	Increase	Decrease	Both
Large	2.27%/22	-2.11%/16	NA/38
Small	0.25%/87	-0.22%/222	NA/309
Total	0.65%/109	-0.35%/238	NA/347

Panel B: CEO-Firm-Year Summary Statistics

	Units = $ thousands unless otherwise specified					
Variable	Mean	SD	p25	p50	p75	N
CEO-Firm-Year						
Large Tax Increase (0, 1)	0.053	0.224	0	0	0	38,786
Large Tax Decrease (0, 1)	0.014	0.116	0	0	0	38,786
Small Tax Increase (0, 1)	0.059	0.235	0	0	0	38,786
Small Tax Decrease (0, 1)	0.140	0.347	0	0	0	38,786
Total Pay (TDC1)	4,774.03	4,702.35	1,404.00	3,096.80	6,388.82	38,786
Salary	711.46	320.73	468.00	680.00	945.00	38,786
Bonus	338.65	624.69	0	0	415.63	38,786
Noneq Incentives	632.48	971.66	0	0	957.26	38,521
Stock Pay	1,367.43	2,122.27	0	220.94	1,918.67	38,521
Option Pay	1,137.50	1,718.18	0	361.24	1,523.38	38,521
Perquisites	196.50	387.61	13.19	54.10	183.03	38,786
Delta	517.19	787.19	75.72	203.27	557.54	37,041
Firm-Year						
Assets	10,101.85	27,717.88	617.95	1,914.76	6,686.20	38,786
Mkt-Book (ratio)	3.07	3.78	1.40	2.17	3.59	38,786
ROA (rate)	0.03	0.11	0.01	0.04	0.08	38,786
Stock Return (rate)	0.14	0.49	-0.14	0.09	0.33	38,786

Table 2. State Personal Income Tax Rate Changes and CEO Pay Changes

This table shows the relationship between state personal income tax rate changes and CEO pay changes. Tax Increase (Decrease) is a dummy variable, which equals one if a state experiences an increase (decrease) in personal income tax rate greater than one percentage point in a year and zero otherwise. The CEO pay growth (ΔCEO pay) is the average change in firm-level CEO pay within a state-year. The test sample is at the state-year level. We use the linear probability model. State-level controls include transformed debt, state GDP, tax revenues, cash savings, population, democrat government indicator, and unemployment rate. Δ denotes the first difference. All specifications include state fixed effects and year fixed effects. Robust standard errors are clustered at the state level. The Appendix provides variable definitions. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)
VARIABLES	Tax Increase	Tax Decrease
ΔCEO pay$_{t-1}$	0.016	0.004
	[1.14]	[0.33]
ΔCEO pay$_{t-2}$	0.008	-0.002
	[0.85]	[-0.10]
ΔLn(SDebt$_{t-1}$)	0.084*	0.018
	[1.69]	[0.31]
ΔLn(State GDP$_{t-1}$)	0.482	-0.122
	[1.62]	[-0.64]
ΔLn(Tax Revenue$_{t-1}$)	-0.163	-0.131
	[-1.25]	[-1.55]
ΔLn(SCash$_{t-1}$)	-0.064	-0.028
	[-1.12]	[-0.59]
ΔLn(Population$_{t-1}$)	-0.421	0.259
	[-0.98]	[0.77]
ΔDemocrat Gov$_{t-1}$	0.018	-0.030
	[1.10]	[-1.50]
ΔUnemployment$_{t-1}$	-0.001	-0.006
	[-0.11]	[-0.54]
Observations	857	857
R-squared	0.121	0.072
State FE	Y	Y
Year FE	Y	Y

Table 3. CEO Compensation Responsiveness to State Personal Income Tax Changes

This table shows the effects of changes in personal income tax rates on CEO compensation. *Tax Increase* (*Decrease*) is a dummy variable that equals one if a CEO's state personal income tax rate increases (decreases) by at least one percentage point in a year and zero otherwise. Panel A (B) shows the effect of tax changes on total pay (components of pay). Total pay is TDC1 in Execucomp database. The dependent variable is Δln(TDC1) or a transformed component of CEO compensation, the control variables are transformed Assets, Mkt-Book, and 1+ROA, Δ denotes difference, and Ln(.) is the natural logarithm. All specifications include CEO fixed effects and year fixed effects. Robust standard errors are clustered at the state level. Variables are defined in the Appendix. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Magnitude and Timing of the Response

VARIABLES	(1) ΔLn(TDC1)	(2) ΔLn(TDC1)	(3) ΔLn(TDC1)
Tax Increase$_{t-1}$	-0.006		-0.003
	[-0.32]		[-0.18]
Tax Increase$_{t-2}$	0.055***		0.057***
	[2.79]		[3.07]
Tax Decrease$_{t-1}$		0.020	0.017
		[0.57]	[0.49]
Tax Decrease$_{t-2}$		0.060	0.063
		[1.37]	[1.50]
ΔLn(Assets$_{t-1}$)	0.324***	0.324***	0.324***
	[11.27]	[11.13]	[11.13]
ΔLn(Mkt-Book$_{t-1}$)	0.013***	0.013***	0.013***
	[5.51]	[5.52]	[5.52]
ΔLn(1+ROA$_{t-1}$)	0.543***	0.544***	0.543***
	[4.78]	[4.77]	[4.78]
Observations	36,709	36,709	36,709
R-squared	0.116	0.116	0.116
CEO FE	Y	Y	Y
Year FE	Y	Y	Y

Panel B: Components of CEO Compensation Responsiveness to Prior Personal Tax Rate Changes

VARIABLES	(1) ΔLn(Salary)	(2) ΔLn(Bonus)	(3) ΔLn(NonEq Incent)	(4) ΔLn(Stock)	(5) ΔLn(Option)
Tax Increase$_{t-1}$	-0.012	0.117	0.008	0.045	-0.094
	[-1.44]	[1.05]	[0.07]	[0.52]	[-0.81]
Tax Increase$_{t-2}$	0.012***	0.034	0.159**	0.126**	-0.082
	[3.42]	[0.37]	[2.04]	[2.39]	[-0.83]
ΔLn(Assets$_{t-1}$)	0.067***	0.422***	0.284***	-0.057	0.246***
	[7.18]	[4.98]	[4.10]	[-1.04]	[2.76]
ΔLn(Mkt-Book$_{t-1}$)	0.001	0.036***	0.024***	0.011**	0.008
	[1.52]	[4.74]	[4.42]	[2.37]	[1.42]
ΔLn (1+ROA$_{t-1}$)	0.017	2.754***	2.487***	0.385**	0.520**
	[0.94]	[17.74]	[7.03]	[2.52]	[2.21]
Observations	36,959	36,959	36,639	33,405	33,281
R-squared	0.263	0.156	0.168	0.236	0.211
CEO FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y

Table 4. Neighboring Control States Without Tax Shocks: Robustness Checks

This table shows the effects of changes in personal income tax rates on CEO compensation. *Tax Increase* (*Decrease*) is a dummy variable that equals one if a CEO's state personal income tax rate increases (decreases) by at least one percentage point in a year and zero otherwise. Column 1 includes tax increase states and neighboring states that have never had a tax rate change. Column 2 includes tax decrease states and neighboring states that have never had a tax rate change. Column 3 includes tax increase states, tax decrease states and neighboring states to both tax increase and tax decrease state that have never had a tax rate change. Total pay is TDC1 in Execucomp database. The dependent variable is Δln(TDC1). The control variables are transformed Assets, Mkt-Book, and 1+ROA, Δ denotes difference, and Ln(.) is the natural logarithm. All specifications include CEO fixed effects and year fixed effects. Robust standard errors are clustered at the state level. Variables are defined in the Appendix. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

VARIABLES	(1) ΔLn(TDC1)	(2) ΔLn(TDC1)	(3) ΔLn(TDC1)
Tax Increase$_{t-1}$	-0.006		-0.004
	[-0.27]		[-0.22]
Tax Increase$_{t-2}$	0.044**		0.047***
	[2.71]		[2.94]
Tax Decrease$_{t-1}$		0.022	0.014
		[0.65]	[0.46]
Tax Decrease$_{t-2}$		0.050	0.058
		[1.12]	[1.33]
ΔLn(Assets$_{t-1}$)	0.289***	0.294***	0.322***
	[7.77]	[9.27]	[9.29]
ΔLn(Mkt-Book$_{t-1}$)	0.014***	0.013***	0.014***
	[7.34]	[7.45]	[5.43]
ΔLn(1+ROA$_{t-1}$)	0.472***	0.521***	0.548***
	[4.08]	[4.64]	[5.08]
Observations	25,528	29,892	34,534
R-squared	0.117	0.118	0.118
CEO FE	Y	Y	Y
Year FE	Y	Y	Y

Table 5. CEO Equity Sales and Option Exercises Following Personal Income Tax Increases

This table shows the effects of personal income tax increases on CEO equity sales and options exercises. The stock and options are those of the firms where CEOs work in. *Tax Increase* is a dummy variable that equals one if a CEO's state personal income tax rate increases (decreases) by at least one percentage point in a year and zero otherwise. Control variables are transformed Assets, Mkt-Book, and 1+ROA, Δ denotes difference, and Ln(.) is the natural logarithm. All specifications include CEO fixed effects and year fixed effects. Robust standard errors are clustered at the state level. Variables are defined in the Appendix. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)
VARIABLES	ΔLn($Shares Sold)	ΔLn($Options Exercised)
Tax Increase$_{t-1}$	0.398**	0.255
	[2.17]	[1.19]
Tax Increase$_{t-2}$	0.148	-0.326
	[0.34]	[-1.49]
ΔLn(Assets$_{t-1}$)	1.646***	1.228***
	[5.54]	[6.16]
ΔLn(Mkt-Book$_{t-1}$)	0.103***	0.059***
	[4.27]	[4.14]
ΔLn(1+ROA$_{t-1}$)	4.790***	3.130***
	[9.76]	[8.37]
Observations	36,709	36,709
R-squared	0.071	0.062
CEO FE	Y	Y
Year FE	Y	Y

Table 6. CEO Delta and Personal Income Tax Changes

This table shows the effects of personal income tax increase on CEO delta. *Tax Increase* is a dummy variable that equals one if a CEO's state personal income tax rate increases by at least one percentage point in a year and zero otherwise. Control variables are transformed Assets, Mkt-Book, and 1+ROA, Δ denotes difference, and Ln(.) is the natural logarithm. All specifications include CEO fixed effects and year fixed effects. Robust standard errors are clustered at the state level. Variables are defined in the Appendix. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)
VARIABLES	ΔLn(delta)	ΔLn(delta)
$Tax\ Increase_{t-1}$	0.035	0.038
	[0.77]	[0.82]
$Tax\ Increase_{t-2}$	0.029**	0.024**
	[2.27]	[2.08]
$\Delta Ln(Assets_{t-1})$	0.542***	0.450***
	[19.46]	[12.81]
$\Delta Ln(Mkt\text{-}Book_{t-1})$	0.140***	0.138***
	[15.77]	[15.96]
$\Delta Ln(1+ROA_{t-1})$		0.691***
		[5.81]
Observations	32,045	32,041
R-squared	0.340	0.354
CEO FE	Y	Y
Year FE	Y	Y

Table 7. A Larger Pie to Share: Industry Profitability

This table shows the role of profitability in the effect of tax changes on CEO compensation. The sample is split into high-profit and low-profit groups based on the within-industry median of profit margin, where the profit margin of a firm is defined as (Sale – COGS)/Sale and industry is classified at the two-digit SIC level. *Tax Increase* is a dummy variable that equals one if a CEO's state personal income tax rate increases by at least one percentage point in a year and zero otherwise. The dependent variable is Δln(TDC1). The control variables are transformed Assets, Mkt-Book, and 1+ROA, Δ denotes difference, and Ln(.) is the natural logarithm. All specifications include CEO fixed effects and year fixed effects. Robust standard errors are clustered at the state level. Variables are defined in the Appendix. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)		(2)
VARIABLES	ΔLn(TDC1)		ΔLn(TDC1)
Group	High Profit Industry		Low Profit Industry
$\text{Tax Increase}_{t-1}$	-0.009		0.021
	[-0.41]		[0.59]
$\text{Tax Increase}_{t-2}$	0.126***		-0.010
	[4.52]		[-0.28]
$\Delta\text{Ln}(\text{Assets}_t)$	0.355***		0.271***
	[8.21]		[8.55]
$\Delta\text{Mkt-Book}_t$	0.019***		0.009***
	[3.36]		[4.78]
ΔROA_t	0.410***		0.704***
	[4.14]		[6.00]
Observations	16,259		19,873
R-squared	0.135		0.125
p-value (coef equal)		0.01	
CEO FE	Y		Y
Year FE	Y		Y

Table 8. CEO Turnovers and CEO Pay Raises Following Personal Income Tax Increases

This table presents univariate and multivariate evidence on the relationship between CEO turnovers and CEO pay raises following personal income tax increases. Panel A shows the comparison of turnovers for CEOs receiving pay raises (Pay Raise) versus not receiving pay raises (No Pay Raise) following a large increase in personal income tax rates (more than one percentage point). The *p*-value is for the *t*-test of the equal means of a turnover dummy between the two groups. Panel B presents linear probability models of CEO turnover on a CEO pay raise dummy, *Pay Raise*, which is equal to one for CEOs who received a pay increase within two years of a personal income tax increase and zero otherwise. All CEOs in this subsample faced a large personal income tax increase in year *t-3*. Both specifications include firm and year fixed effects. Robust standard errors are clustered at the state level. Variables are defined in the Appendix. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Univariate Comparison

	# Turnovers	% Turnovers	*p*-value
Pay Raise	101	4.5%	0.001
No Pay Raise	153	10.0%	

Panel B: Regression Model

	(1)	(2)
VARIABLES	CEO Turnover	CEO Turnover
Pay Raise$_{t-1}$	-0.054**	-0.049**
	[-2.13]	[-2.02]
Log(Assets $_{t-1}$)	0.003	0.010
	[0.13]	[0.43]
Mkt-Book $_{t-1}$	-0.007	-0.005
	[-1.41]	[-1.19]
Cash $_{t-1}$	-0.042	-0.033
	[-0.48]	[-0.41]
Debt $_{t-1}$	-0.098	-0.084
	[-1.00]	[-0.71]
R&D $_{t-1}$	-0.108	-0.096
	[-0.48]	[-0.40]
Old CEO $_{t-1}$	0.086	0.108
	[1.13]	[1.37]
ROA $_{t-1}$	-0.269**	
	[-2.57]	
ROA $_{t-2}$	0.008	
	[0.03]	
Return $_{t-1}$		-0.058**
		[-2.15]
Return $_{t-2}$		-0.014
		[-0.43]
Observations	1,099	1,108
R-squared	0.471	0.467
Firm FE	Y	Y
Year FE	Y	Y

Table 9. Firm Performance and CEO Pay Raises Following Large Personal Income Tax Increases

This table presents univariate and multivariate evidence on the relationship between firm performance and CEO pay raises following personal tax increases. All CEOs in this subsample faced a large personal income tax increase in year *t*-3. We split the subsample based on whether the CEO received a pay increase. We measure firm performance in year *t*. Panel A presents univariate tests on firm performance split based on CEOs who received (or did not receive) a pay increase following a personal income tax rate increase (at least one percentage point). The *p*-value is for the *t*-test of the equal means of the performance measure between the two groups. Panel B presents multivariate tests of firm performance on a CEO pay raises. The CEO pay raise dummy, *Pay Raise*, is equal to one for CEOs who received a pay increase within two years of a personal income tax increase and zero for those who did not. All variables except the pay raise dummy are in first difference in both panels. All specifications include firm fixed effects and year fixed effects. Robust standard errors are clustered at the state level. Variables are defined in the Appendix. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Univariate Comparison

	ΔROA	ΔStock Return
Pay Raise$_{t-1}$	0.004	0.065
No Pay Raise$_{t-1}$	-0.010	0.005
p-value	0.001	0.001

Panel B: Multivariate Model

	(1)	(2)
VARIABLES	ΔROA	ΔStock Return
Pay Raise$_{t-1}$	0.014**	0.116***
	[2.00]	[3.13]
Log(Assets $_{t-1}$)	0.011	-0.463***
	[0.33]	[-3.76]
Mkt-Book $_{t-1}$	0.008*	0
	[1.88]	[0.15]
Cash $_{t-1}$	0.158***	0.738***
	[2.93]	[3.19]
Debt $_{t-1}$	0.148***	0.827***
	[2.80]	[4.14]
R&D $_{t-1}$	0.371	-0.484
	[1.55]	[-0.61]
ROA $_{t-1}$	-0.434***	
	[-3.52]	
ROA $_{t-2}$	-0.207	
	[-1.56]	
Return $_{t-1}$		-0.682***
		[-13.89]
Return $_{t-2}$		-0.232***
		[-4.35]
Observations	943	920
R-squared	0.551	0.673
Firm FE	Y	Y
Year FE	Y	Y

Table 10. Elasticity of CEO Compensation in the Net-of-Tax Rate

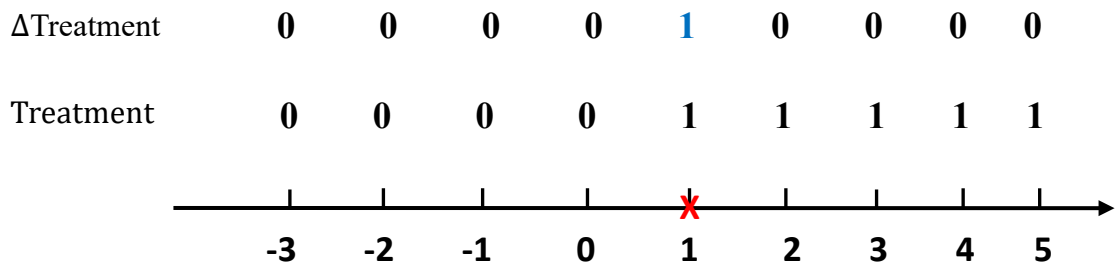
This table shows the elasticity of CEO compensation in the net-of-personal-income-tax rate. The dependent variable is transformed CEO total compensation, Δln(TDC1), control variables include Assets, Mkt-Book, and 1+ROA, , Δ denotes difference, Ln(.) is the natural logarithm, and NOT_t is the after-tax multiple for pay $(1 - \tau_{m,f,t} - \tau_{m,s,t})$ for CEO *m* in year *t* (*f* (*s*) denotes federal (state)). In Column 1 the calculation of NOT_t considers all tax changes of any size. In Column 2 we consider large tax rate increases only (at least one percentage point) and so set $NOT_{t-s}/NOT_{t-(s-1)}$ = 1 for all CEO-year observations when the tax rate change is less than one percentage point and the tax change is positive. All specifications include CEO fixed effects and year fixed effects. Robust standard errors are clustered at the state level. The Appendix provides variable definitions. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)
VARIABLES	ΔLn(TDC1)	ΔLn(TDC1)
Tax Changes	All Changes	Large Changes
Ln(NOT_{t-2}/ NOT_{t-1})	-0.261	-0.437
	[-0.46]	[-0.93]
Ln(NOT_{t-3}/ NOT_{t-2})	0.736*	0.943**
	[1.81]	[1.97]
ΔLn($Assets_{t-1}$)	0.265***	0.265***
	[9.12]	[9.14]
ΔLn($Mkt\text{-}Book_{t-1}$)	0.165***	0.165***
	[19.15]	[19.19]
ΔLn(1+ROA_{t-1})	0.364***	0.363***
	[5.83]	[5.83]
Constant	0.107***	0.106***
	[20.49]	[20.67]
Observations	35,982	35,982
R-squared	0.165	0.165
CEO FE	Y	Y
Year FE	Y	Y

Internet Appendix

Figure IA1. The First-difference Setting of the DiD Analysis

This figure illustrates the correspondence of the level of treatment dummy and the first difference in the treatment dummy. The upper (lower) panel shows the event study based on a single (two) event(s) as indicated by the red cross(es) on the time axis. *Treatment* is the treatment dummy (counter) variable that equals one (the number of treatments) after the corresponding shock(s). *Δ Treatment* is the first difference in *Treatment* and indicates an appearance of a new shock.



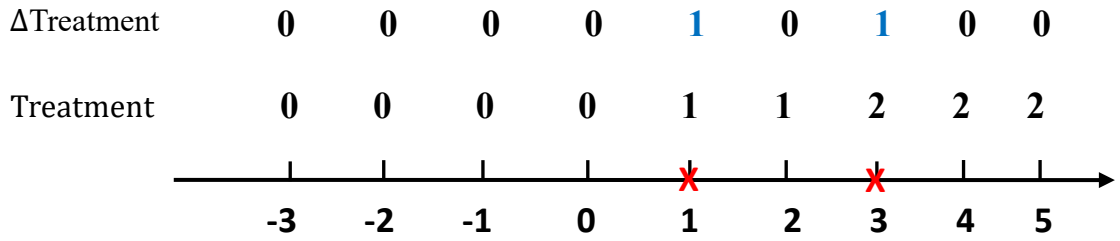


Figure IA2. Differences in CEO Pay Changes Between Treated and Control Groups in Years Around the Tax Changes: Extended Time Window

This figure shows the differences in CEO pay changes between the treated group and control group. The treated group includes CEOs in firms headquartered in states experiencing large personal income tax rate changes (at least one percentage point). The control group includes CEOs in firms headquartered in states without personal income tax changes. Panel A (B) is for tax increases (decreases). The x-axis shows the year relative to an event year (as year 0). The y-axis shows the difference in CEO pay changes [Δln(TDC1), to be used as the dependent variable in DiD analysis]. The blue dots represent the average yearly differences in Δln(TDC1) between treated and control groups. The upper and lower bounds of the bars show the 90% confidence intervals. The red dashed line indicates the zero value of the y-axis.

Panel A. Tax increases

Panel B. Tax decreases

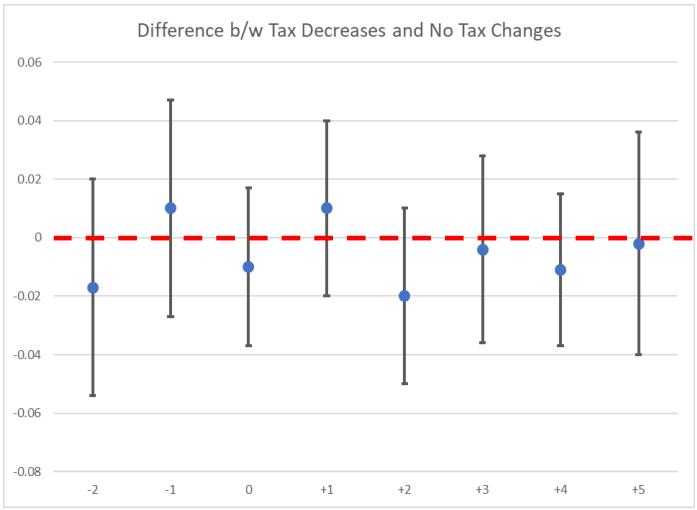


Table IA1. CEO Compensation Responsiveness to Both State and Federal-Level Personal Income Tax Rate Changes

This table shows the effects of personal income tax rate changes on CEO total compensation, where personal income tax rate changes include changes at both the federal-level and state-level tax changes. *Tax Increase* (*Decrease*) is a dummy variable that equals one if a CEO's personal income tax rate increases (decreases) by at least one percentage point in a year, and zero otherwise. Total pay is TDC1 in Execucomp. ΔIn(TDC1) is the dependent variable. All specifications include CEO fixed effects and year fixed effects. Robust standard errors are clustered at the state level. Variable definitions are in the Appendix. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

VARIABLES	(1) ΔLn(TDC1)	(2) ΔLn(TDC1)	(3) ΔLn(TDC1)
Tax Increase$_{t-1}$	0.025		0.027
	[0.64]		[0.73]
Tax Increase$_{t-2}$	0.081***		0.084***
	[4.94]		[4.88]
Tax Decrease$_{t-1}$		0.015	0.011
		[0.34]	[0.26]
Tax Decrease$_{t-2}$		0.056	0.062
		[0.93]	[1.09]
ΔLn(Assets$_{t-1}$)	0.324***	0.323***	0.324***
	[11.20]	[11.12]	[11.05]
ΔLn(Mkt-Book$_{t-1}$)	0.013***	0.013***	0.013***
	[5.51]	[5.50]	[5.51]
ΔLn(1+ROA$_{t-1}$)	0.543***	0.544***	0.544***
	[4.78]	[4.79]	[4.80]
Observations	36,709	36,709	36,709
R-squared	0.116	0.116	0.116
CEO FE	Y	Y	Y
Year FE	Y	Y	Y

Table IA2. NEO (Non-CEO) Compensation Responsiveness to Personal Income Tax Changes

This table shows the effects of changes in personal income tax rates on non-CEO NEO total compensation. *Tax Increase* (*Decrease*) is a dummy variable that equals one if an NEO's state personal income tax rate increases (decreases) by at least one percentage point in a year and zero otherwise. Total pay is TDC1 in Execucomp. The dependent variable is Δln(TDC1), the control variables are transformations of Assets, Mkt-Book, and 1+ROA, Δ denotes difference, and Ln(.) is the natural logarithm. All specifications include NEO fixed effects and year fixed effects. Robust standard errors are clustered at the state level. Variables are defined in the Appendix. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

VARIABLES	(1) ΔLn(TDC1)	(2) ΔLn(TDC1)	(3) ΔLn(TDC1)
Tax Increase$_{t-1}$	-0.017		-0.016
	[-1.30]		[-1.22]
Tax Increase$_{t-2}$	0.025		0.025
	[1.64]		[1.47]
Tax Decrease$_{t-1}$		0.024	0.020
		[1.17]	[0.92]
Tax Decrease$_{t-2}$		0.003	0.003
		[0.09]	[0.07]
ΔLn(Assets$_{t-1}$)	0.276***	0.266***	0.276***
	[6.66]	[7.07]	[6.63]
ΔLn(Mkt-Book$_{t-1}$)	0.009***	0.009***	0.009***
	[5.54]	[5.56]	[5.54]
ΔLn(1+ROA$_{t-1}$)	0.172**	0.409***	0.172**
	[2.05]	[3.69]	[2.06]
Observations	114,391	114,391	114,391
R-squared	0.134	0.136	0.134
NEO FE	Y	Y	Y
Year FE	Y	Y	Y

Table IA3. Compensation Responsiveness to Personal Income Tax Changes: State Border Tests

This table shows the effects of changes in personal income tax rates on CEO total compensation. *Tax Increase* is a dummy variable that equals one if an CEO's state personal income tax rate increases by at least one percentage point in a year and zero otherwise. *Miles to nearest state border* is the number of miles from a firm's address to its nearest neighbor state border. Total pay is TDC1 in Execucomp. The dependent variable is Δln(TDC1). The control variables are transformed Assets, Mkt-Book, and 1+ROA, Δ denotes difference, and Ln(.) is the natural logarithm. All specifications include CEO fixed effects and year fixed effects. Specification 2 drops any CEO-year observations where the firm is located less than 125 miles from the nearest neighbor state border. Robust standard errors are clustered at the state level. Variables are defined in the Appendix. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)
VARIABLES	ΔLn(TDC1)	ΔLn(TDC1)
Sample	All	CEOs ≥ 125 miles from state border
Tax Increase$_{t-1}$	-0.009	0.012
	[-0.42]	[0.37]
Tax Increase$_{t-2}$	0.081***	0.059**
	[3.03]	[2.22]
Tax Increase$_{t-2}$ × Miles to nearest border state	-0.000	
	[-1.25]	
Miles to nearest border state	0.000	
	[0.21]	
ΔLn(Assets$_{t-1}$)	0.337***	0.356***
	[10.44]	[7.54]
ΔLn(Mkt-Book$_{t-1}$)	0.013***	0.019***
	[7.03]	[4.69]
ΔLn(1+ROA$_{t-1}$)	0.524***	0.383*
	[4.35]	[1.80]
Observations	31,199	11,143
R-squared	0.112	0.128
NEO FE	Y	Y
Year FE	Y	Y

Table IA4. Voluntary CEO Turnover following State Tax Increases

This table shows the effects of state tax increases and subsequent CEO pay raises on CEO voluntary turnover. *Tax Increase* is a dummy variable that equals one if an CEO's state personal income tax rate increases by at least one percentage point in the previous two years and zero otherwise. *Voluntary Turnover* is equal to one if there was a turnover in a given firm-year that was not defined as a forced turnover following Peters and Wagner (2014). Specification 1 (2) includes CEO-year observations in which CEOs did not (did) receive a pay raise following the state tax increase. Total pay is TDC1 in Execucomp. The dependent variable is Δln(TDC1). The control variables are transformed Assets, Mkt-Book, and 1+ROA, Δ denotes difference, and Ln(.) is the natural logarithm. All specifications include CEO fixed effects and year fixed effects. Robust standard errors are clustered at the state level. Variables are defined in the Appendix. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)
VARIABLES	Voluntary Turnover	Voluntary Turnover
Sample	No Pay Raise	Pay Raise
Tax Increase$_{t-1 \text{ to } t-2}$	0.067**	0.000
	[2.11]	[0.06]
ΔLn(Assets$_{t-1}$)	-0.063	-0.004
	[-1.61]	[-0.27]
ΔLn(Mkt-Book$_{t-1}$)	0.002	0.000
	[0.56]	[0.56]
ΔLn(1+ROA$_{t-1}$)	0.180*	0.114***
	[1.95]	[3.15]
Observations	2,808	20,545
R-squared	0.385	0.135
CEO FE	Y	Y
Year FE	Y	Y