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The Economics of Managerial Taxes and Corporate Risk-Taking

Abstract: We examine the relation between managers' personal income tax rates and their corporate investment decisions. Using plausibly exogenous variation in federal and state tax rates, we find a positive relation between managers' personal tax rates and their corporate risk-taking. Moreover—and consistent with our theoretical predictions—we find that this relation is stronger among firms with investment opportunities that have a relatively high rate of return per unit of risk, and stronger among CEOs who have a relatively low marginal disutility of risk. Importantly, our results are unique to senior managers' tax rates—we do not find similar relations for middle-income tax rates. We also find that the tax-induced risk-taking relates to idiosyncratic rather than systematic risk, suggesting that it will not be priced by well-diversified shareholders. Collectively, our findings provide evidence that managers' personal income taxes influence their corporate risk-taking.

Keywords: Corporate risk-taking; risky investment; risk-taking incentives; personal income taxes; federal income taxes; state income taxes; agency conflict

1. Introduction

Fiscal policy—and taxation in particular—is one of the most important tools that policymakers can use to influence the economy. While the effect of *corporate* taxes on managers' corporate investment decisions has been extensively studied, little is known about the effect of managers' *personal* taxes on their corporate investment decisions (see Shackelford and Shevlin, 2001; Graham, 2003; Hanlon and Heitzman, 2010 for reviews of the corporate tax literature). We aim to fill this gap by examining the relation between personal income taxes levied directly on senior managers, hereafter "managerial taxes," and their corporate risk-taking. In this regard, we relate taxes on corporate decision-makers to their corporate decisions. Given their unique position as primary decision-makers at the firm, understanding whether and how taxes on senior managers affect corporate decisions has important implications for fiscal policy. As Hall and Liebman (2000, 2) note: *"[T]op executives manage assets worth billions of dollars, their compensation arrangements and the incentives they face are of substantial importance to the performance of the U.S. economy ... their responsiveness to taxation has important revenue and efficiency implications.*"

The intuition for how taxes affect managers' real investment decisions is similar to how taxes affect shareholders' personal investment decisions (e.g., Domar and Musgrave, 1944; Mossin, 1968; Stiglitz, 1969; Poterba and Samwick, 2002). In particular, taxes facilitate risk-sharing with the government. By reducing the disutility that a risk-averse manager associates with risky investments, taxes increase their incentive (or, equivalently, reduce their disincentive) to take risk. We use a simple theoretical framework to formalize the intuition that risk-averse managers who face different tax *rates*, but who are otherwise identical (i.e., have the same level of risk aversion, pre-tax compensation, equity holdings, and corporate investment opportunities) will make different investment decisions; and we use the insights from this framework to inform the design of our empirical tests.[1]

We empirically examine the relation between the tax rate on senior managers and corporate risk-taking using exogenous variation in federal and state statutory income tax rates. We measure a manager's marginal income tax rate using the combined statutory tax rate for the top federal and state income bracket assuming that the manager works in the state of the firm's headquarters, and measure corporate risk-taking using research and development (e.g., Coles, Daniel, and Naveen, 2006; Gormley, Matsa, and Milbourn, 2013).[2] A key advantage of this measure of corporate risk-taking is that it is directly controllable by senior managers, and it is not mechanically related to trading activity in capital markets, disclosure, or taxes on shareholders (e.g., capital gains taxes). Nevertheless, to ensure that our inferences are not unique to a specific measure of risk-taking, in subsequent analyses we confirm that our results are robust to using earnings volatility and idiosyncratic return volatility as additional measures of risk-taking.

We test for a relation between managerial taxes and corporate risk-taking using multiple distinct sets of tests that exploit different sources of exogenous variation in managerial taxes. Our first set of tests consists of a between-group analysis that relies on comparisons between time periods, states, and firms. These tests estimate the relation between managerial taxes and corporate risk-taking using all of the variation in managerial taxes, regardless of its source (i.e., federal or state, cross-sectional or time-series). Consistent with our theoretical predictions, we find a positive relation between managerial taxes and corporate risk-taking. This relation is

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[1] We use the term "manager" or "senior manager" to describe our predictions rather than CEO, because theory suggests the effects we document to generalize to any manager who (i) is risk-averse, (ii) faces a fixed marginal tax rate, (iii) is paid a share of the project outcome, and (iv) has decision rights in selecting the riskiness of the project. See Section 2 for more details.

[2] Regardless of firm performance, we find that the base salary of nearly all CEOs in our sample is sufficient to put them in the top bracket.

robust to controlling for a battery of time-varying firm characteristics (e.g., size, performance, and growth opportunities), managerial characteristics (e.g., tenure, age, and equity incentives), and state characteristics (e.g., local economic growth, corporate taxes, and political affiliation of the local legislature).

Our second set of tests consists of a within-group analysis that relies on comparisons within a given time period, state, firm, or manager. The primary advantage of these tests is that they help alleviate concerns that our results are attributable to omitted firm characteristics (e.g., industry and governance practices), manager characteristics (e.g., "managerial style"), state characteristics (e.g., geographic location and availability of natural resources), or common macroeconomic shocks or time trends. One potential disadvantage of these tests is that by controlling for common temporal variation, they necessarily eliminate all of the variation in taxes at the federal level. These tests estimate the relation between managerial taxes and corporate risk-taking using only state-level variation in managerial taxes. Despite the resulting reduction in power, we continue to find that managerial taxes are positively related to corporate risk-taking.

In our third set of tests, we examine settings where our theoretical framework predicts the effect of managerial taxes will be particularly strong. Specifically, theory suggests that the positive relation between managerial taxes and corporate risk-taking is stronger among firms with investment opportunities that have a high rate of return per unit of risk, and among managers who have a relatively low marginal disutility of risk. The intuition for these predictions is that in the former (latter) circumstance, the marginal benefit (marginal cost) of risk is relatively high (low). The higher the marginal benefit (or the lower the marginal cost), the greater the amount of risk that is taken; and the greater the amount of risk that is taken, the greater the benefit to sharing risk with the government. Consistent with these predictions, we find that the relation is stronger in industries where the investment opportunity set provides a relatively high rate of return per unit of risk and for Chief Executive Officers (CEOs) who have a relatively low marginal disutility of risk. By linking the relation between managerial taxes and corporate risk-taking to characteristics of the firm and CEO, these findings strengthen our inference that the relation is attributable to the decisions of senior managers (as opposed to mid-level managers or investors).

Finally, we conduct an extensive battery of sensitivity tests. First, we repeat our primary tests including the middle-income tax rate as an additional control. By holding the middle-income rate fixed, the residual variation in senior managers' tax rate captures the difference, or "wedge," between the rate paid by senior managers and the rate paid by middle-income earners. To the extent that an omitted variable (e.g., a state-level economic shock) equally affects both rates, this analysis also controls for these omitted variables. We continue to find that the tax rate on senior managers is related to corporate risk-taking, and no evidence of an incremental relation between middle-income rates and corporate risk-taking. These findings suggest that the relation between managerial taxes and corporate risk-taking is not attributable to personal income taxes in general, but rather is specific to the tax rate on senior managers. Although we cannot definitively rule out the possibility of a correlated omitted variable, to explain our collective results an omitted variable would have to be (i) correlated with corporate risk-taking, (ii) vary systematically with firms' investment opportunity sets and CEOs' marginal disutility to risk, and (iii) cause a difference in the rates between senior managers and middle-income earners.

Second, we examine the relation between managerial taxes and three alternative outcome-based measures of risk-taking: earnings volatility, idiosyncratic return volatility, and systematic return volatility. The distinction between idiosyncratic and systematic volatility is important. Diversified shareholders are risk neutral (risk averse) with respect to idiosyncratic (systematic) risk. If managers were to take more systematic risk, shareholders would be directly affected and might seek to prevent this behavior. In contrast, if managers were to take more idiosyncratic risk, then shareholders would be less inclined to discourage this behavior since idiosyncratic risk is diversifiable and shareholders want managers to adopt all positive net present value projects regardless of idiosyncratic risk (Armstrong and Vashishtha, 2012). Consequently, in equilibrium, we expect managerial taxes to primarily affect firms' idiosyncratic rather than systematic risk. We find evidence of a positive relation between managerial taxes and both earnings volatility and idiosyncratic return volatility, but no evidence of a relation with systematic return volatility. The notion that managers' tax-induced risk-taking is diversifiable potentially explains the puzzling findings in prior literature that boards—acting on behalf of shareholders—do not alter managers' incentive-compensation contracts in response to changes in personal tax rates (e.g., Goolsbee, 2000; Hall and Liebman, 2000; Frydman and Molloy, 2011). Our collective results provide evidence that managers' personal taxes can and do affect their corporate investment decisions.

Our research question and findings should be of interest to policymakers, boards, and academics. With respect to policymakers, our work adds to the large public finance literature on the responses to taxation. Although a complete accounting of all the benefits and costs of tax policy is beyond the scope of any single study, understanding the various margins of response to taxation is at the heart of optimal tax policy. We contribute to this literature by documenting a previously unidentified margin of response to personal taxation—namely, corporate risk-taking. Insofar as the effects that we document are attributable to the top personal income tax rate on senior managers and not the tax rate on middle-income employees (or middle-income shareholders), they potentially represent a heretofore overlooked externality of changes in the top personal income tax rate. Changes in the top personal income tax rate cause a shift in corporate resources toward high risk projects which can affect lower-level employees and other corporate stakeholders who are not directly subject to the tax.

With respect to boards, our findings suggest that personal income taxes can alter the disutility that senior managers associate with corporate risk-taking, and thus directly affect their real investment decisions. While our empirical results suggest that any tax-induced risk-taking is diversifiable, or idiosyncratic, to the extent that shareholders are undiversified, boards might want to consider how taxation affects managerial risk-taking incentives.

Finally, with respect to academics, our study contributes to the large literature on managerial risk-taking. Numerous prior studies have sought to link managerial compensation and corporate risk-taking, but in doing so have largely ignored the role of taxation (e.g., Lambert, Larcker, and Verrecchia, 1991; Guay, 1999; Rajgopal and Shevlin, 2002; Coles et al., 2006; Armstrong and Vashishtha, 2012). We add to this literature by showing that managers' personal income taxes have a measurable effect on corporate risk-taking.

The remainder of this paper proceeds as follows. Section 2 provides some simple numerical examples that illustrate the effect of income taxes on a manager's selection of risky projects. Section 3 reviews the personal tax treatment of common forms of managerial compensation and discusses the contributions of our study relative to prior literature. Section 4 describes our sample and measurement choices. Section 5 presents our results, and Section 6 provides concluding remarks.

2. Hypothesis Development

The intuition for how personal income taxes affect managers' choice of risky projects is quite general and is similar to how taxes affect shareholders' choice of personal investments (e.g., Mossin, 1968; Stiglitz, 1969). In this section, we illustrate the intuition with a series of simple numerical examples in which we assume a fixed marginal tax rate and an exogenous set of investment opportunities. In order to focus on the most fundamental and general intuition, we deliberately abstract away from complex issues concerning progressive tax rates, moral hazard, and adverse selection. We refer the interested reader to Fellingham and Wolfson (1985), Katuscak (2009), Niemann (2008), and Krenn (2016) for a formal treatment of these issues in the context of managerial taxes.

2.1. Benchmark case of project selection

Consider a manager who faces a choice between two mutually exclusive projects that differ in their payoffs to the manager, but are otherwise identical. Both projects have two potential outcomes that occur with equal likelihood. Project A pays the manager $4 in the bad state and $5 in the good state. Project B pays the manager $3.25 in the bad state and $7.75 in the good state. The payoffs are as follows:

Project A		Project B	
Prob.	Payoff	Prob.	Payoff
$^1/_2$	$4.00	$^1/_2$	$3.25
$^1/_2$	$5.00	$^1/_2$	$7.75
μ(A)	$4.50	μ(B)	$5.50
σ^2(A)	$0.25	σ^2(B)	$5.06

where $\mu(i)$ denotes the expected payoff of project *i* and $\sigma^2(i)$ denotes the variance of the payoff to project *i*. A manager's choice between these projects depends on whether he is risk-neutral or risk-averse.

Risk-Neutral Manager. If the manager is risk-neutral, he is indifferent towards risk, σ^2, and simply chooses the project with the highest expected payoff, μ, which corresponds to Project B.

Risk-Averse Manager. If the manager is risk-averse, his choice will depend on how he trades off the risk, σ^2, and the reward, μ, of the two projects. Without additional assumptions about the manager's preferences (i.e., utility function), it is not possible to determine which project he will choose.

Consider a risk-averse manager who has mean-variance utility of the form:

$$U(\mu, \sigma^2) = \alpha\, \mu(i) - \beta\, \sigma^2(i) \quad (1)$$

where $\alpha > 0$ and $\beta > 0$ are arbitrary fixed parameters. Mean-variance utility is a parsimonious way to formalize the notion that a risk-averse manager likes projects that have greater expected payoffs, $\mu(i)$, and dislikes projects with more risk, or variance, $\sigma^2(i)$.[3] Here, β represents the manager's risk-aversion: higher β implies greater disutility per unit of variance. Thus, the manager's choice between Project A and B depends on the parameters α and β. For example, if $\alpha = 1$ and $\beta = 0.3$, the manager's utility from adopting Project A is 4.43 (4.5 – 0.3 x 0.25), and his utility from adopting Project B is 3.98 (5.5 – 0.3 x 5.06). In this case, the manager will choose Project A.

2.2. Effect of taxes on project selection

Now consider how taxes affect the manager's project selection. Suppose that the manager is subject to a 40% tax. Taxes have two effects on a risk-averse manager. First, they alter the expected payoff by a factor of $(1 - t)$, or 0.6 in this case. Second, they alter the risk the manager associates with the project by a factor of $(1 - t)^2$, or 0.36 in this case. When the manager faces a tax rate of 40%, his utility from adopting Project A is 2.67 (0.6 x 4.5 – 0.3 x 0.36 x 0.25), and his

[3] Our choice of a mean-variance utility function is motivated by the mean-variance certainty equivalent representation that is common in agency models. For example, setting $\alpha = 1$ and $\beta = \rho/2$ in Eq. (1) corresponds to the special case of negative exponential utility (i.e., CARA) with normally distributed payoffs, where ρ is the manager's coefficient of absolute risk aversion. Another way to derive a mean-variance representation is to assume power utility (i.e., CRRA) coupled with payoffs that follow a lognormal distribution. For simplicity, we assume that the manager's preferences have a mean-variance representation. This representation does not require any assumptions about the distribution of payoffs.

utility from adopting Project B is 2.75 (0.6 x 5.5 – 0.3 x 0.36 x 5.06). Consequently, in the presence of taxes, the risk-averse manager will now choose Project B, which is the riskier project.

To see how these two effects manifest in the manager's utility function, note that we can rewrite the utility function as follows:

$$U(\mu, \sigma^2) = \alpha\,(1 - t)\,\mu(i)\; - \beta\,(1 - t)^2\,\sigma^2(i) \qquad (2)$$

The first term, $\alpha(1 - t)$, represents the reduction in the manager's expected payoff, and the second term, $\beta(1 - t)^2$, represents the reduction in the disutility that the risk-averse manager associates with risky projects. The higher the tax rate, t, the larger the reduction in disutility a risk-averse manager associates with risky projects. Eq. (2) illustrates how two risk-averse managers who face different income tax rates—but who are otherwise identical—will evaluate risk differently. To demonstrate that this intuition is not an artifact of the specific parameter values, we next solve for the optimal project as a function of the tax rate, the parameters of the investment opportunity set, and the parameters of the manager's utility function.

2.3. Taxes with a continuum of projects

It is straightforward to extend our simple example from a choice between two projects to a choice from a continuum of projects. To do so, we must first specify the set of available projects, or investment opportunities, in mean-variance space. Let the set of available projects be given by a concave efficient frontier (e.g., Sharpe, 1964) that takes the form:

$$\mu(i) = \varphi + \theta\;\; log(1 + \sigma^2(i)) \qquad (3)$$

where *log(.)* is the natural log operator, and φ represents the payoff to the risk-free project where $\sigma^2(i) = 0$, and θ determines the slope of the frontier. A concave efficient frontier captures the notion that to increase the expected payoff, the manager must accept increasingly more risk.

Figure 1 plots the frontier for $\varphi = 5$, $\theta = 1$ in blue. The y-axis (x-axis) is the expected pre-tax payoff (variance).

Substituting Eq. (3) into Eq. (2) and maximizing the manager's utility over the choice of $\sigma^2(i)$ yields the following first-order-condition:

$$\alpha(1-t)\left(\frac{\theta}{1+\sigma^2(i)}\right)-\beta(1-t)^2=0 \tag{4}$$

Re-arranging to solve for the risk of the optimal project, $\sigma^2(i^*)$, yields:

$$\sigma^2(i^*)=\left(\frac{\alpha}{\beta}\right)\left(\frac{\theta}{1-t}\right)-1 \tag{5}$$

provided $\alpha\,\theta \geq \beta\,(1-t)$, and 0 otherwise. If this inequality is not satisfied, the marginal benefit of risk is strictly less than the marginal cost (expressed in "utils") and there is no interior solution: it is never optimal to take *any* risk and the manager will always choose the risk-free project. Because this scenario is not empirically descriptive, for the remainder of the paper, we assume the existence of an interior solution (i.e., the optimal level of risk-taking is strictly positive). Eq. (5) shows that, provided there is an interior solution, the risk of the optimal project is unambiguously increasing in the tax rate, i.e., $\frac{\partial\sigma^2(i^*)}{\partial t}>0$.

Figure 1 plots the manager's indifference curves for tax rates $t = 0$ and $t = 0.4$ in solid red and dashed red, respectively (assuming $\alpha = 1$ and $\beta = 0.3$ as in our earlier example). Figure 1 illustrates that, as taxes increase, the slope of the indifference curve shifts downward—the manager associates less disutility with risk and, consequently, is willing to select riskier projects. Figure 1 shows that by reducing the disutility associated with a given level of risk, taxes reduce the slope of the manager's indifference curve and, in turn, cause the manager to select a riskier project.[4]

2.4. Cross-sectional predictions

In addition to illustrating how taxes affect a manager's choice of risky projects, our simple example also illustrates that the effect of taxes on risk-taking depends on specific characteristics of the firm and the manager. The general intuition behind these predictions is that the effect of taxes on risk-taking is stronger when either the marginal benefit of risk is high or the marginal cost of risk is low.

2.4.1. Marginal benefit of risk

Eq. (5) shows that the effect of taxes on the risk of the optimal project is increasing in the slope of the firm's investment opportunity set, $\frac{\partial^2 \sigma^2(i^*)}{\partial t \partial \theta} > 0$. In other words, t and θ are complements. For two levels of θ, $\theta_{High} > \theta_{Low,}$, the effect of taxes is larger in the former circumstance.

$$\left.\frac{\partial \sigma^2(i^*)}{\partial t}\right|_{\theta = \theta_{High}} > \left.\frac{\partial \sigma^2(i^*)}{\partial t}\right|_{\theta = \theta_{Low}}$$

The intuition for this result is that θ measures the marginal benefit to risk-taking. The higher the marginal benefit, the greater the amount of risk that is taken; and because more risk is taken, the manager derives greater benefit from sharing risk with the government.

Panel A of Figure 2 plots the investment frontier for $\theta = 1.6$ in blue and the manager's indifference curves for tax rates $t = 0$ and $t = 0.4$ in solid red and dashed red, respectively (assuming $\alpha = 1$ and $\beta = 0.3$ as in Figure 1). As before, Panel A shows that taxes cause the slope

[4] It is important to note that this does not imply that the manager is better off. Indeed, the manager is strictly worse off. For $t = 0$, the utility-maximizing project yields utility of 6.90, whereas for $t = 0.4$, the utility-maximizing project yields utility of 4.52.

of the indifference curve to shift downward. However, because the slope of the investment opportunity set is steeper relative to Figure 1, the point of tangency entails a greater increase in risk-taking.

2.4.2. Marginal cost of risk

Eq. (5) shows that the effect of taxes on the risk of the optimal project is decreasing in the manager's risk aversion, $\frac{\partial^2 \sigma^2(i^*)}{\partial t \partial \beta} < 0$. In other words, t and β are substitutes. That is, for two levels of β, $\beta_{High} > \beta_{Low,}$, the effect of taxes is smaller in the former circumstance.

$$\left.\frac{\partial \sigma^2(i^*)}{\partial t}\right| \beta = \beta_{High} \quad < \quad \left.\frac{\partial \sigma^2(i^*)}{\partial t}\right| \beta = \beta_{Low}$$

The intuition for this result is that β measures the marginal cost, or disutility, to risk-taking. The higher the marginal cost, the lower the amount of risk that is taken, and the less valuable it is to share risk with the government.

Panel B of Figure 2 plots the manager's indifference curves for tax rates $t = 0$ and $t = 0.4$ in solid red and dashed red, respectively, assuming $\alpha = 1$ and $\beta = 0.6$, and the frontier in blue (for $\theta = 1$ as in Figure 1). Because the manager is more risk-averse, the slope of the indifference curve is steeper. As before, Panel B shows that taxes still cause the slope of the indifference curve to shift downward. However, because the manager is more risk-averse (relative to Figure 1), the downward shift in slope is less than before, and the point of tangency entails a smaller increase in risk-taking. Thus, when the marginal disutility of risk is high (low) taxes provide less (more) of an incentive to take risk.

One important empirical consideration is that it is inherently difficult to measure managers' risk aversion. Consequently, it is necessarily difficult to test such a prediction. However, the same prediction also applies to the sensitivity of the manager's compensation to performance, where the latter is a theoretical construct that is relatively more amenable to empirical tests (e.g., Core and Guay, 2002). To see that the same predictions apply, note that the utility function of a manager who is compensated with a δ-share of the project outcome, where $\delta > 0$, is given by:

$$U(\mu, \sigma^2) = \alpha\,(1-t)\,\delta\,\mu(i) - \beta\,(1-t)^2\,\delta^2\,\sigma^2(i) \tag{6}$$

Note that we previously assumed that $\delta = 1$, which corresponds to the special case in which the manager receives the entire payoff.

Borrowing terminology from Ross (2004), Eq. (6) shows that δ "magnifies" both the risk and the reward of the project: expected compensation increases by a factor of δ and the variance increases by a factor of δ^2. It is easy to verify that the risk of the optimal project is now given by:

$$\sigma^2(i^*) = \theta\left(\frac{\alpha}{\beta\delta}\right)\left(\frac{1}{1-t}\right) - 1 \tag{7}$$

Eq. (7) shows that the manager's risk aversion, β, and the sensitivity of the manager's compensation to project outcome, δ, operate in exactly the same manner. The intuition for this result is that just like β, higher values of δ correspond to a greater marginal disutility of risk (see related discussions in Lambert, Larcker, and Verrecchia, 1991; Ross, 2004; and Armstrong, Larcker, Ormazabal, and Taylor, 2013).[5] As before, when the marginal disutility of risk is high, taxes provide less of an incentive to take risk. Thus, for two levels of δ, $\delta_{High} > \delta_{Low}$,, the effect of taxes is smaller in the former circumstance.

$$\left.\frac{\partial\sigma^2(i^*)}{\partial t}\right|_{\delta=\delta_{High}} < \left.\frac{\partial\sigma^2(i^*)}{\partial t}\right|_{\delta=\delta_{Low}}$$

[5] Consistent with this theoretical result, CEOs whose equity portfolios are more sensitive to changes in stock price have greater marginal disutility of risk and have been shown to take less risk (e.g., Coles et al., 2006; Armstrong and Vashishtha, 2012).

This comparative static provides a prediction that is more amenable to empirical tests than does the analogous comparative static based on the manager's risk aversion (which is unobservable).

2.5. Discussion

In this section, we discuss four caveats that apply to our simple framework.

Risk-Neutral Manager. Our analysis assumes that the manager is risk-averse and has preferences that can be approximated with mean-variance utility. If the manager is risk-neutral, he will select the project with the highest expected after-tax payoff (μ), regardless of its risk. In this case, taxes will not influence his risk-taking decision. The intuition for this result is that risk-neutral managers only care about expected after-tax payoffs and a fixed marginal tax rate does not affect the ordering of projects when ranked according to after-tax payoffs. Thus, we expect our predictions to be empirically descriptive only insofar as managers are *risk-averse* and mean-variance utility sufficiently approximates their preferences.[6]

Fixed marginal tax rate. One of the key assumptions in our analysis is that the manager's marginal tax rate is not affected by the project's outcome (i.e., the manager's tax rate is fixed). For a manager's tax *rate* to vary with project outcome, the outcome would have to cause the manager to shift to a different tax bracket. In our sample, we find that the 97% of CEOs are in the highest tax bracket based on their salaries alone. Moreover, we find no evidence that poor accounting or stock performance is related to their tax bracket.[7] These findings not only validate our assumption of a fixed marginal tax rate, but also contrast sharply with the marginal corporate tax rate and capital gains tax rates which vary with performance (e.g., vary for gains or losses). Admittedly, if the manager's marginal income tax rate varies with performance then, similar to

[6] Feldstein (1969) and Stiglitz (1969) show that although this intuition does not generalize to all classes of utility functions, it holds for common utility functions that exhibit constant absolute risk aversion (CARA) and constant relative risk aversion (CRRA).

[7] We report and discuss this analysis in detail in Table IA.1 of the Internet Appendix.

the corporate rate, managerial taxes could potentially lead to *decreased* risk-taking (e.g., Fellingham and Wolfson, 1985; Auerbach, 1986; Ljungqvist, Zhang, and Zuo, 2017). We view this possibility as adding tension to our empirical analysis.

Partial equilibrium. Our simple framework is inherently a partial equilibrium analysis; we do not model how shareholders adjust managers' incentive-compensation contracts in response to tax rates (see Katuscak, 2009; Niemann, 2008; and Krenn, 2016 for examples of such models). Although this would seem to be a limitation of our simple framework, an extensive body of empirical literature finds limited evidence that shareholders adjust managers' incentive-compensation contracts in response to changes in personal income tax rates (see related literature described in Section 3.2).[8] While this remains an ongoing puzzle in the empirical literature, it does seem to suggest that a simple framework that ignores recontracting may nevertheless be empirically descriptive (and perhaps more descriptive than a framework predicated on recontracting). One potential explanation for the absence of recontracting is that, empirically, we find that tax-induced risk-taking is exclusively idiosyncratic in nature. Idiosyncratic risk is diversifiable—and thus not priced by diversified shareholders. Consequently, shareholders will be less inclined to alter managers' incentive-compensation contracts following a change in personal tax rates than they would if the risk-taking entailed non-diversifiable risk (i.e., systematic risk).

Performance Pay and Decision Rights. Our simple framework assumes that the manager's compensation varies with project performance (i.e., $\delta > 0$) and that the manager has decision rights in selecting the riskiness of the project. In this regard, our results generalize to senior managers beyond the CEO. However, we caution that our results are not likely to

[8] This finding is also consistent with a large literature that finds that shareholders generally appear reluctant to recontract with managers or debtholders, even when it would seem to be in their interest to do so (see Armstrong, Guay, and Weber, 2010 for a review).

generalize to (lower-level) employees who do not receive a fraction of the payoff from the project or who do not have decision rights regarding project selection.

Horizon vs. Volatility. Our predictions relate to the *volatility* of cash flows rather than the *horizon* of cash flows. These are distinct concepts. Horizon refers to the timing of a project's cash flows and does not necessarily correspond to volatility. For example, a 30-year Treasury bond is an investment with a relatively long horizon but with relatively low cash flow volatility. Although our analysis does not preclude an effect of taxes on managers' horizon, formally examining this concept is beyond the scope of our simple framework. The results from any such extension would depend on how the relation between horizon and cash flow volatility is parameterized. For example, if short- (long-) horizon projects are more volatile from the manager's perspective, then taxes could potentially lead the manager to select shorter- (longer-) horizon projects.

3. Institutional Background and Related Literature

3.1. Personal taxation of managerial compensation

Consistent with prior literature, we adopt an expansive definition of compensation that includes not only a manager's "flow pay" (e.g., salary, bonus, new equity grants, etc.), but also the change in the value of his existing equity holdings. Appendix A provides a synopsis of the federal income tax treatment of stock options, stock appreciation rights, restricted stock, unrestricted stock, pensions, and salary, bonus, and long-term incentive plans. Most states follow the federal tax treatment.[9]

[9] Pennsylvania taxes all stock options as non-qualified stock options. Hawaii and Rhode Island do not tax option grants to employees of certain qualified companies.

Two institutional features of the taxation of managerial compensation inform the design of our empirical tests. First, all forms of managerial compensation are taxed as *ordinary income* at the time the compensation is either received (salary, bonus, and long-term incentive plans), vested (restricted stock), or exercised (stock options and stock appreciation rights). This means that the *entire value of the portfolio* is taxed at the prevailing personal income rate at the time it is received, vested, or exercised. Second, any appreciation in value between the vesting/exercise date and the date the shares are sold is also taxed as ordinary income, unless the shares are sold more than twelve months after vesting/exercise.[10] Only appreciation in the value of unrestricted stock that is sold more than twelve months after vesting/exercise is not subject to ordinary income tax and is instead taxed at the long-term capital gains rate. Thus, the vast majority of a manager's compensation and equity portfolio is taxed at the prevailing ordinary income rate. For example, Jin and Kothari (2008) estimate that if the average CEO were to sell all of his vested equity, the capital gains tax burden would only be 2% of the value of the vested equity.[11] Assuming a 20% long-term capital gains tax rate, their estimate implies that only 10% of the value of the average CEO's *vested equity* would be subject to long-term capital gains tax.

Given these two features of the taxation of managerial compensation, we focus our empirical analysis on managers' income tax rate rather than the long-term capital gains tax rate. This is not to suggest that the long-term capital gains rate is not relevant for managers' risk-taking decisions, but rather that capital gains taxes are not *necessary* to give rise to the effects that we predict and find. Because states generally tax capital gains and ordinary income at the same rate, prior work on capital gains taxes focuses primarily on capital gains taxes at the federal

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[10] For example, if a manager exercises options and sells the shares acquired from the exercise during the subsequent twelve months, no long-term capital gains are generated from either the grant, exercise, or sale. Instead, everything will be taxed at the prevailing personal income tax rate.

[11] See Jin and Kothari (2008) Table 1 and Table B1.

level (e.g., Dhaliwal, Krull, and Li, 2007; Campbell, Chyz, Dhaliwal, and Schwartz, 2013).[12] In this regard, an important feature of our research design is the inclusion of time period effects, which control for the prevailing federal long-term capital gains rate in a given year.

3.2. Related literature on managerial taxes

We conjecture that tax rates on senior managers affect corporate risk-taking incremental to the effect of such taxes on compensation and equity incentives. We refer to this as the "direct effect" of taxes on risk-taking decisions. However, boards might also alter managers' incentive-compensation contracts, or managers might adjust their equity holdings, in response to tax changes. These would represent a separate "indirect effect" of taxes on risk-taking decisions. Figure 2 illustrates these two channels.

Prior literature focuses exclusively on the latter channel and finds limited evidence of changes in managers' incentive-compensation contracts and equity holding in response to changes in the manager's tax rate. This suggests that the indirect effect is muted. For example, Hall and Liebman (2000) use variation in the top federal income tax rate between 1980 to 1994 to examine the relation between managers' tax rates and managerial compensation. During their sample period, the top federal income tax rate fell from 70% to 42.5%. Hall and Liebman (2000, 42) find no evidence of a relation between taxes and either the amount or the form of managers' compensation and conclude that "*attempts to use tax policy to influence executive compensation have had little effect*". Frydman and Molloy (2011) use data on the top federal income tax rate from 1946 to 2005 to examine a similar question. Despite substantial variation in tax rates during

[12] In 2015, in every state but Hawaii, for individuals in the highest tax bracket, the state ordinary income rate was the same as the state capital gains rate (source: The Tax Foundation, Center for State Tax Policy). Some states have provisions that exclude the capital gains on certain securities or a certain amount of capital gains from state income tax.

the post-War period, they also find little evidence that either the amount or form of managerial compensation responds to changes in tax rates.

Goolsbee (2000) examines the effect of an increase in the top federal income tax rate on the timing of option exercises in the period surrounding passage of the Omnibus Budget Reconciliation Act of 1993.[13] Goolsbee (2000) finds that the Act led managers to accelerate their option exercises. Hall and Liebman (2000) examine the effect of two pronounced decreases in the top federal income tax rate in the context of the Economic Recovery Tax Act of 1981 (top federal rate reduced from 70% to 50%) and the Tax Reform Act of 1986 (top federal rate reduced from 50% to 28%). In contrast to Goolsbee (2000), they find no evidence that large changes in income tax rates affected the timing of managers' option exercises, and show that Goolsbee's (2000) results are an artifact of failing to control for stock price appreciation.

Jin and Kothari (2008) find a negative relation between equity sales and the total tax liability that a manager would owe in connection with the sale of *all* of their vested equity holdings. Jin and Kothari (2008) calculate the total tax liability associated with the hypothetical sale of all of a manager's vested equity holdings as the product of: (i) the respective tax rate, (ii) the appreciation in value (i.e., the difference between current stock price and cost basis), and (iii) the number of vested shares (or equivalents) in the manager's portfolio. Importantly, since the total tax liability is a function of three variables—tax rate, price appreciation, and the number of vested shares—it is not clear whether the negative relation between managers' tax liability and equity sales is evidence that (i) managers sell less when tax rates are high, (ii) managers sell less when prices are high, or (iii) managers sell less when they hold more equity.

While these studies focus on *federal* rather than *state* taxes, the consistent finding that relatively large changes in federal income taxes (e.g., from 50% to 28%) do not result in changes

[13] The Act increased the top federal income tax rate from 31% to 39.6%.

in managers' compensation and equity holdings suggests that it is unlikely that comparatively small changes in state income taxes would have a measurable effect on these outcomes.[14] The results in prior literature, combined with explicit controls for managers' pre-tax compensation and equity incentives in our tests, suggests that our findings are evidence of a "direct effect" of taxes.[15]

3.3. Related literature on corporate taxes

Several recent studies explore the relation between corporate taxes and firm risk. For example, Heider and Ljungqvist (2015) and Ljungqvist et al. (2017) examine the relation between changes in state corporate tax rates and changes in firm leverage and earnings volatility, respectively. Both studies find evidence of a positive relation between state corporate taxes and risk-taking. Langenmayr and Lester (2017) examine the relation between a country's statutory corporate tax rate and firms' earnings volatility, and whether this relation varies with asymmetry in the corporate rate for gains and losses. Langenmayr and Lester (2017) show that when the corporate rate is symmetric (asymmetric), there is more (less) corporate risk-taking. Our study differs from these papers in that we examine *managerial* rather than *corporate* income taxes. We highlight three economic distinctions between these two types of taxes.

(1) *Managers v. Shareholders.* The difference between who is taxed (shareholders or managers) manifests in the type of risk-taking that one might expect to observe. In particular, corporate

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[14] Supplemental analyses in the Internet Appendix extend these results to state taxes. Table IA.2 in the Internet Appendix reports no evidence of a relation between state income tax rates and either total cash pay or equity portfolio incentives in our sample.

[15] There is also a literature that examines labor migration in response to taxes. For example, Moretti and Wilson (2014, 2017) and Akcigit, Baslandze, and Stantcheva (2016) find that the geographic dispersion of scientists within a given corporation is affected by state tax changes. However, the existence of both intra-company geographic movement among a firm's employees, i.e., employees relocating from offices in high tax jurisdictions to offices in low tax jurisdictions, and increased levels of corporate research are not necessarily inconsistent. There is also a potential difference between how scientists and managers are compensated. In particular, senior managers typically receive a fraction of the payoff from the project (which corresponds to δ in our framework), whereas many (but not all) researchers receive fixed compensation (i.e., $\delta = 0$). If scientists do not receive a share of the project's outcome, then higher income tax rates would not reduce the disutility associated with risky projects.

taxes fall on shareholders, and diversified shareholders are risk-averse with respect to systematic risk, but risk-neutral with respect to idiosyncratic risk.[16] Consequently, corporate taxes should primarily affect the amount of *systematic risk* (i.e., risk that is non-diversifiable and is priced by shareholders). In contrast, managers are not diversified and are therefore averse to both systematic and idiosyncratic risk. Prior studies on corporate taxes and risk-taking generally do not make the distinction between managers or shareholders, or between idiosyncratic and systematic risk.

The incentives literature discusses how the difference between shareholders' and managers' aversion to idiosyncratic risk creates a risk-related agency problem whereby shareholders want managers to adopt all positive net present value (NPV) projects, regardless of their idiosyncratic risk, while managers prefer to reject some of those projects that entail "too much" idiosyncratic risk (e.g., Armstrong and Vashishtha, 2012; Armstrong, Core, and Guay, 2016). In our setting, taxes on managers (but not shareholders) encourage managers to take more risk in general. However, if managers were to take more systematic risk, shareholders would be directly affected and might seek to prevent this behavior (e.g., Acharya and Bisin, 2009; Armstrong and Vashishtha, 2012). In contrast, if managers were to take more idiosyncratic risk, then shareholders would be less likely to discourage this behavior—as idiosyncratic risk is diversifiable and shareholders want managers to adopt all NPV positive projects regardless of the level of idiosyncratic risk. Consequently, in equilibrium, we expect managerial taxes to primarily affect firms' idiosyncratic rather than systematic risk.

(2) *Absence of Asymmetry*. A manager's marginal tax rate does not depend on corporate performance (i.e., corporate losses). In our sample, we find that 97% of CEOs are in the top tax

[16] A fixed marginal tax rate will not alter well-diversified shareholders' preferences toward idiosyncratic risk. If a project has a positive expected value, they will want to take it regardless of its idiosyncratic risk.

bracket based on their salaries alone. Moreover, we find no evidence that either poor accounting or stock performance alters their tax bracket.[17] Regardless of whether the firm has a gain or loss, or increases or decreases R&D, we find that nearly all CEOs remain in the highest marginal tax bracket. Because a manager's marginal tax rate does not depend on corporate performance, it does not have an asymmetric effect on risk-taking over gains and losses like capital gains taxes or corporate taxes (e.g., Auerbach, 1986). In our setting the marginal personal tax rate is fixed and results in *increased* risk-taking. Therefore, from a theoretical perspective, managerial and corporate taxes have potentially different effects on risk-taking.

(3) *Endogeneity and Measurement of Marginal Tax Rates.* The marginal corporate tax rate and corporate investment decisions are endogenously determined. Recent literature uses plausibly exogenous variation in statutory corporate tax rates either across countries or across the state of firms' headquarters to address this concern. However, *statutory* corporate tax rates are known to be a poor proxy for *marginal* corporate tax rates for at least two reasons (e.g., Shevlin, 1990; Graham, 1996; Blouin, Core, and Guay, 2010). First, the error with which statutory rates measure marginal rates is correlated with firm performance and risk (e.g., net operating losses).[18] In contrast, the sheer size of managers' annual compensation implies that managers' marginal income tax rates almost always coincide with the highest statutory tax rate, regardless of corporate performance or risk. Second, US corporations are subject to nexus rules that require them to pay taxes based on where their sales are made, their income is earned, and their assets and employees are located—not based on the state of the firm's headquarters. Nexus issues are

[17] We report and discuss this analysis in more detail in Table IA.1 of the Internet Appendix.
[18] Statutory tax rates measure marginal tax rates with error. Net operating losses increase the error with which statutory rates measure marginal rates. Firms that perform poorly and that take more risk are more likely to have net operating losses. Consequently, measurement error (i.e., the difference between the statutory tax rate and the true, but unobservable, marginal tax rate) is correlated with both firm performance and risk.

less of a concern in our setting since senior managers' compensation is likely to be concentrated in—and therefore taxed by—the state of their firm's headquarters.[19]

4. Sample Construction and Variable Measurement

4.1. Sample construction

Our sample is constructed as the intersection of Compustat/CRSP, EDGAR, Execucomp, Thomson Institutional Ownership, and several government and non-profit datasets. Specifically, we require non-missing market value, total assets, total liabilities, cash holdings, plant, property, and equipment, sales, sales growth, and net income from Compustat; stock returns during the year from CRSP; historical location of the firm's corporate headquarters from the firm's EDGAR filings, and CEO cash compensation, equity ownership, age, and tenure from Execucomp. Additionally, we require data on political affiliation of state legislatures from the National Conference of State Legislatures; state economic activity from the Bureau of Economic Analysis; corporate tax rates from the Federation of Tax Administrators; and federal and state personal income tax rates from the National Bureau of Economic Research (NBER). We also collect data on state research and development tax credits and statutory carrybacks and carryforward periods from Wilson (2009), Ljungqvist et al. (2017), and state tax websites. Our sample is constructed as the intersection of these datasets, excluding financial service firms (SIC codes 6000-6999) and utilities (SIC 4900-4999), and consists of 16,490 firm-years (2,202 unique firms and 3,891 unique managers) from 1996 to 2012.

We follow Jennings, Lee, and Matsumoto (2017) and determine the location of a firm's corporate headquarters each year using the address the firm lists as its "principal executive offices" in its annual 10-K filing. Because firms update this address each time they file a 10-K,

[19] Even if managers move their personal residence, their compensation is still taxed by the state in which it is earned.

this item reflects any changes in the state of a firm's headquarters over time.[20] Figure 3 presents the distribution of our sample according to the state of firms' corporate headquarters. Figure 3 shows that most of our sample firms are headquartered in California, Texas, Illinois, Ohio, Pennsylvania, New Jersey, New York, Massachusetts, and Connecticut. In our within-group analysis we use state- and firm- fixed effects to control for any systematic differences in corporate risk-taking between firms that are headquartered in these (and other) states.[21]

4.2. Variable measurement

4.2.1. Measurement of managerial taxes

We measures managerial taxes using cross-sectional and time-series variation in federal and state personal income tax rates. Our measure of managerial taxes, *ManagerRate*, is the combined marginal tax rate on personal income for individuals in the highest federal and state tax bracket. The rate is calculated assuming that managers pay income taxes in the state of the firm's principal executive offices, are married filing jointly with \$150,000 of itemized deductions (e.g., property taxes), and allowing for the reciprocal deductibility of federal and state income taxes where applicable (e.g., Feenberg and Coutts, 1993). Notably, every state taxes both residents and non-residents on income that was earned in the state. Thus, it seems reasonable to assume that managers are subject to income tax in the state of the firm's principal executive offices. To the extent that managers do not pay income taxes in the state of their firm's principal

[20] Because this item is not available on Compustat, Jennings et al. (2017) use a Python script to "scrape" this information from 10-K filings on EDGAR. There are several alternative sources for identifying the state of a firm's corporate headquarters, but these are known to have issues. For example, Compustat lists the state of a firm's *current* corporate headquarters on the "Company" file, but does not provide the *historical* location of its headquarters. Alternatively, the SEC's EDGAR system automatically appends a header to each corporate filing that includes the state of headquarters. However, Heider and Ljungqvist (2015) and Jennings et al. (2017) report that the header is updated with considerable delay and in an inconsistent manner. In untabulated analyses, we find that the positive relation between managerial taxes and corporate risk-taking continues to be significant at the 1% level when using either the state of headquarters listed on the SEC header data (available on Scott Dyreng's website) or hand-collected data provided by Alexander Ljungqvist.

[21] In untabulated analyses, we remove those states with fewer than 100 firm-year observations from our sample and continue to find that the positive relation between managerial taxes and corporate risk-taking is statistically significant at the 1% level.

executive offices, any resulting measurement error biases against finding a relation between managerial taxes and corporate risk-taking.[22]

We focus on a manager's tax rate rather than a manager's tax liability for two reasons. First, a manager's tax liability reflects not only the tax rate, but also share price appreciation and the amount and form of the manager's equity holdings (e.g., Jin and Kothari, 2008), both of which prior work suggests are endogenous with respect to corporate risk-taking (e.g., Coles et al., 2006; Hayes, Lemmon, and Qiu, 2012; Gormley et al., 2013). Second, apart from any concerns about endogeneity, the tax liability is the product of both managers' equity holdings and the tax rate, and conflates two potential effects on risk-taking: the effect of holding more equity and the effect of a higher tax rate. Given our prediction that higher tax rates lead to *increased* risk-taking, whereas greater equity holdings can lead to *decreased* risk-taking (e.g., Lambert et al., 1991; Ross, 2004; Armstrong and Vashishtha, 2012), these effects could work in opposite directions. The opposing nature of these effects makes it difficult to use managers' tax liability to draw meaningful inferences about the effect of taxes on corporate risk-taking. Instead, we follow prior work in the tax responsiveness literature in economics (see Saez, Slemrod, and Giertz, 2012 for a review) and measure the tax rate on senior managers directly.

4.2.2. Measurement of corporate risk-taking

Following prior work in the incentive-compensation literature, our primary measure of corporate risk-taking, *RiskyInvest*, is annual research and development expense scaled by ending total assets (e.g., Coles et al. 2006; Gormley et al., 2013).[23] In the context of our research

[22] Data are from NBER TAXSIM and are available at: http://users.nber.org/~taxsim/state-rates/. Table IA.3 of the Internet Appendix repeats our primary tests using the marginal tax rate calculated without assuming any itemized deductions. This alternative rate is 0.99 correlated with that used in our analysis. Inferences are unaffected. All measures of managerial taxes used in our analysis are available at (BLIND WEBSITE).

[23] Following these studies, we replace missing values of research and development with zero. In untabulated analyses, we find that the positive relation between managerial taxes and corporate risk-taking continues to be statistically significant at the 1% level if we exclude such observations.

question, research and development has several desirable properties as a measure of risky investment. First, it is directly controllable by senior managers and is commonly viewed as being more risky than alternative uses of funds (e.g., Bhagat and Welch, 1995; Kothari, Laguerre, and Leone, 2002). Second, unlike earnings-based measures of risk (e.g., earnings volatility), research and development is not mechanically affected by managers' accrual choices (e.g., depreciation, bad debt expense, etc.), and unlike market-based measures of risk (e.g., return volatility), research and development is not mechanically affected by the disclosure of public information, trading activity in the capital market, or taxes on shareholders (e.g., capital gains taxes). Nevertheless, to ensure that our inferences are not unique to this specific measurement choice, in subsequent analyses we confirm that our results are robust to using three alternative measures of risk-taking: earnings volatility, idiosyncratic return volatility, and systematic return volatility.

4.3. Descriptive statistics

Table 1 presents descriptive statistics for our sample at the firm-, manager-, and state-levels in Panels A, B, and C, respectively. All variables are as defined in Appendix B and are winsorized at the 1st and 99th percentiles.[24] Panel A shows that the average (median) firm in our sample has just over \$6.3 (\$1.1) billion in total assets (mean *Assets* = \$6,397, median *Assets* = \$1,156). Panel B shows that average *ManagerRate* is 41% with a standard deviation of 3%. The minimum *ManagerRate* is 35%, which is the tax rate on individuals working in states without a personal income tax in the years after the "Bush tax cuts" (beginning 2003), and the maximum *ManagerRate* is 46.7%, which is the rate for individuals working in California prior to the Bush tax cuts. Panel C shows that the average firm has a combined federal and state statutory tax rate of 40% (mean *CorporateRate* = 0.40), the statutory rate at which the firms may claim a R&D tax

[24] In untabulated analyses, we find that the positive relation between managerial taxes and corporate risk-taking continues to be statistically significant at the 1% level if we do not winsorize variables.

credit is 6% (mean *R&DCredit* = 0.06), and can carry net operating losses back (forward) 0.69 (13.61) years (mean *CorpCarryBack* = 0.69, mean *CorpCarryForward* = 13.61).[25]

Table 2 presents average values of *ManagerRate* by year, as well as the top federal rate for the year. Prior to 2003, the average *ManagerRate* varies between 43% and 44%. Beginning in 2003 (i.e., after the Bush tax cuts), the average *ManagerRate* varies between 39% and 40%. In all years, the interquartile range (i.e., the difference between the 25th and 75th percentiles) is between 2% and 4%. This suggests that the amount of variation in taxes over time is similar to the amount of variation in taxes across states. Indeed, we find that time-series variation accounts for 55% of the total variation in *ManagerRate* (cross-sectional variation accounts for the remainder).[26] Notably, during our sample period, the total variation in the top federal rate (std. dev. of 0.02) is equal to the within-year variation in the top state rate (std. dev. of 0.02). This suggests that there are similar amounts of variation in both rates during our sample period. Figure 4 presents average values of *ManagerRate* by state. When ranked according to average *ManagerRate*, the top five states are Vermont, Rhode Island, New Mexico, North Dakota, and California, and the bottom five states are Wyoming, Texas, Nevada, Florida, South Dakota, and Washington (tied).

5. Empirical Tests and Results

5.1. Between-group analysis

In our first set of tests, we conduct a between-group analysis that relies on comparisons between time periods, states, and firms. These tests estimate the relation between managerial

[25] Data on *R&DCredit* through 2006 were provided by Wilson (2009), and data on *CorpCarryBack* and *CorpCarryForward* were provided by Ljungqvist et al. (2016), ignoring nexus issues. Data on these variables in subsequent years comes from tax forms available on state Department of Revenue websites.
[26] 55% is calculated as the adjusted-R^2 from a regression of *ManagerRate* on year fixed effects.

taxes and corporate risk-taking using all of the variation in managerial taxes, regardless of its source (i.e., federal or state, cross-sectional or time-series). In our first set of tests, we estimate the following pooled regression:

$$RiskyInvest_{t+1} = \gamma_0 + \gamma_1 ManagerRate_t + \boldsymbol{\omega}\, FirmControls_t + \boldsymbol{\pi}\, ManagerControls_t + \boldsymbol{\psi}\, StateControls_t + \varepsilon_t \qquad (8)$$

where *RiskyInvest* and *ManagerRate* are as previously defined, *FirmControls* is a vector of time-varying firm-level controls, *ManagerControls* is a vector of time-varying manager-level controls, and *StateControls* is a vector of time-varying state-level controls. Throughout all of our analyses, we base our inferences on standard errors that are two-way clustered by state and year.[27]

Similar to prior research (e.g., Coles et al., 2006; Ljungqvist et al., 2017), we control for the following firm-level variables: firm size (*Log(Assets)*), firm leverage (*Leverage*), market-to-book ratio (*MB*), sales growth (*SalesGrowth*), capital intensity (*CapIntensity*), cash holdings (*Cash*), accounting performance (*ROA* and *Loss*), whether the firm has a tax loss carryforward (*TaxLoss*), stock returns (*Returns*), and ownership by retail investors (*RetailOwn*).[28] The inclusion of retail ownership helps control for the possibility that variation in risk-taking is driven by the composition of the investor base. Since retail investors are more prone to home bias, controlling for the size of the retail investor base (i.e., holding the composition of the investor base fixed) controls for any potential home bias.

Following Armstrong et al. (2013), we also control for the following manager-level variables: CEO age (*Log(Age)*), tenure (*Log(Tenure)*), pre-tax cash compensation

[27] In untabulated analyses we find that the positive relation between managerial taxes and corporate risk-taking is statistically significant at the 1% level if we either (i) cluster by state only, (ii) cluster by firm only, or (iii) two-way cluster by firm and year.

[28] Our set of firm-level controls generally subsumes those used in prior research on the determinants of "discretionary" research and development expense (e.g., Roychowdhury, 2006). See Becker (2013) for a list of controls used in prior research that models research and development expense.

(*Log(CashPay)*), and pre-tax equity incentives (*Log(Delta)*) and *Log(Vega)*). The inclusion of these variables controls for risk-taking incentives provided by CEOs' *pre-tax* compensation and pre-tax equity incentives. We control for the level and structure of compensation in order to isolate the "direct effect" of managers' tax rates on risk-taking (i.e., the top arrow in Figure 3).

Following Heider and Ljungqvist (2015) and Ljungqvist et al. (2017), we control for the growth in gross state product (*StateEconGrowth*) and, notwithstanding the aforementioned nexus issues, the highest combined federal and state statutory corporate tax rate, (*CorporateTax*), the statutory rate at which firms may claim a state R&D tax credit (*R&DCredit)*, and the number of years which a firm can carry back (forward) a net operating loss in the state (*CorpCarryBack* and *CorpCarryForward*). Following Gilligan and Matsusaka (2001) and Omer and Shelley (2004), we also control for the political affiliation of the governor (*RepubGovernor*) and the political affiliation of the legislature (*RepubLegislature*).

Table 4 presents results from estimating Eq. (8). Column (1) reports a positive and statistically significant coefficient on *ManagerRate* in the absence of any controls (*t*-stat 2.51). Columns (2) through (4) progressively add time-varying firm-, manager-, and state-level controls. When firm-level controls are included, column (2) shows that although the coefficient on *ManagerRate* is smaller in magnitude (i.e., 0.246), the precision of the estimate increases (*t*-stat 5.34). Columns (3) and (4) report similar results after the inclusion of manager and state characteristics.

The estimate of the effect of taxes *without* controls for managers' compensation and equity incentives is 0.246, whereas the estimate of the effect of taxes *with* these controls is 0.237. The former specification conflates both the indirect and direct effects in Figure 3, whereas the latter specification measures only the direct effect since it controls for the amount and structure of managers' incentive-compensation. In other words, because we hold compensation and equity incentives fixed, the coefficient on *ManagerRate* in the latter specification measures the effect of taxes on risk-taking for a fixed incentive-compensation package. The small difference between the two estimates suggests that the indirect effect of taxes on risk-taking—operating through the incentive-compensation channel—is modest. This finding is consistent with inferences from prior research that suggest that boards do not alter managers' compensation or equity incentives in response to changes in personal income tax rates (e.g., Goolsbee, 2000; Hall and Liebman, 2000; Frydman and Molloy, 2011).

Column (5) reports results after decomposing *ManagerRate* into the federal tax component, *ManagerRate_Fed*, and the state tax component, *ManagerRate_State*.[29] The key difference between these rates is that the federal rate varies over time, but not across firms, while the state rate varies both over time and across firms. We find a positive relation between both federal and state taxes and corporate risk-taking (*t*-stats 1.94 and 2.65, respectively).[30] Because there is no cross-sectional variation in the federal rate, we caution that this test cannot distinguish between the effect of the federal rate and the effect of any confounding macroeconomic events or time trends. To overcome these issues, our subsequent analyses exploit variation in tax rates across states and within states.

5.2. Within-group analysis

[29] *ManagerRate_Fed* is the rate on the top federal income tax bracket, and *ManagerRate_State* is the difference between *ManagerRate* and *ManagerRate_Fed*. While federal and state taxes are not strictly additive, calculating *ManagerRate_State* in this manner ensures that the effects of cross-deductibility and compounding appear in state taxes (so that all individuals have the same federal rate).

[30] Similar to Ljungqvist et al. (2016, Table 7, Panel B), we find no evidence of a relation between the corporate tax rate and research and development expense.

In our second set of tests, we conduct a within-group analysis that relies on comparisons within a given time period, state, firm, or manager. Specifically, we modify Eq. (8) to include year, state, firm, and manager fixed effects:

$$\begin{aligned} RiskyInvest_{t+1} = \gamma_0 + \gamma_1 ManagerRate_t & \\ + \boldsymbol{\omega}\, FirmControls_t + \boldsymbol{\pi}\, ManagerControls_t + \boldsymbol{\psi}\, StateControls_t & \\ + \boldsymbol{\chi}\, Year_t + \boldsymbol{\Psi}\, State + \boldsymbol{\Omega}\, Firm + \boldsymbol{\Gamma}\, Manager + \varepsilon_t & \qquad (9) \end{aligned}$$

We estimate four versions of Eq. (9) that progressively add each of the four levels of fixed effects, beginning with year fixed effects. In each specification, we require at least two observations at the level of each fixed-effect (e.g., at least two observations per firm in specifications that include firm fixed effects). This requirement results in slightly different sample sizes across the four specifications.[31]

There are two noteworthy features of this research design. First, in the presence of year fixed effects, the only remaining variation in *ManagerRate* is at the state-level. Thus, our second set of tests estimate the relation between managerial taxes and corporate risk-taking using exclusively state-level variation in managerial taxes, which consists of both variation in managerial taxes across states and time-series variation in managerial taxes within a given state. Accordingly, this set of tests effectively controls for any and all variation in federal tax rates. Second, the inclusion of state, firm, and manager fixed effects controls for any cross-sectional differences between states, firms (and industries), or managers that might otherwise confound our results. For example, California generally has the highest top personal income tax rate and firms in California are predominantly technology firms that are known to take substantial risk. By including state, firm, and manager effects, these tests estimate the relation between managerial taxes and corporate risk-taking using only variation in managerial taxes *within* a

[31] Note that manager fixed-effects can be estimated in the presence of firm fixed-effects because of variation in the CEO-firm pairing during our sample period. For those CEOs and firms that are always paired together, we exclude the respective CEO effect.

given state, firm, or manager. Thus, these tests remove any time-invariant cross-sectional effects that might otherwise explain our results.[32]

Table 5 presents results from estimating Eq. (9). In every specification, we find robust evidence of a positive relation between managerial taxes and corporate risk-taking. The coefficient on *ManagerRate* ranges from 0.203 to 0.347, with the associated *t*-statistics ranging from 2.74 to 6.51. As a robustness check, column (5) presents results from replacing year fixed effects with industry-year fixed effects, which are constructed as a unique vector of year fixed effects for each two-digit SIC code. This specification controls for any time-varying industry shocks that might arise as a result of technological changes within an industry or secular industry trends. We continue to find a positive relation between managerial taxes and corporate risk-taking (*t*-stat 3.82).

Having shown a statistically significant positive relation between managers' personal tax rates and corporate risk-taking, we next assess the economic magnitude of this relation. To calculate the economic magnitudes, we estimate the change in research and development expenditure for a 100 basis point increase in the tax rate (e.g., from 39% to 40%). The coefficient from column (4) in Table 3 is 0.135. This implies that a 100 basis point increase in the tax rate is associated with a 13.5 basis point increase in the ratio of R&D to assets (e.g., from 4% of assets for the average firm to 4.135% of assets).

This estimate comes with four caveats. (1) Theory does not provide predictions about the magnitude of the effect, so we have no basis for gauging whether an effect is "too large" or "too small" to be plausible. (2) Point estimates often vary substantially depending on the particular

[32] For example, the inclusion of firm fixed effects controls for those firms that never invest in research and development during our sample period. In untabulated analyses, we find that the positive relation between managerial taxes and corporate risk-taking remains statistically significant at the 1% level if we exclude these firms from the sample. We choose to retain these firms because our alternative measures of risk-taking are not based on research and development, and because eliminating these firms introduces the potential for look-ahead bias.

specification. For example, the point estimate of the effect size in the absence of controls is 43.9 basis points (column (1) of Table 3), compared to 13.5 basis points with controls (column (4) of Table 3), and 23.7 basis points with controls and fixed effects (column (4) of Table 4).[33] (3) Our point estimates have large confidence intervals. For example, the 95% confidence interval for our point estimate of 0.135 is 0.046-0.223. Thus, a 100 basis point increase in the tax rate is associated with anywhere between a 4.6 and 22.3 basis point increase in the ratio of R&D to assets and we can not distinguish between effect sizes in this interval. (4) We caution against linearly extrapolating these estimates to larger (e.g., 500 or 1000 basis point) changes in tax rates. In the presence of a concave efficient frontier (as in Section 2, see e.g., Figures 1 and 2), the effect of a 1000 basis point change will not be ten times that of a 100 basis point change. The effects we document are locally linear, but not globally linear.

5.3. Cross-sectional predictions

In our next set of tests, we examine settings where theory predicts that the relation between managerial taxes and corporate risk-taking will be particularly strong. If our theoretical predictions are empirically descriptive, then these settings should provide more powerful tests of our predictions. In particular, theory suggests the positive relation between managers' personal tax rate and corporate risk-taking will be stronger at firms with investment opportunities that have a higher rate of return per unit of risk, and for CEOs who have a lower marginal disutility of risk (see, for example Eq. (5)).

Our tests proceed as follows. First, we develop proxies for each of these firm- and manager- specific characteristics and partition our sample into observations with relatively high

[33] We focus on effect size from the between-group analysis without fixed effects because in the presence of fixed effects, the estimated effect size is not representative. For example, in the presence of year, state, firm, and manager fixed effects, the coefficient is empirically identified using only a small portion of the variation in tax rates and represents a "within" effect.

and low values of each proxy. Second, we estimate Eq. (9) separately for each subsample and test for a difference in the coefficient on *ManagerRate* between the two subsamples. For example, we develop an empirical proxy for θ, the slope of the investment opportunity set featured in Eq. (5), and then test whether the positive relation between taxes and risk-taking is more pronounced in settings where θ is high. Viewing *ManagerRate* as the exogenous "treatment," these tests examine whether there is evidence of heterogeneous treatment effects (i.e., whether the treatment effect varies with θ). The advantage of this research design (i.e., estimating separate treatment effects for each setting) is that it does not constrain the coefficients on our control variables or fixed effects to be the same across the various settings.[34]

5.3.1. Investment opportunity set

Table 5 presents results from examining whether the relation between managerial taxes and corporate risk-taking is stronger in firms that have an investment opportunity set that yields a higher rate of return per unit of risk. We measure the rate of return using two measures of the slope of the investment opportunity set, *Industry Q* and *Industry θ*, with larger values of each measure corresponding to greater returns for each additional unit of risk.[35] *Industry Q* is the aggregate Tobin's Q of the respective industry-year. *Industry Q* is calculated as the market value of equity plus book value of debt for all firms in the industry-year, scaled by book value of assets for all firms in the industry-year.[36] *Industry θ* is a structural estimate of the slope coefficient in

[34] We use the median to partition the sample to ensure that the two resulting sub-samples are of similar size and, in turn, that our tests have similar power. Note that this design is equivalent to fully interacting an indicator for whether the observation is above or below the median with all of the control variables and fixed effects, and testing whether the interaction with *ManagerRate* is different from zero.

[35] We use the relation between risk and return at the industry-level to proxy for the relation between risk and return at the project level. Although our theoretical discussion in Section 2 is framed in terms of a manager of a firm choosing among risky projects, an alternative interpretation is to assume that the manager instead directly selects the risk of the firm as a whole. In this regard, Eq. (3) can be thought of as describing a firm's efficient frontier, and the manager simply chooses where on the frontier his firm will be located.

[36] In untabulated analyses, we find that our inferences are robust to using the average Tobin's Q for all firms in the respective industry-year.

Eq. (3) estimated at the industry-year level. In particular, for all firm-years within a given industry-year, we estimate a regression of buy-and-hold returns during the year on the natural logarithm of one plus the variance of monthly stock returns during the year. The slope coefficient from this regression corresponds to θ in Eq. (3). Larger values of Q and θ correspond to a greater marginal benefit for each additional unit of risk.

Panel A presents results from estimating the relation between managerial taxes and corporate risk-taking after partitioning on *Industry Q*. First, consistent with our theoretical predictions, we find higher levels of risky investment in settings where *Industry Q* is high (difference in mean *RiskyInvest* of 0.031, p-value < 0.01). The notion that managers take more risk in industries with high Q validates that *Industry Q* measures the returns to risk-taking. Second, consistent with our predictions, we find that the effect of managerial taxes on risk-taking is stronger in industries with high Q. For firms in high Q industries (*Industry Q* > 1.49), the coefficient on *ManagerRate* is 0.464 (t-stat 3.15) and for firms in low Q industries (*Industry Q* ≤ 1.49) the coefficient on *ManagerRate* is –0.056 (t-stat –1.02). The difference between these two coefficients is statistically significant at the 1% level (two-tailed p-value < 0.01).

Panel B presents similar results, but with somewhat lower levels of statistical significance, when using *Industry* θ to measure the rate of return on the investment opportunity set. Collectively, the results in Table 5 suggest that the effect of managerial taxes on corporate risk-taking is stronger in firms that have an investment opportunity set that yields a higher rate of return per unit of risk. Indeed, for some industries—namely those with relatively low Q—we find that the rewards to risk-taking are sufficiently small that managerial taxes *do not* incentivize risk-taking.

5.3.2. Managers' marginal disutility to risk

Table 6 presents results from examining whether the relation between managerial taxes and corporate risk-taking is stronger for CEOs who have a relatively low marginal disutility of risk. We measure the marginal disutility of risk using two CEO-specific characteristics, *Delta* and *Age*, where *Delta* is the sensitivity of the CEO's equity portfolio to a 1% change in stock price (in millions) and *Age* is the CEO's age in years. Larger values of both measures correspond to a greater marginal disutility of risk. In particular, older CEOs are commonly thought to be more risk averse, where greater levels of risk aversion correspond to a greater disutility to risk-taking (e.g., Malmendier and Tate, 2005; Malmendier, Tate, and Yan, 2011; Malmendier and Nagel, 2011). In addition, although *Delta* technically increases both the marginal benefit and the marginal disutility to risk (see Armstrong et al., 2013 for a discussion), we find that the latter effect dominates theoretically and empirically.[37] As a consequence, in our setting, *Delta* should primarily capture the marginal disutility to risk-taking.

Panel A presents results from estimating the relation between managerial taxes and corporate risk-taking after partitioning on *Delta.* First, consistent with our theoretical framework, we find higher levels of risky investment in settings where *Delta* is relatively low (difference in mean *RiskyInvest* of 0.009, p-value < 0.01). The notion that CEOs with less *Delta* take more risk corroborates the validity of *Delta* as a measure of the disutility to risk-taking. Second, consistent with our predictions, we find that the effect of managerial taxes on risk-taking is stronger for CEOs whose portfolios are relatively less sensitive to changes in stock price. For CEOs with a relatively low sensitivity (*Delta* ≤ 0.22), the coefficient on *ManagerRate* is 0.701 (t-stat 4.54), whereas for CEOs with a relatively high sensitivity (*Delta* > 0.22), the coefficient on

[37] Theoretically, Eq. (7) shows that the manager's risk aversion (β) and pay-for-performance sensitivity (δ) affect the choice of risky project in exactly the same manner; and empirically, *Delta* is known to be negatively related to risk-taking (see Table 3 and Coles et al., 2006).

ManagerRate is –0.091 (*t*-stat –1.32). The difference between these two coefficients is statistically significant at the 1% level (two-tailed *p*-value < 0.01).

Panel B presents similar results, but with somewhat lower of statistical significance, when using *Age* to measure the marginal disutility to risk-taking. Collectively, the results in Table 6 suggest that the effect of managerial taxes on corporate risk-taking is stronger for CEOs who have a relatively low marginal disutility to risk-taking. Indeed, for some CEOs—namely those whose portfolios are more sensitive to price changes—we find that the disutility associated with risk-taking is sufficiently high that managerial taxes *do not* incentivize risk-taking.

6. Sensitivity Analyses

6.1. Whose taxes?

Table 7 presents results from estimating Eq. (9) after including the tax rate on middle-income earners (*NonManagerRate*) as an additional control. This analysis provides an important sensitivity test that helps to rule out other potential alternative explanations for our main results. For example, it is conceivable that the tax rate on senior managers is correlated with the tax rate on lower-level employees or retail investors and that it is these individuals—rather than senior managers—who are responsible for the tax-induced risk-taking. By including *NonManagerRate* as an additional control, the coefficient on *ManagerRate* measures the relation between corporate risk-taking and the difference, or "wedge," between the tax rates on high- and middle-income earners. Accordingly, this specification controls for any omitted variables that have a similar correlation with these two rates. If an omitted variable is correlated with both the tax rates in the same way, then controlling for the latter effectively controls for the omitted variable.

We use two measure of *NonManagerRate*: (i) the average tax rate paid by residents of the firm's state of headquarters, *AverageResidentRate*, and (ii) the combined federal and state marginal tax rate on $100,000 of wage income (married filing jointly), *MargRate100K*.[38] Panel A reports descriptive statistics for these variables. Note that the standard deviations of these alternative tax rates are 0.02 and 0.04, compared to 0.03 for *ManagerRate*. This suggests that there are similar amounts of variation in all three rates. Not surprisingly, Panel B indicates that our measures of *NonManagerRate* are highly correlated with *ManagerRate* (correlations range from 0.76 to 0.82).

Panel C presents regression results. Columns (1), (2), (5) and (6) present results when including *NonManagerRate*, but excluding *ManagerRate*. We find a positive relation between *NonManagerRate* and corporate risk-taking that is marginally significant in one specification, in the absence of fixed effects (column (1) *t*-stat of 1.74), but that it is not significant in the other three columns. Columns (3), (4), (7) and (8) present results from including *NonManagerRate* simultaneously with *ManagerRate*. When the two variables are included simultaneously, we find no evidence of a relation between *NonManagerRate* and corporate risk-taking, but continue to find strong evidence of a relation between *ManagerRate* and corporate risk-taking. Collectively, these results suggest that the relation between managerial taxes and corporate risk-taking is not an artifact of taxes on middle-income employees or retail investors.

6.2. Alternative measures of risk-taking

[38] *AverageResidentRate* is calculated as federal and state income taxes paid by residents of the firm's state of headquarters scaled by adjusted gross income of state residents. Data on *AverageResidentRate* ends in 2011 and is available at http://users.nber.org/~taxsim/allyup/.

Table 8 presents results from estimating Eq. (9) using three alternative measures of risk-taking: earnings volatility (*EarnVol*), idiosyncratic risk (*IdVol*), and systematic risk (*SysVol*).[39] Panel A presents descriptive statistics for each of the three alternative measures, and Panel B presents regression results. Consistent with the additional risk-taking manifesting in more volatile earnings, column (1) reports a positive relation between managerial taxes and earnings volatility (*ManagerRate t*-stat 2.26). Columns (2) and (3) present results for idiosyncratic and systematic risk. Consistent with the additional risk-taking primarily being idiosyncratic in nature, we find a strong positive relation between managerial taxes and idiosyncratic risk and no relation between managerial taxes and systematic risk (*ManagerRate t*-stats 3.28 and 0.62, respectively).

6.3 Alternative specifications

To further assess the robustness of our findings, we conduct four additional analyses described briefly below, and in greater detail in the Internet Appendix.

1. We estimate Eq. (9) after including additional time-varying state-level controls for: (i) state real estate prices, (ii) state tax credits for capital expenditures, (iii) state tax credits for job creation, (iv) state unemployment rates, (v) the fraction of the state's population with a bachelor's degree, and (vi) the fraction of the state's population that are high-income earners. Table IA.4 shows that the inclusion of these additional controls does not affect our inferences.
2. We estimate Eq. (9) after including an indicator for whether the state tax rate applied retroactively, and the interaction between this indicator and *ManagerRate*. Table IA.5 shows

[39] Following Ljungqvist et al. (2017), *EarnVol* is the variance of seasonally-adjusted quarterly pre-tax earnings over the subsequent eight quarters multiplied by 100, where quarterly pre-tax earnings is calculated as operating income after depreciation scaled by total assets, and seasonally adjusted by subtracting the value in the same quarter of the prior year. *IdVol* (*SysVol*) is calculated as the variance of residuals (predicted values) from a Fama-French four factor model estimated for each firm-year using monthly returns over the subsequent year and multiplied by 100 for ease of interpretation.

that: (i) retroactive tax rate changes are rare (N = 393 firm-year observations), and (ii) the interaction term is negative and statistically significant, suggesting that retroactive tax rates have less of an effect on corporate risk-taking.

3. We estimate Eq. (9) distinguishing between tax rate increases and decreases, and distinguishing between large and small changes (2 x 2). Table IA.6 reports that the coefficients on small increases and small decreases are statistically insignificant, consistent with managers not responding to small rate changes. Table IA.6 also reports that the coefficient on large increases is statistically significant in all specifications, while the coefficient on large decreases is of similar magnitude but is not statistically distinguishable from zero. *F*-tests fail to reject a difference between the magnitudes of the coefficients on large increases and large decreases (*p*-value 0.74).
4. We estimate Eq. (9) including three leads and three lags of $ManagerRate_t$. This lead-lag specification is commonly used in prior work as a way to assess the validity of assumptions related to timing and parallel trends. Table IA.7 reports that the coefficient on $ManagerRate_t$ remains statistically significant, and that the coefficients on all lead and lags are not significantly different from zero, which is consistent with parallel trends.[40]

7. Conclusion

[40] We provide two caveats. First, while the inclusion of multiple leads and lags of the independent variable of interest is a common specification used to assess the validity of the parallel trends assumption (e.g., Atansov and Black, 2016; Ljungqvist et al., 2017), this assumption is inherently untestable—in the same way that the correlated omitted variable assumption is also untestable (e.g., Roberts and Whited, 2013; Bertomeu, Beyer, and Taylor, 2016). Thus, even if the leads and lags are not statistically significant, this test can not validate the parallel trends assumption (it can only invalidate it). Second, we caution that the inclusion of multiple leads and lags (in addition to control variables and the firm-, state-, and year fixed effects) produces a highly multicolinear specification. For example, the correlation between $ManagerRate_t$ and $ManagerRate_{t-1}$ is 0.96. Consequently, empirical identification comes from a relatively small amount of variation and these results should be interpreted with caution. This limitation is not unique to our setting and potentially applies to any specification that includes multiple leads and lags of the variable of interest.

We examine the relation between managers' *personal* tax rates and their *corporate* investment decisions. We use a simple theoretical framework to illustrate how taxes reduce the disutility a risk-averse manager associates with risky investment and increase the incentive (or, equivalently, reduce the disincentive) to take risk; and to illustrate how the effect varies with firm and manager characteristics. Consistent with our theoretical predictions, we find evidence of a strong positive relation between managerial tax rates and corporate risk-taking, and that this relation is stronger in firms where the investment opportunity set provides a relatively high rate of return per unit of risk, and for senior managers who have a relatively low marginal disutility of risk. By linking the relation between managers' *personal* tax rates and corporate risk-taking to characteristics of the firm and CEO, these findings strengthen our inference that the relation is attributable to a reduction in the disutility that risk-averse managers associate with risky projects.

In additional analyses, we find that our results are unique to senior managers' tax rates—we do not find similar relations for middle-income tax rates—and we find that the tax-induced risk-taking relates to idiosyncratic rather than systematic risk. These findings suggest that the tax-induced risk-taking that we document is not attributable to taxes on either lower-level employees or retail investors, and that it is diversifiable. Collectively, we are among the first to suggest that managers' personal tax rates affect their corporate investment and risk-taking decisions, and our findings suggest that this is a promising area for future research.

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Appendix A. Personal Income Taxes on Managerial Compensation

In this Appendix we review the personal income tax treatment of the most common forms of managerial compensation (see Hall and Liebman, 2000 for a review of the parallel corporate tax treatment).

Employee stock options. Most employee stock options are treated as non-qualified stock options (NQSOs) for income tax purposes. NQSOs have no tax implications when they are granted However, at the time of exercise, the difference between the stock price and the exercise price is taxed at the ordinary income tax rate.[41]

Stock appreciation rights. Stock appreciation rights (SARs) are instruments that replicate the payoff of a stock option, and pay the employee the difference between the stock price and the exercise price when exercised. The primary difference is that, unlike stock options, SARs do not require the employee to pay the exercise price to the corporation and the employee does not receive shares of stock upon exercise. Although less common than stock options, SARS are generally taxed the same as NQSOs.

Restricted stock. Restricted stock grants are taxed at the ordinary income tax rate when the shares vest, at which point they become unrestricted stock. In the event of immediate vesting, they are taxed in the year of the grant as ordinary income.[42]

Unrestricted stock. Unrestricted stock refers to stock that was obtained through option exercises, restricted stock that has vested, or stock that the employee purchased on the open market. Gains on unrestricted stock are subject to capital gains tax when realized at the time of the sale. Any realized short-term capital gains (from holding shares less than a year) are taxed at the ordinary income rate, while any long-term capital gains (from holding shares more than a year) are taxed at the long-term capital gains rate.

Pension and Deferred Compensation. The tax treatment of pensions and deferred compensation can be quite complicated, but in general, these forms of compensation are taxable to the employee after the employee retires and therefore have no current tax consequences.

Salary, Bonus, Perquisites, and Long-term Incentive Plans. In addition to equity grants, most senior managers receive an annual salary, bonus, and various perquisites such as the use of a corporate jet or car. These are all generally taxed as ordinary income in the year received. Many executives also receive long-term incentive plan payouts, which are typically in the form of cash. These payments are also taxed as ordinary income in the year received.

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[41] The second type of employee stock options is known as incentive stock options (ISOs), which are far less common than NQSOs. ISOs are limited to $100,000 that can vest for a manager per year, and their appreciation is not tax-deductible for the company. However, there is a tax advantage for the manager because the profits from exercising ISOs are not taxed as ordinary income. Instead, the executive is only liable for capital gains tax on any appreciation of the shares acquired from exercising the options. Hall and Liebman (2000) find that ISOs account for less than five percent of total option awards.

[42] Executives also have the option to make a Section 83(b) election for restricted stock grants. This election results in the restricted stock being taxed immediately (i.e., at the time of the grant) as ordinary income and any subsequent gains and losses being taxed at the capital gains rate. However, managers rarely make the Section 83(b) election in practice (e.g., Jin and Kothari, 2008).

Appendix B. Variable Definitions

This Appendix defines the variables used in our primary analyses.

Firm Characteristics

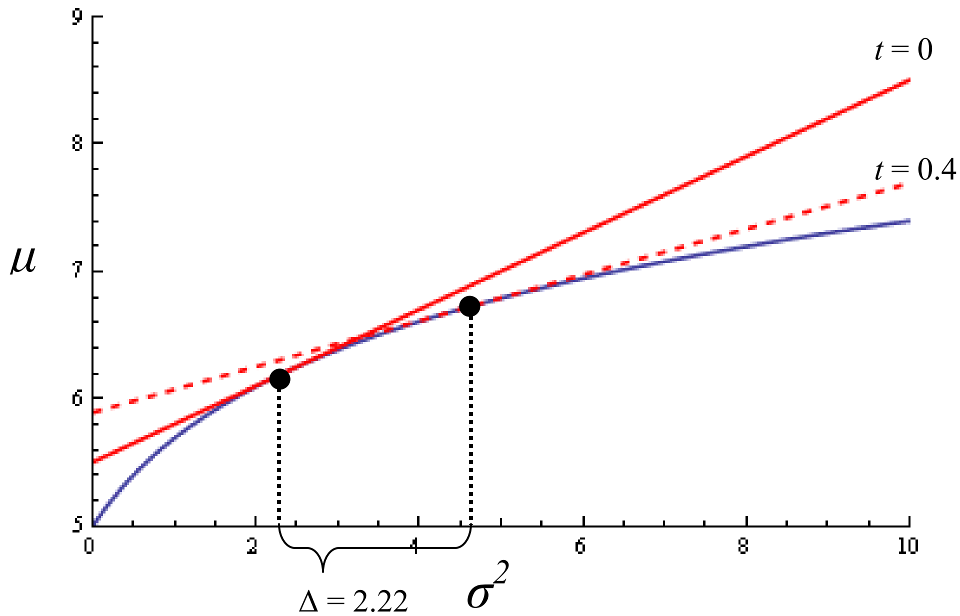
Assets	Book value of total assets.
Leverage	Book value of total debt to the book value of total assets.
MB	Market value of assets to book value of assets.
SalesGrowth	Change in sales scaled by lag sales.
CapIntensity	Net plant, property, and equipment scaled by total assets.
Cash	Cash holdings scaled by total assets.
ROA	Income before extraordinary items scaled by total assets.
Loss	An indicator variable equal to one if income before extraordinary items is negative and zero otherwise.
LossCarry	An indicator variable equal to one if the firm has a tax loss carryover and zero otherwise.
Return	Buy and hold return over the year.
RetailOwn	One minus the fraction of institutional ownership.
RiskyInvest	Research and development expense scaled by total assets.
Industry Q	Market value of equity plus book value of debt of all firms in the industry-year scaled by book value of assets of all firms in the industry-year.
Industry θ	Slope coefficient from a regression of buy-and-hold return over the year on the natural log of one plus the variance of monthly returns over the year. Regressions are estimated separately for each industry-year.
EarnVol	Variance of seasonally-adjusted quarterly pre-tax earnings over the subsequent eight quarters, where quarterly pre-tax earnings ($Earn_{i,t,q}$) is calculated as operating income after depreciation scaled by total assets, and we seasonally adjust by subtracting the value in the same quarter of the prior year ($Earn_{i,t,q} - Earn_{i,t-1,q}$) and multiplied by 100.
IdVol	Variance of residuals from a Fama French four factor model estimated annually for each firm over the subsequent year and multiplied by 100.
SysVol	Variance of predicted values from a Fama French four factor model estimated annually for each firm over the subsequent year and multiplied by 100.

CEO Characteristics

ManagerRate	Highest combined federal and state income tax rate, assuming the individual is in top brackets at both the federal and state levels, married filing jointly with $150,000 in deductible property taxes, and allowing for deductibility of state income taxes in states where applicable.
Age	Age of the manager (in years).
Tenure	Tenure of the manager (in years).
CashPay	Total cash compensation (in millions).
TotalPay	Total compensation (in millions).
Delta	Dollar change of the CEO's portfolio value for a 1% change in firm stock price (in millions).
Vega	Dollar change of the CEO's portfolio value for a 0.01 change in return volatility (in millions).

State Characteristics	
StateEconGrowth	The change in gross state product, scaled by the beginning gross state product.
RepubGovernor	Indicator variable equal to one if the state's governor identifies as a Republican and zero otherwise.
RepubLegislature	Indicator variable equal to one if all houses of the state's legislature have a majority of members who identify as Republican and zero otherwise.
CorporateRate	Highest combined federal and state corporate tax rate.
R&DCredit	Statutory rate at which firms may claim a R&D tax credit
CorpCarryBack	The number of years which a firm can carry back a net operating loss in the state
CorpCarryForward	The number of years which a firm can carry forward a net operating loss in the state
AverageResidentRate	Total federal and state income tax paid by state residents scaled by total adjusted gross income of state residents (data through 2011).
MargRate100K	Combined federal and state marginal income tax rate on $100,000 in wage income, assuming the taxpayer is married filing jointly, and allowing for deductibility of state income taxes in states where applicable.

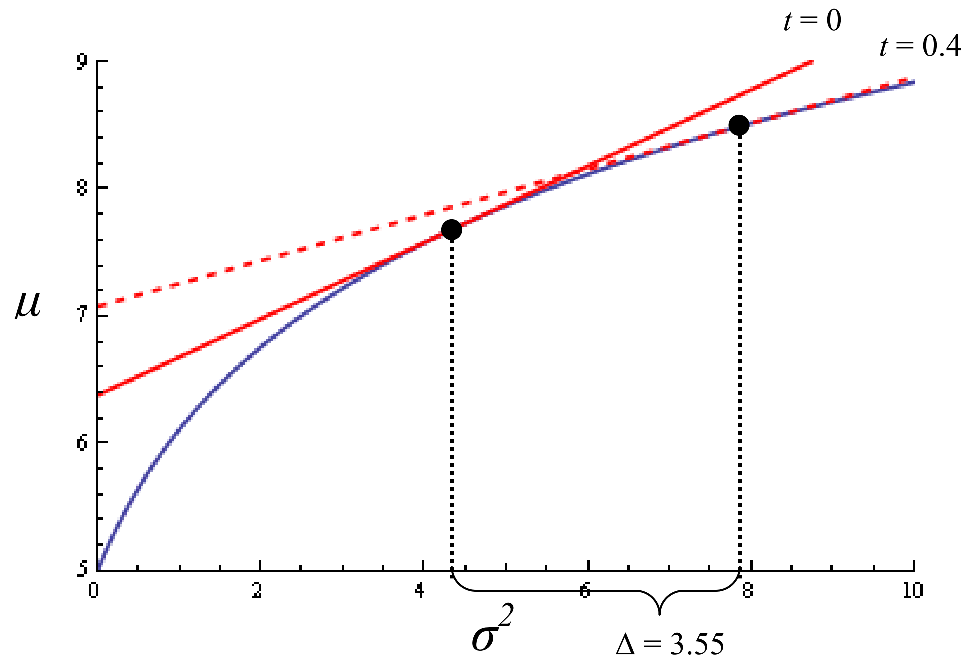
Figure 1. Efficient Project Frontier and Manager's Indifference Curves



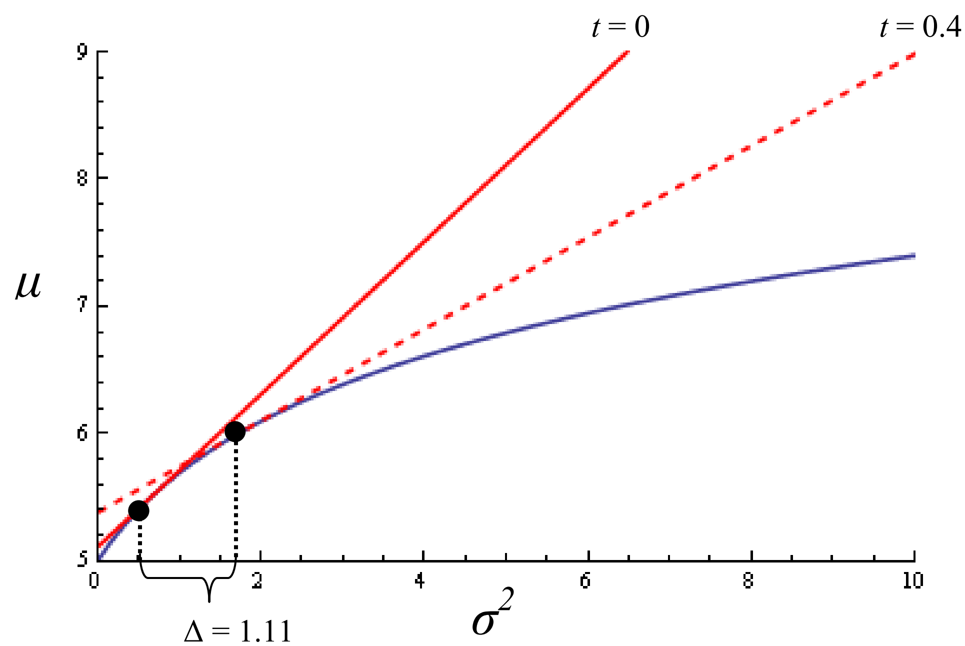
This figure plots the efficient frontier of projects and a risk-averse manager's indifference curves in pre-tax mean-variance space. The project's pre-tax expected payoff (variance) appears on the *y*-axis (*x*-axis). The efficient frontier of available projects appears in blue. The solid red line represents the manager's indifference curve at the point of tangency in the absence of taxes, $t = 0$. The dashed red line represents the manager's indifference curve at the point of tangency in the presence of a 40% tax rate, $t = 0.40$. In our example, $\varphi = 5$, $\theta = 1$, $\alpha = 1$ and $\beta = 0.3$. The point of tangency, for $t = 0$ is {2.33, 6.20}. The point of tangency for $t = 0.40$ is {4.55, 6.71}.

Figure 2. Cross-Sectional Predictions

Panel A. Marginal Benefit to Risk



Panel B. Marginal Disutility to Risk



This figure plots the efficient frontier of projects and a risk-averse manager's indifference curves in pre-tax mean-variance space after altering the marginal benefit and marginal disutility to risk. The project's pre-tax expected payoff (variance) appears on the *y*-axis (*x*-axis). The efficient frontier of available projects appears in blue. The solid red line represents the manager's indifference curve at the point of tangency in the absence of taxes, $t = 0$. The dashed red line represents the manager's indifference curve at the point of tangency in the presence of a 40% tax rate, $t = 0.40$. Panel A illustrates the effect of the marginal benefit of risk on the relation between taxes and project selection by increasing the slope of the efficient frontier from $\theta = 1$ in Figure 1 to $\theta = 1.6$ ($\varphi = 5$, $\theta = 1.6$, $\alpha = 1$ and $\beta = 0.3$). The point of tangency for $t = 0$ is {4.33, 7.67}. The point of tangency for $t = 0.40$ is {7.88, 8.49}. Panel B illustrates the effect of the marginal cost of risk on the relation between taxes and project selection by increasing the manager's risk aversion from $\beta = 0.3$ in Figure 1 to $\beta = 0.6$ ($\varphi = 5$, $\theta = 1$, $\alpha = 1$ and $\beta = 0.6$). The point of tangency, for $t = 0$ is {0.66, 5.51}. The point of tangency for $t = 0.40$ is {1.77, 6.02}.

Figure 3. Manager's Tax Rate and Corporate Decisions

This figure illustrates the endogenous nature of the manager's compensation with corporate decisions, and two channels through which the manager's tax rate might affect corporate decisions: (i) directly, by reducing disutility associated with the adoption of risky projects, and (ii) indirectly, by altering the compensation and incentives the board provides to the manager.

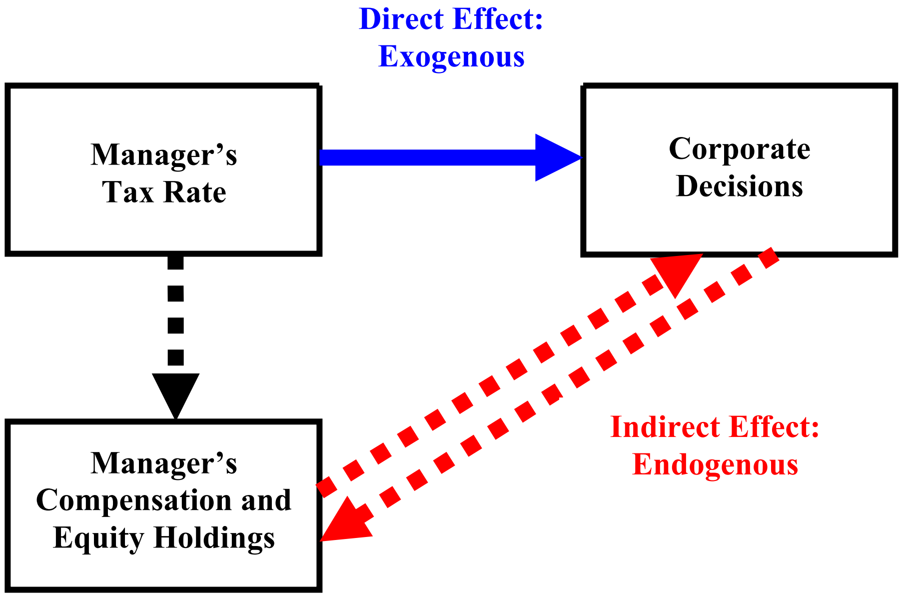


Figure 4. Number of Observations by State

This figure presents the number of observations in our sample by state. The sample is comprised of 16,490 firm-years drawn from each of the 50 states, plus Washington D.C., from 1996 to 2012.

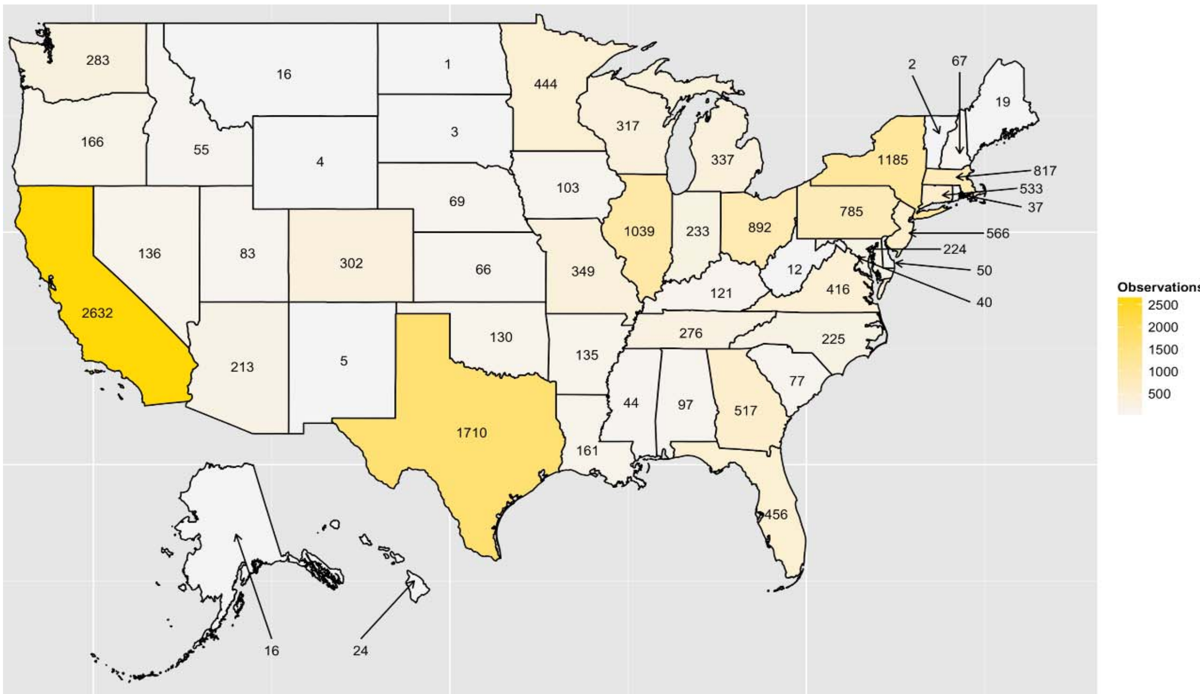


Figure 5. Tax Rates by State

This figure presents average values of *ManagerRate*, by state, for our sample of 16,490 firm-years from 1996 to 2012. *Managerial Tax Rate* is the highest combined federal and state income tax rate, assuming that the manager works in the state of the firm's headquarters, is married filing jointly, and allowing for reciprocal deductibility of federal and state taxes and $150,000 in property taxes.

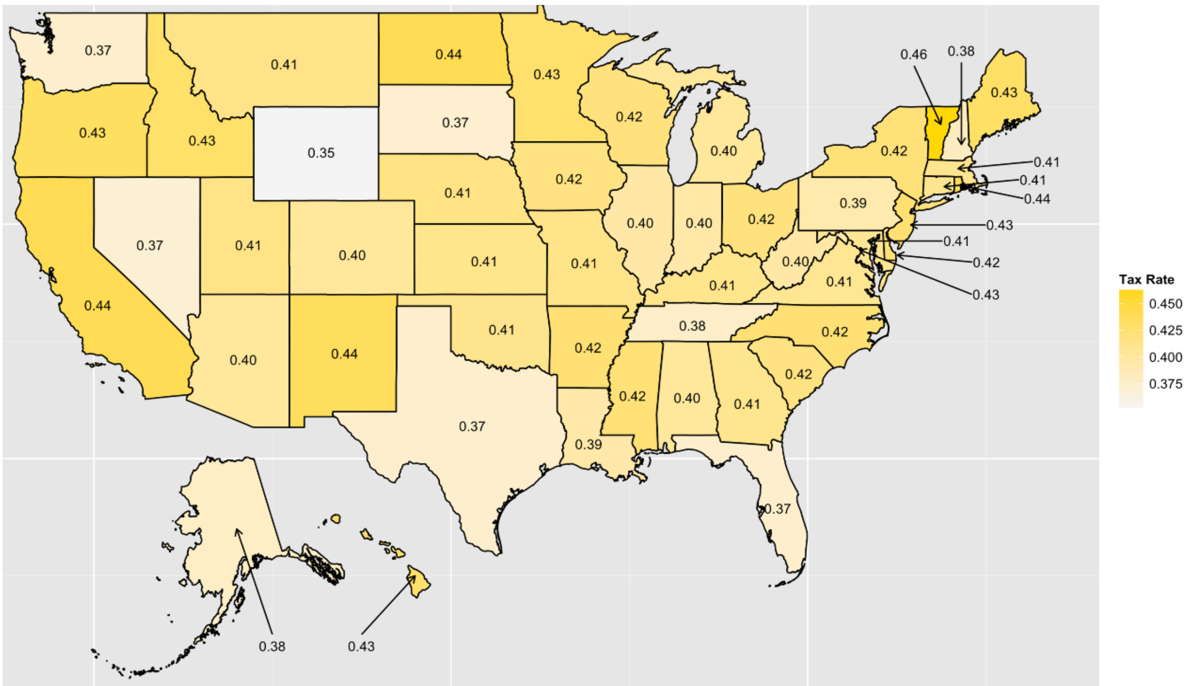


Table 1. Descriptive Statistics

Panel A. Firm Characteristics

Variable	*Mean*	*Std*	*25th*	*Median*	*75th*
Assets	6,397.28	27,288.71	422.86	1,156.14	3,594.60
Leverage	0.22	0.19	0.04	0.20	0.33
MB	2.09	1.52	1.22	1.61	2.35
SalesGrowth	0.15	0.42	0.00	0.09	0.21
CapIntensity	0.26	0.22	0.10	0.20	0.38
Cash	0.16	0.18	0.03	0.09	0.24
ROA	0.03	0.16	0.01	0.05	0.09
Loss	0.20	0.40	0.00	0.00	0.00
LossCarry	0.42	0.49	0.00	0.00	1.00
Return	0.17	0.59	–0.17	0.09	0.37
RetailOwn	0.28	0.22	0.11	0.24	0.41
RiskyInvest	0.04	0.07	0.00	0.01	0.05

Panel B. CEO Characteristics

Variable	*Mean*	*Std*	*25th*	*Median*	*75th*
ManagerRate	0.41	0.03	0.39	0.41	0.43
Age	55.39	7.31	50.00	55.00	60.00
Tenure	7.20	7.47	2.00	5.00	10.00
CashPay	1.14	1.05	0.54	0.83	1.29
TotalPay	4.68	5.65	1.25	2.69	5.70
Delta	0.70	1.58	0.08	0.22	0.60
Vega	0.12	0.28	0.01	0.04	0.12

Panel C. State Characteristics

Variable	*Mean*	*Std*	*25th*	*Median*	*75th*
StateEconGrowth	0.02	0.03	0.01	0.02	0.04
RepubGovernor	0.53	0.50	0.00	1.00	1.00
RepubLegislature	0.31	0.46	0.00	0.00	1.00
CorporateRate	0.40	0.02	0.38	0.40	0.41
R&DCredit	0.06	0.05	0.00	0.06	0.10
CorpCarryBack	0.69	1.09	0.00	0.00	2.00
CorpCarryForward	13.61	6.47	7.00	15.00	20.00

This table presents descriptive statistics for the variables used in our primary analysis. Our sample is constructed from the intersection of CRSP/Compustat (accounting and stock price data), Execucomp (compensation), and SEC EDGAR 10-K filings (historical data on state of headquarter's), after excluding utilities (SIC codes 4900–4999) and financial firms (SIC codes 6000–6999) over the time period 1996 to 2012. Our final sample covers a total of 16,490 firm-years (2,202 firms and 3,891 managers). Panel A reports descriptive statistics for firm characteristics used in our analysis, Panel B reports descriptive statistics for manager characteristics, and Panel C reports descriptive statistics for characteristics of the firm's state of headquarters. All variables are as defined in Appendix B.

Table 2. Managerial Tax Rates By Year

		ManagerRate (combined Top Federal + Top State)					Top Federal Rate Only	
Year	N	*Mean*	*Std*	*25th*	*Median*	*75th*		
1996	836	0.44	0.02	0.43	0.44	0.45	0.396	
1997	935	0.44	0.02	0.43	0.44	0.45	0.396	
1998	885	0.44	0.02	0.43	0.44	0.45	0.396	
1999	940	0.44	0.02	0.43	0.44	0.45	0.396	
2000	981	0.44	0.02	0.43	0.44	0.46	0.396	
2001	945	0.44	0.02	0.42	0.44	0.45	0.391	
2002	929	0.43	0.02	0.42	0.43	0.44	0.386	Bush Tax Cuts
2003	980	0.40	0.02	0.38	0.40	0.41	0.350	
2004	927	0.40	0.02	0.38	0.40	0.41	0.350	
2005	950	0.40	0.02	0.38	0.40	0.41	0.350	
2006	978	0.39	0.02	0.38	0.39	0.41	0.350	
2007	1,073	0.39	0.02	0.38	0.39	0.40	0.350	
2008	1,125	0.39	0.02	0.37	0.39	0.40	0.350	
2009	1,026	0.39	0.02	0.37	0.39	0.41	0.350	
2010	1,023	0.39	0.02	0.37	0.39	0.41	0.350	
2011	1,056	0.39	0.02	0.37	0.39	0.41	0.350	
2012	901	0.39	0.03	0.37	0.39	0.39	0.350	
Total	16,490	0.41	0.03	0.39	0.41	0.43		

This table presents descriptive statistics for *ManagerRate*, by year, for our sample of 16,490 firm-years. *ManagerRate* is the highest combined federal and state income tax rate, assuming the individual is in top brackets at both the federal and state levels, married filing jointly with $150,000 in deductible property taxes, and allowing for reciprocal deductibility of state and federal income taxes in states where applicable.

Table 3. Managerial Taxes and Corporate Risk-Taking: Between-Group Analysis

	(1)		(2)		(3)		(4)		(5)	
	No Controls		Firm Characteristics		Firm and Manager Characteristics		Firm, Manager, and State Characteristics		Federal and State Components	
Variable:	coeff	*t*-stat	coeff	*t*-stat	coeff	*t*-stat	coeff	*t*-stat	coeff	*t*-stat
ManagerRate	0.439***	(2.51)	0.246***	(5.34)	0.237***	(5.25)	0.135***	(2.99)	.	
ManagerRate_Fed	.		.		.		.		0.190***	(2.65)
ManagerRate_State	.		.		.		.		0.100*	(1.94)
Firm-Year Controls										
Log(Assets)	.		–0.001**	(–1.14)	–0.003**	(–2.49)	–0.002**	(–2.32)	–0.002**	(–2.23)
Leverage	.		–0.020***	(–3.64)	–0.020***	(–3.51)	–0.018***	(–3.18)	–0.017***	(–3.10)
MB	.		0.007***	(6.32)	0.007***	(7.07)	0.007***	(7.40)	0.007***	(7.47)
SalesGrowth	.		0.007*	(1.60)	0.007*	(1.83)	0.007*	(1.70)	0.007*	(1.71)
CapIntensity	.		–0.020***	(–4.83)	–0.018***	(–4.29)	–0.016***	(–4.21)	–0.016***	(–4.02)
Cash	.		0.136***	(9.69)	0.135***	(10.09)	0.125***	(9.66)	0.125***	(9.38)
ROA	.		–0.124***	(–6.65)	–0.122***	(–6.59)	–0.119***	(–6.35)	–0.119***	(–6.36)
Loss	.		0.004	(1.24)	0.004	(1.18)	0.004	(1.21)	0.004	(1.18)
LossCarry	.		0.009***	(2.65)	0.009***	(2.71)	0.007***	(2.59)	0.007**	(2.50)
Return	.		–0.007***	(–4.42)	–0.006***	(–4.31)	–0.006***	(–3.94)	–0.006***	(–4.02)
RetailOwn	.		0.001	(0.13)	0.003	(0.55)	0.006	(0.94)	0.006	(1.02)
Manager-Year Controls										
Log(Age)	.		.		–0.001	(–0.16)	–0.001	(–0.08)	–0.001	(–0.10)
Log(Tenure)	.		.		0.001	(0.31)	0.001	(0.38)	0.001	(0.35)
Log(CashPay)	.		.		–0.001	(–0.32)	–0.001	(–0.23)	–0.001	(–0.24)
Log(Delta)	.		.		–0.012***	(–3.30)	–0.012***	(–3.29)	–0.012***	(–3.27)
Log(Vega)	.		.		0.057***	(7.26)	0.052***	(6.90)	0.052***	(6.69)
State-Year Controls										
StateEconGrowth	.		.		.		0.043***	(2.35)	0.047***	(2.59)
RepubGovernor	.		.		.		–0.001	(–0.03)	0.001	(0.30)
RepubLegislature	.		.		.		–0.005**	(–2.47)	–0.005**	(–2.30)
CorporateRate	.		.		.		0.110	(1.40)	0.091	(1.06)
R&DCredit	.		.		.		0.087***	(4.03)	0.080***	(3.41)
CorpCarryBack	.		.		.		–0.002**	(–1.74)	–0.002*	(–1.81)
CorpCarryForward	.		.		.		–0.001	(–1.13)	0.001	(–1.24)
F / N	56.21 / 16,490		142.15 / 16,490		118.56 / 16,490		104.91 / 16,490		101.98 / 16,490	

This table presents results from estimating Eq. (8) using a between-group design. Columns (1) through (4) present results from progressively including firm-, manager-, and state-level control variables. Column (5) presents results from additively decomposing *ManagerRate* into the federal tax component, *ManagerRate_Fed*, and the state tax component *ManagerRate_State*. *ManagerRate_Fed* is the rate on the top federal income tax bracket, and *ManagerRate_State* is the difference between *ManagerRate* and *ManagerRate_Fed*. All variables are as defined in Appendix B. *t*-statistics appear in parentheses and are based on standard errors clustered by state and year. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels (two-tail), respectively.

Table 4. Managerial Taxes and Corporate Risk-Taking: Within-Group Analysis

	(1) Within-Year: Year Fixed Effects		(2) Within-State: Year and State Fixed Effects		(3) Within-Firm: Year, State, and Firm Fixed Effects		(4) Within-Manager: Year, State, Firm, and Manager Fixed Effects		(5) Time-varying industry shocks: Industry-Year, State, Firm, and Manager Fixed Effects	
Variable:	coeff	*t*-stat	coeff	*t*-stat	coeff	*t*-stat	coeff	*t*-stat	coeff	*t*-stat
ManagerRate	0.203***	(2.74)	0.254***	(3.00)	0.347***	(6.51)	0.237***	(3.89)	0.290***	(3.72)
Firm-Year Controls										
Log(Assets)	–0.003**	(–2.52)	–0.003**	(–2.51)	–0.008**	(–2.23)	–0.006**	(–2.51)	–0.007***	(–3.00)
Leverage	–0.017***	(–3.04)	–0.017***	(–2.98)	–0.012***	(–3.51)	–0.015***	(–1.81)	–0.013*	(–1.69)
MB	0.007***	(6.79)	0.007***	(6.95)	–0.001	(–0.25)	–0.001	(–0.43)	–0.001	(–0.52)
SalesGrowth	0.006	(1.59)	0.006	(1.46)	0.003*	(1.68)	0.003	(1.38)	0.002	(1.05)
CapIntensity	–0.015***	(–3.79)	–0.011***	(–2.72)	0.030***	(3.97)	0.025***	(3.01)	0.030***	(3.90)
Cash	0.126***	(9.29)	0.119***	(7.63)	0.006	(0.61)	0.015*	(1.64)	0.015*	(1.64)
ROA	–0.120***	(–6.21)	–0.118***	(–5.91)	–0.024***	(–3.27)	–0.019**	(–1.98)	–0.020**	(–2.28)
Loss	0.004	(1.30)	0.004	(1.11)	0.001	(0.68)	0.001	(1.02)	0.001	(0.62)
LossCarry	0.007**	(2.34)	0.007**	(2.29)	0.001	(0.08)	–0.001	(–0.35)	–0.001	(–0.41)
Return	–0.006***	(–3.06)	–0.006***	(–3.26)	–0.003**	(–2.49)	–0.002**	(–2.41)	–0.002**	(–2.47)
RetailOwn	0.006	(0.93)	0.009	(1.55)	0.002	(0.57)	0.005	(1.48)	0.004	(1.39)
Manager-Year Controls										
Log(Age)	–0.001	(–0.02)	–0.003	(–0.39)	–0.010**	(–2.06)	0.003	(0.34)	–0.001	(–0.02)
Log(Tenure)	0.001	(–1.55)	0.001	(0.26)	–0.001	(–0.87)	–0.003	(–1.33)	–0.003	(–1.55)
Log(CashPay)	0.001	(1.58)	0.002	(0.57)	0.005***	(2.71)	0.003*	(1.90)	0.003	(1.58)
Log(Delta)	–0.011***	(–3.18)	–0.012***	(–3.22)	0.001	(0.70)	–0.001	(–0.12)	–0.001	(–0.10)
Log(Vega)	0.054***	(6.63)	0.053***	(6.01)	0.002	(0.44)	0.001	(0.32)	0.006	(0.87)
State-Year Controls										
StateEconGrowth	–0.001	(–0.03)	0.031	(–1.14)	–0.027	(–1.55)	–0.015	(–0.96)	–0.018	(–1.33)
RepubGovernor	0.001	(0.25)	–0.002	(1.09)	0.001	(0.62)	–0.001	(–0.53)	–0.001	(–0.28)
RepubLegislature	–0.004*	(–1.89)	0.003**	(2.17)	0.001	(1.80)	0.001	(1.19)	0.001	(1.09)
CorporateRate	0.065	(0.66)	0.073	(0.64)	–0.008	(–0.32)	–0.054*	(–1.73)	–0.073	(–1.22)
R&DCredit	0.085***	(3.34)	0.014	(0.59)	0.028	(1.37)	0.022	(1.18)	0.022	(0.96)
CorpCarryBack	–0.002*	(–1.95)	0.001	(0.61)	0.001	(0.16)	0.001	(0.66)	0.001	(1.13)
CorpCarryForward	–0.001	(–0.94)	0.001	(0.52)	–0.001	(–0.17)	–0.001	(–1.10)	–0.001	(–1.21)
F / N	773.91 / 16,490		125.19 / 16,489		17.11 / 16,231		7.70 / 15,461		35.00 / 15,324	

This table presents results from estimating Eq. (9) using a within-group design that incorporates various levels of fixed effects. Column (1) presents results from a within-year analysis that includes year effects. Column (2) presents results from a within-state analysis that includes both year and state effects. Column (3) presents results from a within-firm analysis that includes year, state, and firm effects. Column (4) presents results from a within-manager analysis that includes year, state, firm, and manager effects. Column (5) presents results from replacing year effects with industry-year effects, where industry-year effects are based on two-digit SIC codes. For parsimony, we do not tabulate coefficients on control variables. All variables are as defined in Appendix B. *t*-statistics appear in parentheses and are based on standard errors clustered by state and year. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels (two-tail), respectively.

Table 5. Cross-Sectional Tests: Returns to an Additional Unit of Risk

Panel A. Tobin's Q

	(1) Low Return per Unit of Risk	(2) High Return per Unit of Risk
	Industry $Q \leq 1.49$	Industry $Q > 1.49$
Mean *RiskyInvest*	0.022	0.053
Variable		
ManagerRate	–0.006	0.464***
	(–0.14)	(3.15)
Time–Varying Controls		
Firm–Year	Yes	Yes
State–Year	Yes	Yes
Manager–Year	Yes	Yes
Fixed Effects		
Year	Yes	Yes
State	Yes	Yes
Firm	Yes	Yes
Manager	Yes	Yes
F / N	18.38 / 7,476	16.62 / 7,303

Panel B. Slope of the Investment Opportunity Set

	(1) Low Return per Unit of Risk	(2) High Return per Unit of Risk
	Industry $\theta \leq 1.70$	Industry $\theta > 1.70$
Mean *RiskyInvest*	0.033	0.042
Variable1		
ManagerRate	0.170*	0.338***
	(1.96)	(3.21)
Time–Varying Controls		
Firm–Year	Yes	Yes
State–Year	Yes	Yes
Manager–Year	Yes	Yes
Fixed Effects		
Year	Yes	Yes
State	Yes	Yes
Firm	Yes	Yes
Manager	Yes	Yes
F / N	43.21 / 7,178	25.02 / 6,990

This table presents results from estimating whether the effect of managerial taxes on corporate risk-taking varies with two measures of the return to an additional unit of risk: industry growth opportunities, *Industry Q*, and the slope coefficient of the investment opportunity set for the industry given in Eq. (3), *Industry θ*. *Industry Q* is calculated as market value of equity plus book value of debt scaled by book value of assets, where numerator and denominator are aggregated over all firms in the respective industry-year. Larger values of *Industry Q* correspond to industries with more growth opportunities. *Industry θ* is the slope coefficient from regression of buy-and-hold return over the year on the natural log of one plus the variance of monthly returns, and regressions are estimated separately for each industry-year. Larger values of *Industry θ* correspond to a larger return for each additional unit of risk. We estimate Eq. (9) separately for firms with above and below median values of these variables, and allow the coefficients on all control variables and fixed effects to vary across the two groups of firms. All variables are as defined in Appendix B. *t*–statistics appear in parentheses and are based on standard errors clustered by state and year. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels (two–tail), respectively.

Table 6. Cross-Sectional Tests: Disutility to an Additional Unit of Risk

Panel A. Sensitivity of Portfolio to Stock Price

	(1) High Disutility: *Delta* > 0.22	(2) Low Disutility: *Delta* ≤ 0.22
Mean *RiskyInvest*	0.033	0.042
Variable		
ManagerRate	–0.091	0.701***
	(–1.32)	(4.54)
Time–Varying Controls		
Firm–Year	Yes	Yes
State–Year	Yes	Yes
Manager–Year	Yes	Yes
Fixed Effects		
Year	Yes	Yes
State	Yes	Yes
Firm	Yes	Yes
Manager	Yes	Yes
F / N	7.80 / 7,303	12.15 / 7,476

Panel B. CEO Age

	(1) High Disutility: *Age* > 55	(2) Low Disutility: *Age* ≤ 55
Mean *RiskyInvest*	0.030	0.044
Variable		
ManagerRate	0.275***	0.420***
	(2.68)	(2.96)
Time–Varying Controls		
Firm–Year	Yes	Yes
State–Year	Yes	Yes
Manager–Year	Yes	Yes
Fixed Effects		
Year	Yes	Yes
State	Yes	Yes
Firm	Yes	Yes
Manager	No	No
F / N	12.59 / 7,303	38.08 / 7,476

This table presents results from estimating whether the effect of managerial taxes on corporate risk-taking varies with two measures of the disutility to an additional unit of risk: the sensitivity of the value of the CEO's equity portfolio to a 1% change in stock price (*Delta*) and the CEO's age in years (*Age*). Larger values of *Delta* and *Age* correspond to greater disutility for each additional unit of risk. We estimate Eq. (9) separately for CEOs with above and below median values of these variables, and allow the coefficients on all control variables and fixed effects to vary across the two groups of firms. We exclude manager fixed effects when estimating whether the effect of taxes varies with manager age. All variables are as defined in Appendix B. *t*-statistics appear in parentheses and are based on standard errors clustered by state and year. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels (two–tail), respectively.

Table 7. Whose Taxes? Tax Rates on Non-Management Employees

Panel A. Descriptive statistics

Variable	*Mean*	*Std*	*25th*	*Median*	*75th*
AverageResidentRate	0.15	0.02	0.14	0.15	0.16
MargRate100K	0.31	0.04	0.28	0.31	0.34

Panel B. Correlation matrix

Variable	*ManagerRate*	*AverageResidentRate*	*MargRate100K*
ManagerRate	1.00	0.80	0.82
AverageResidentRate	0.78	1.00	0.78
MargRate100K	0.82	0.76	1.00

Panel C. Regression results

	NonManagerRate =							
	AverageResidentRate: Average taxes paid by state residents scaled by average state household income				*MargRate100K*: Tax rate on family of four with income of $100,000			
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ManagerRate	.	.	0.175**	0.224**	.	.	0.152**	0.212***
	.	.	(2.44)	(2.09)	.	.	(2.42)	(3.15)
NonManagerRate	0.166*	0.159	–0.084	0.009	0.072	0.161	–0.02	0.125
	(1.74)	(0.64)	(–0.48)	(0.03)	(1.39)	(1.45)	(–0.40)	(1.08)
Time-Varying Controls								
Firm-level	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Manager-level	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-level	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects								
Year	No	Yes	No	Yes	No	Yes	No	Yes
State	No	Yes	No	Yes	No	Yes	No	Yes
Firm	No	Yes	No	Yes	No	Yes	No	Yes
Manager	No	Yes	No	Yes	No	Yes	No	Yes
F	95.60	30.98	87.05	32.75	108.8	7.73	100.88	7.25
N	15,589	14,598	15,589	14,598	16,490	15,461	16,490	15,461

This table presents results from estimating Eq. (9) replacing the tax rate on senior managers with either the average tax rate paid by state residents (*AverageResidentRate*) or the combined federal and state marginal tax rate on $100,000 in wage income (*MargRate100K*). All variables are as defined in Appendix B. Panel A presents descriptive statistics, Panel B presents the correlation matrix with Pearson (Spearman) correlations above (below) the diagonal, and Panel C presents regression results. *t*-statistics appear in parentheses and are based on standard errors clustered by state and year. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels (two-tail), respectively.

Table 8. Alternative Measures of Risky Investment

Panel A. Descriptive Statistics

Variable	*Mean*	*Std*	*25th*	*Median*	*75th*
EarnVol	0.061	0.189	0.003	0.008	0.032
IdVol	0.872	1.160	0.224	0.470	1.006
SysVol	1.135	1.706	0.251	0.567	1.238

Panel B. Multivariate Regressions

	(1)	(2)	(3)
Variable	*EarnVol*	*IdVol*	*SysVol*
ManagerRate	2.920**	12.573***	4.472
	(2.26)	(3.28)	(0.62)
Time-Varying Controls:			
Firm-level	Yes	Yes	Yes
State-level	Yes	Yes	Yes
Manager-level	Yes	Yes	Yes
Fixed Effects:			
Year	Yes	Yes	Yes
State	Yes	Yes	Yes
Firm	Yes	Yes	Yes
Manager	Yes	Yes	Yes
F / N	21.20 / 15,382	14.60 / 15,382	51.93 / 15,382

This table presents results from estimating Eq. (9) using three alternative measures of risk-taking: *Earnings Volatility*, *Idiosyncratic Volatility*, and *Systematic Volatility*. Panel A presents descriptive statistics for each of the three alternative measures and Panel B presents regression results. For parsimony, we do not tabulate coefficients on control variables. *t*-statistics appear in parentheses and are based on standard errors clustered by state and year. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels (two-tail), respectively.

Internet Appendix

This appendix outlines results from additional analyses.

Table IA.1 Effect of firm performance on tax rate paid by senior managers

Table IA.1 presents results from examining the percentage of firm-years where the CEO's salary exceeds the threshold needed to qualify for the highest state income tax bracket. Using historical data on state income thresholds from the Tax Policy Center from 2000 to 2012 (http://www.taxpolicycenter.org/statistics/state-individual-income-tax-rates-2000-2016), we code an indicator variable, *CEOTopBracket*, equal to one if the CEO's salary in that year is sufficient to qualify the CEO for the state tax rate used in our primary analysis (i.e., the rate for the highest state income tax bracket). By definition, *CEOTopBracket*, is coded as one for states with a single tax rate for all taxpayers and for states with no income tax, as all CEOs in such states would qualify for that rate.

Panel A presents the percentage of observations where the CEO's salary exceeds the threshold needed to qualify for the highest state income tax bracket (i.e., *CEOTopBracket* = 1).[43] Results in Panel A suggests that the base salary of nearly all top managers in our sample is sufficient to put them in the top bracket—regardless of the performance of their firm. Panel B presents the percentage of observations where the CEO's salary exceeds the income threshold separately for firm-years with profits and losses (i.e., *Loss* = 1). The CEO appears in the highest tax bracket for 96.59% of loss firms and 97.16% of profitable firms, a difference of 0.57% (*p*-value = 0.13). Panel C presents results from using a linear probability model to estimate the probability that the CEO's salary qualifies for the top bracket as a function on accounting and stock performance (*ROA, Loss*, and *Return*). We find no evidence of a relation between firm performance and the manager's tax bracket. Collectively, these finding support the notion (and our maintained assumption) that managers' personal income tax rates are invariant with respect to their firm's performance or corporate tax situation—managers are almost always taxed at the highest rate.

Table IA.2 Manager Tax Rates and Compensation

Table IA.2 shows results from examining the relation between manager tax rates and manager compensation. Columns (1), (2), and (3) present results from a regression of CEO cash compensation (*CashPay*) and portfolio equity incentives (*Delta* and *Vega*) on the CEO's tax rate. Regression specifications follow specification #4 in Table 4 and include the full set of firm-year controls, manager characteristics, state-year controls, and fixed effects. We find no evidence of a relation between tax rates and any of these incentive variables (*t*-stats 0.51, –0.65, and 1.35 respectively). Prior literature finds no evidence that boards alter managerial compensation in response to *federal* income taxes, and these results suggest boards also do not appear to alter incentive-compensation contracts in response to *state* income taxes.

[43] Our sample is reduced to 11,913 firm-years from 2000 to 2013 and we have no firm-years for Vermont or North Dakota over this period.

Table IA.3 Alternative Tax Rate: No Itemized Deductions

In the calculation of *ManagerRate* we assumed $150,000 in itemized deductions (e.g., property taxes). Table IA.3 presents results from estimating Eq (9). using an alternative tax rate that is calculated analogously, but assuming no itemized deductions (*ManagerRate_NoDeduct*). Specifically, *ManagerRate_NoDeduct* is the combined marginal tax rate on personal income for individuals in the highest federal and state tax bracket ($1.5 million income). The rate is calculated assuming that managers pay income taxes in the state of the firm's principal executive offices, are married filing jointly and allowing for the reciprocal deductibility of federal and state income taxes where applicable. Panel A shows a very high, 0.99 correlation between *ManagerRate* and *ManagerRate_NoDeduct* suggesting the presence of itemized deductions does not materially affect the calculated rates. Panel B presents regression results. Regression specifications follow specification #4 in Table 4. Panel B shows that the coefficient is attenuated (coefficient of 0.162 versus 0.237 in Table 4) but statistical significant is increased (*t*-statistic of 4.45 versus 3.89 in Table 4).

Table IA.4 Additional State-Level Control Variables

Table IA.4 presents results from repeating our primary analyses after including several additional time-varying state-level controls. We include the following additional state-level controls variables. *RealEstateIndex* is end-of-year housing price index compiled by the Federal Housing Authority for the respective state-year.[44] *CapitalCredit* is the rate at which a firm can deduct capital expenditures directly from its state corporate income tax liability in addition to the usual depreciation deductions against taxable income.[45] *JobCredit* is an indicator variable equal to one if the state offers a tax credit in return for hiring new workers and zero otherwise.[46] *UnemploymentRate* is the state unemployment rate, in percent.[47] *Resident_Bachelor* is the number of individuals with at least a bachelor's degree scaled by state population.[48] *Resident_TopEarner* is the number of tax returns listing adjusted gross income in excess of $200,000 scaled by state population.[49]

The resulting "saturated models" include a total of 11 firm-year controls, 5 manager-year controls, and 13 state-level controls—the 7 state-level controls from our primary analyses (e.g., *StateEconGrowth*, *RepubGovernor*, *RepubLegislature*, *CorporateRate*, *R&DCredit*, *CorpCarryBack*, *CorpCarryForward*) and 6 additional state-level variables described above. With regard to these additional variables, results in column (1) suggest the provision of capital expenditure credits are negatively related to risk-taking and state unemployment rate is positively related to risk-taking (*t*-stats of –2.09 and 1.94 respectively). However, consistent with the results from our primary analysis, column (2) reports that none of the 13 time-varying state-level controls are statistically significant at conventional levels in the within-group analysis that

[44] Data are available at https://www.fhfa.gov/KeyTopics/Pages/House-Price-Index.aspx.
[45] Data on *CapitalCredit* through 2006 were provided by Chirinko and Wilson (2008), and data for subsequent years come from tax forms available on State Department of Revenue websites (see, Ljungqvist et al., 2016).
[46] Data are from Appendix A1 in Neumark and Grijalva (2016).
[47] Data are available at https://beta.bls.gov/dataQuery/find?q=unemployment
[48] Date come from the US Census and are available at https://www.census.gov/support/USACdataDownloads.html. We use a state-specific linear trend to interpolate state populations between census years.
[49] Data are available at https://www.irs.gov/uac/soi-tax-stats-historic-table-2.

includes state-level fixed effects. Regardless of specification, we find our inferences regarding the relation between the manager's tax rate and corporate risk-taking is unaffected (*ManagerRate* *t*-stats of 3.90 and 3.01).

Table IA.5 Differential Effect of Retroactively Applied Tax Rates

Table IA.5 presents results from estimating Eq. (9) distinguishing tax rates that were retroactively applied. In some instances, legislatures pass tax changes that apply retroactively rather than prospectively. We find that retroactive rates affect 393 firm-years in our sample, suggesting that retroactively applied tax legislation is relatively rare. Moreover, we find that all retroactive rates in our sample apply to the current year (i.e., year *t* tax rate), leaving managers with time to respond even if they were unaware of the pending legislation until after it was passed. For example, in May 2009 the Hawaiian governor approved tax legislation that was retroactive to January 2009.

To examine whether there is a differential effect of retroactive rates, we estimate Eq. (9) after including: (i) an indicator variable equal to one if the state tax rate in year *t* was retroactive (*RetroActive*) and (ii) the interaction between the indicator and *ManagerRate* (*RetroActive*ManagerRate*). In this manner, the total effect of a retroactive rate will be the sum of the coefficient on the tax rate (i.e., the main effect) and the interaction term. Table IA.5 reports that the interaction term is negative and statistically significant, suggesting that retroactive tax rates have less of an effect.

Table IA.6 Large and Small Increases and Decreases

Table IA.6 presents results from estimating Eq. (9) after decomposing $ManagerRate_t$ into its lagged value ($ManagerRate_{t-1}$) and the change during the year ($\Delta ManagerRate_t$) as follows:

$$ManagerRate_t = ManagerRate_{t-1} + \Delta ManagerRate_t$$

where

$$\Delta ManagerRate_t = \Delta^{Lg+} ManagerRate_t + \Delta^{Sm+} ManagerRate_t + \Delta^{Lg-} ManagerRate_t + \Delta^{Sm-} ManagerRate_t$$

$\Delta^{Lg-} ManagerRate_t$ is the change in tax rate if it is less than –75 basis points; $\Delta^{Sm-} ManagerRate_t$ is the change in tax rate if it is between–75 and zero basis points; $\Delta^{Sm+} ManagerRate_t$ is the change in tax rate if it is between zero and 75 basis points; and $\Delta^{Lg+} ManagerRate_t$ is the change in tax rate if it is greater than 75 basis points. Table IA.6 reports that the coefficients on small increases and decreases are tiny and statistically insignificant, consistent with managers not responding to small rate changes. In contrast, the coefficient on large increases is statistically significant, while the coefficient on large decreases is of similar magnitude to that of large increases, but is not statistically different from zero. *F*-tests fail to reject a difference in the magnitudes of the coefficients on large increases and large decreases (*p*-value 0.74). We interpret these results as being consistent with a lack of power in the latter setting since there are fewer large decreases than large increases.

Table IA.7 Timing Tests

Table IA.7 presents results from estimation Eq. (9) after including three-years of leads and lags of *ManagerRate*. Specifically, we estimate:

$$
\begin{aligned}
RiskyInvest_{t+1} = \gamma_0 &+ \gamma_1 ManagerRate_t \\
&+ \gamma_2 ManagerRate_{t-1} + \gamma_3 ManagerRate_{t-2} + \gamma_4 ManagerRate_{t-3} \\
&+ \gamma_5 ManagerRate_{t+1} + \gamma_6 ManagerRate_{t+2} + \gamma_7 ManagerRate_{t+3} \\
&+ \mathbf{\Omega}\ \text{Controls} + \boldsymbol{\theta}\ \text{Fixed Effects} + \varepsilon_t
\end{aligned}
$$

This lead-lag specification is commonly used to assess the validity of assumptions related to timing and parallel trends (e.g., Ljungqvist et al., 2017). In this specification, the coefficient on each *ManagerRate* variable represents an incremental effect. We find that $ManagerRate_t$ remains statistically significant at conventional levels, and that all lead and lags are insignificant at conventional levels. Finding that the coefficients on the lead terms are not statistically signficiant suggests that corporate risk-taking exhibits parallel trends. Finding that the coefficients on the lead terms are not statistically significant suggests that corporate risk-taking exhibits parallel trends. For example, if managers reversed the increase in risk, then tax rate in t would be positively correlated with risk, but tax rates in t–1, ..., t–3 would be *negatively* correlated with risk.

Table IA.1 Effect of Firm Performance on Tax Rate Paid by Senior Managers

Panel A. Percentage of Observations where the CEO's Salary Exceeds the Threshold to Qualify for the Highest State Bracket

AK	100%	GA	100%	MD	78%	NJ	76%	SD	100%
AL	100%	HI	100%	ME	100%	NM	100%	TN	100%
AR	100%	IA	97%	MI	100%	NV	100%	TX	100%
AZ	99%	ID	100%	MN	99%	NY	85%	UT	98%
CA	98%	IL	100%	MO	96%	OH	99%	VA	100%
CO	100%	IN	100%	MS	100%	OK	100%	WA	100%
CT	95%	KS	100%	MT	100%	OR	100%	WI	98%
DC	100%	KY	100%	NC	100%	PA	100%	WV	100%
DE	100%	LA	100%	NE	100%	RI	95%	WY	100%
FL	100%	MA	100%	NH	100%	SC	97%	VT & ND	N/A
Total Number of Observations 11,913; Total Percentage of Observations In Excess of Threshold: 97%									

Panel B. Corporate Losses and CEO Tax Bracket

Loss Firm	*Percentage of Observations where the CEO's Salary Exceeds the Threshold to Qualify for the Highest State Bracket*
Yes (N = 2550 firm-years)	96.59% (N = 2,463)
No (N = 9,363 firm-years)	97.16% (N = 9,097)
Difference	0.57% p-value test of differences: 0.13

Panel C. Effect of Firm Performance on CEO Tax Bracket

	(1) Between Group Analysis		(2) Within-Group Analysis	
Variable	coeff	*t*-stat	coeff	*t*-stat
ROA	0.017	(1.10)	–0.004	(–0.17)
Loss	–0.004	(–1.02)	–0.002	(–0.28)
Return	–0.012	(–1.28)	–0.001	(–0.52)
Fixed Effects:				
Year	No		Yes	
State	No		Yes	
Firm	No		Yes	
Manager	No		Yes	
F / N	1.97 / 11,913		0.12 / 11,128	

This table shows results from examining the percentage of firm-years where the CEO's salary exceeds the threshold needed to qualify for the highest state income tax bracket. Using historical data on the state income thresholds from the Tax Policy Center from 2000 to 2012 (http://www.taxpolicycenter.org/statistics/state-individual-income-tax-rates-2000-2016), we code an indicator variable, *CEOTopBracket*, equal to one if the CEO's salary in that year exceeds the respective income threshold to qualify for the state tax rate used in our primary analysis (the highest state income tax bracket). *CEOTopBracket* is coded as one for states with a single tax rate for all taxpayers. Sample of 11,913 firm-years from 2000 to 2013. Panel A presents the percentage of observations where the CEO's salary exceeds the income threshold by state (i.e., *CEOTopBracket* = 1). We have no firm-years for Vermont or North Dakota over this period. Panel B presents the percentage of observations where the CEO's salary exceeds the income threshold separately for loss firms. Panel C presents results from using a linear probability model to estimate the probability that the CEO's salary qualifies for the top bracket as a function on accounting and stock performance (*ROA, Loss*, and *Return*). All variables are as defined in Appendix B. *t*-statistics appear in parentheses and are based on standard errors clustered by state and year. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels (two-tail), respectively.

Table IA.2 Manager Tax Rates and Compensation

	Dependent Variable:					
	(1)		(2)		(3)	
	Log(CashPay)		*Log(Delta)*		*Log(Vega)*	
Variable:	Coeff	*t*-stat	Coeff	*t*-stat	Coeff	*t*-stat
ManagerRate	–0.569	(0.51)	–0.569	(–0.65)	0.378	(1.35)
Firm-Year Controls						
Log(Assets)	0.098***	(5.41)	0.198***	(9.85)	–0.031***	(4.68)
Leverage	–0.175***	(–6.01)	–0.161***	(–4.20)	–0.032	(–1.20)
MB	0.015***	(3.41)	0.075***	(13.27)	0.004**	(2.07)
SalesGrowth	0.021	(1.62)	0.010	(1.22)	0.001	(0.24)
CapIntensity	–0.066	(–1.38)	0.013	(0.22)	–0.006***	(–0.24)
Cash	–0.050	(–1.52)	–0.011	(–0.26)	0.004***	(0.57)
ROA	–0.036	(0.90)	–0.005	(–0.13)	0.013*	(1.78)
Loss	–0.046***	(–3.28)	–0.038***	(–3.67)	–0.011***	(–3.06)
LossCarry	–0.001	(–0.01)	–0.017	(–1.23)	–0.003	(–0.88)
Return	0.026***	(2.97)	0.042***	(4.66)	–0.002	(–0.97)
RetailOwn	0.012	(0.36)	0.084**	(2.01)	0.016	(1.36)
Manager-Year Controls						
Log(Age)	0.035	(0.36)	0.351	(1.53)	0.063**	(2.54)
Log(Tenure)	0.018	(1.19)	0.055***	(4.25)	0.026***	(3.61)
State-Year Controls						
StateEconGrowth	0.222	(1.59)	0.232	(1.42)	0.102*	(1.80)
RepubGovernor	–0.001	(–0.03)	–0.014	(–1.56)	–0.001	(–0.28)
RepubLegislature	0.022*	(1.66)	–0.015*	(–1.64)	–0.001	(–0.05)
CorporateRate	–0.002	(–0.01)	0.454	(0.82)	–0.083	(–0.48)
R&DCredit	0.268	(1.42)	0.046	(0.21)	0.074	(0.86)
CorpCarryBack	–0.002	(–0.21)	0.003	(0.35)	0.002	(0.42)
CorpCarryForward	–0.001	(–0.50)	0.001	(1.07)	–0.001	(–0.14)
Fixed Effects:						
Year	Yes		Yes		Yes	
State	Yes		Yes		Yes	
Firm	Yes		Yes		Yes	
Manager	Yes		Yes		Yes	
F / N	34.60 / 15,461		131.17 / 15,461		50.30 / 15,461	

This table presents results from examining the relation between managerial compensation and managerial tax rate. Column (1) presents results from a regression of cash compensation (*CashPay*) on the manager's total tax rate and control variables. Column (2) presents results from regressions of equity incentives as it relates to price (*Delta*) on the manager's total tax rate and control variables. Column (3) presents results from regressions of equity incentives as it relates to risk (*Vega*) on the manager's total tax rate and control variables. Consistent with our primary analyses, all regression specifications include year, state, firm, and manager fixed effects. All variables are as defined in Appendix B. *t*-statistics appear in parentheses and are based on standard errors clustered by state and year. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels (two-tail), respectively.

Table IA.3 Alternative Tax Rate: No Itemized Deductions

Panel A. Correlation Between Rates

Variable	*ManagerRate*	*ManagerRate_NoDeduct*
ManagerRate	1.00	0.99
ManagerRate_NoDeduct	0.99	1.00

Panel B. Regression results

Variable	Coeff.	*t*-stat
ManagerRate_NoDeduct	0.162***	(4.45)
Time-Varying Controls:		
Firm-level	Yes	
State-level	Yes	
Manager-level	Yes	
Fixed Effects:		
Year	Yes	
State	Yes	
Firm	Yes	
Manager	Yes	
F / N	5.93 / 15,461	

This table presents results from using an alternative tax rate that assumes zero itemized deductions (*ManagerRate_NoDeduct*). *ManagerRate_NoDeduct* is the combined marginal tax rate on personal income for individuals in the highest federal and state tax bracket ($1.5 million income). The rate is calculated assuming that managers pay income taxes in the state of the firm's principal executive offices, are married filing jointly and allowing for the reciprocal deductibility of federal and state income taxes where applicable. Panel A presents the correlation between this alternative rate and the rate used in our analysis (which is calculated analogously but assuming $150,000 in itemized deductions). Panel B presents results from estimating Eq. (9) using *ManagerRate_NoDeduct*. Regression specifications follow column (4) in Table 4. *t*-statistics appear in parentheses and are based on standard errors clustered by state and year. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels (two-tail), respectively.

Table IA.4 Alternative Specification: Additional State-Level Control Variables

Panel A. Descriptive statistics

Variable	*Mean*	*Std*	*25th*	*Median*	*75th*
RealEstateIndex	327.871	130.642	226.810	292.480	396.820
CapitalCredit	0.017	0.024	0.000	0.000	0.030
JobCredit	0.743	0.436	0.000	1.000	1.000
UnemploymentRate	6.015	2.076	4.600	5.400	6.800
Resident_Bachelors	0.204	0.057	0.161	0.189	0.234
Resident_TopEarners	0.006	0.003	0.004	0.005	0.009

Panel B. Regression Results

	(1) Between Group Analysis		(2) Within Group Analysis	
Variable	Coeff.	*t*-stat	Coeff.	*t*-stat
ManagerRate	0.217***	(3.01)	0.217***	(3.01)
Additional State-Year Controls				
RealEstateIndex	0.001	(1.48)	–0.001	(–0.17)
CapitalCredit	–0.067**	(–2.09)	0.035	(1.03)
JobCredit	–0.001	(–0.48)	0.001	(0.43)
UnemploymentRate	0.001*	(1.94)	–0.001	(–0.53)
Resident_Bachelors	0.033	(0.96)	0.047	(0.27)
Resident_TopEarners	–0.225	(–0.31)	0.719	(0.66)
Time-Varying Controls:				
Firm-level	Yes		Yes	
State-level	Yes		Yes	
Manager-level	Yes		Yes	
Fixed Effects:				
Year	No		Yes	
State	No		Yes	
Firm	No		Yes	
Manager	No		Yes	
F / N	102.84 / 16,490		18.17 / 15,461	

This table presents results from repeating our analysis after including several additional time varying state-level controls. We include the following additional state-level controls variables: an index of state real estate value (*RealEstateIndex*), an indicator for whether the state offered an investment tax credit in the respective year (*CapitalCredit*), an indicator for whether the state offered tax credit for job creation in the respective year (*JobCredit*), the state unemployment rate (*UnemploymentRate*), the percent of state residents with bachelor's degrees (*Resident_Bachelor*) and the percentage of state residents filing taxes in the top state and federal brackets (*Resident_TopEarner*). Column (1) presents results from repeating our between group analysis, and Column (2) presents results from repeating our within-group analysis that includes year, state, firm, and manager fixed effects. *t*-statistics appear in parentheses and are based on standard errors clustered by state and year. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels (two-tail), respectively.

Table IA.5 Differential Effect of Retroactively Applied Tax Rates

Variable	Coeff.	*t*-stat
ManagerRate	0.259***	(4.31)
*RetroActive*ManagerRate*	–0.130***	(–7.01)
RetroActive	0.051***	(7.01)
Time-Varying Controls:		
Firm-level	Yes	
State-level	Yes	
Manager-level	Yes	
Fixed Effects:		
Year	Yes	
State	Yes	
Firm	Yes	
Manager	Yes	
F / N / N(RetroActive = 1)	47.78 / 15,461 / 393	

This table presents results from estimation Eq. (9) after including: (i) an indicator variable equal to one if the state tax rate in year *t* was retroactive (*RetroActive*) and (ii) the interaction between the indicator and *ManagerRate* (*RetroActive*ManagerRate*). Regression specifications follow column (4) of Table 4. *t*-statistics appear in parentheses and are based on standard errors clustered by state and year. Sample of 393 firm-years affected by retroactive rates. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels (two-tail), respectively.

Table IA.6 Large and Small Increases and Decreases

Variable	Coeff.	t-stat
Lag Value		
$ManagerRate_{t-1}$	0.246**	(2.52)
Increases		
Δ^{Lg+} $ManagerRate_t$	0.004**	(2.22)
Δ^{Sm+} $ManagerRate_t$	–0.001	(–0.45)
Decreases		
Δ^{Lg-} $ManagerRate_t$	–0.003	(–1.50)
Δ^{Sm-} $ManagerRate_t$	–0.001	(–0.90)
Time-Varying Controls:		
Firm-level	Yes	
State-level	Yes	
Manager-level	Yes	
Fixed Effects:		
Year	Yes	
State	Yes	
Firm	Yes	
Manager	Yes	
F / N	42.08 / 15,461	
p-value test: Δ^{Sm-} $ManagerRate_t$ + Δ^{Sm+} $ManagerRate_t = 0$	0.80	
p-value test: Δ^{Lg-} $ManagerRate_t$ + Δ^{Lg+} $ManagerRate_t = 0$	0.74	

This table presents results from estimating Eq. (9) after decomposing $ManagerRate_t$ into its lagged value ($ManagerRate_{t-1}$) and the change during the year ($\Delta ManagerRate_t$) as follows:

$$ManagerRate_t = ManagerRate_{t-1} + \Delta ManagerRate_t$$

where

$$\Delta ManagerRate_t = \Delta^{Lg+} ManagerRate_t + \Delta^{Sm+} ManagerRate_t + \Delta^{Lg-} ManagerRate_t + \Delta^{Sm-} ManagerRate_t$$

Δ^{Lg-} $ManagerRate_t$ is the change in tax rate if it is less than –75 basis points; Δ^{Sm-} $ManagerRate_t$ is the change in tax rate if it is between–75 and zero basis points; Δ^{Sm+} $ManagerRate_t$ is the change in tax rate if it is between zero and 75 basis points; and Δ^{Lg+} $ManagerRate_t$ is the change in tax rate if it is greater than 75 basis points. Regression specifications follow column (4) of Table 4. t-statistics appear in parentheses and are based on standard errors clustered by state and year. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels (two-tail), respectively.

Table IA.7 Timing Tests

Variable	Coeff.	*t*-stat
$ManagerRate_t$	0.240***	(6.83)
Lags		
$ManagerRate_{t-1}$	–0.181	(–1.31)
$ManagerRate_{t-2}$	0.346	(1.39)
$ManagerRate_{t-3}$	0.216	(0.90)
Leads		
$ManagerRate_{t+1}$	0.008	(0.07)
$ManagerRate_{t+2}$	0.051	(0.52)
$ManagerRate_{t+3}$	–0.044	(–0.87)
Time-Varying Controls:		
Firm-level	Yes	
State-level	Yes	
Manager-level	Yes	
Fixed Effects:		
Year	Yes	
State	Yes	
Firm	Yes	
Manager	Yes	
F / N	38.99 / 15,461	

This table presents results from estimating Eq. (9) after including three leads and lags of $ManagerRate_t$ (i.e., $ManagerRate_{t-3}$, ..., $ManagerRate_{t+3}$). Regression specifications follow column (4) of Table 4. *t*-statistics appear in parentheses and are based on standard errors clustered by state and year. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels (two-tail), respectively.