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Taxes and Executive Compensation: Evidence from the 1990s

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Abstract

This article analyzes the effect of personal income taxation on the pay-to-stock-price sensitivity of executive compensation contracts generated by stock option and restricted stock grants. Using Execucomp data for 1992–1996 and variation in the ordinary income marginal tax rate of top earners in the same time period, I find that an increase in the tax rate *decreases* the *pre-tax* pay-to-performance sensitivity generated by option grants, whereas stock grant sensitivity is found to be unresponsive to the same change. Even though these results can be explained by joint tax optimization of executives and their employers, they suggest that after-tax incentive provision for executives is quite sensitive to variation in the ordinary income tax rate. (JEL codes: D21, H24)

Keywords: Executive, compensation, tax, incentives.

1 Introduction

The use of performance-based pay in corporate executive compensation has skyrocketed in the last 25 years (Hall and Liebman 1998; Murphy 1999). The presumed objective of this compensation design is to align interests of company's executives with interests of its shareholders by relating executive pay to company performance. Personal income, both ordinary and capital gains, taxes create a wedge between what companies pay their executives and what the executives receive after tax. One important implication of this observation is that it is the after-tax rather than the pre-tax pay-to-performance sensitivity that accounts for the strength of high-powered incentives from the executives' viewpoint. It is therefore interesting to ask to what extent companies perceive this tax wedge and adjust their pre-tax compensation packages in response to changes in the marginal tax rates affecting personal income. Since incentive-based pay is, nowadays, used in a majority of publicly traded companies in the USA, this question is of a significant interest for both positive and normative analysis. In particular, understanding how personal income taxation affects the design of

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executive compensation is key to evaluating the distortionary impact of taxation on incentives of an important group of individuals.

There have been several previous studies dealing with the impact of personal income taxation on the design of executive pay packages. Hite and Long (1982), Miller and Scholes (1982), and Hall and Liebman (2000) investigate the impact of the tax system on the design of executive compensation from the perspective of joint tax efficiency of an executive and his employer, labeled as 'global contracting perspective' by Scholes and Wolfson (1992). They argue that salary, restricted stock grants, and stock option grants can all be understood as different means of compensation deferral. Then, depending on the relative tax burden of these instruments, a company, holding the after-tax present value of its cash flow constant, chooses an instrument with the highest present value of the after-tax payout to the manager. As shown by Hall and Liebman (2000), the joint tax efficiency predicts that nonqualified stock options (NQSOs) always dominate cash pay as long as the underlying stock is expected to appreciate and the capital gains tax rate is positive. The reason is that options avoid capital gains taxes on stock appreciation that the executive would have to pay if he invests his after-tax wage in company stock. Another prediction is that the tax advantage of options decreases with the ordinary income and corporate income tax rates and increases with the capital gains tax rate. Hall and Liebman (2000) also provide an empirical test of this theory. When using the tax advantage of options as the explanatory variable, they find that stock options become more important relative to cash pay when the tax advantage of options increases. However, when using the three tax rates as the explanatory variables, the ordinary income tax changes in the 1980s and early 1990s have no significant impact on the composition of executive compensation between cash pay and stock options.[1]

[1] There is also a literature dealing with the impact on the design of executive compensation of other aspects and provisions of the tax law. Hall and Liebman (2000), Perry and Zenner (2001) and Rose and Wolfram (2002) investigate the impact of the 'million-dollar rule' instituted in 1993, and effective since 1994, which limits the corporate income tax deductibility of nonincentive-based executive pay to 1 million dollars. They concluded that companies whose executives' salaries were close to the threshold limited their post-1993 salary growth and used more incentive-based pay instead. However, the effect of the legislation in reducing salary growth appears to be only modest, and there is no significant effect on the level of total compensation. On a different note, Goolsbee (2000a, 2000b) finds large sensitivity of executive stock option exercises to 1993 and 1994 increases in the ordinary income marginal tax rate. There is also a more recent literature dealing with incentive provision and *corporate* income tax reporting decisions of executives. Chen and Chu (2005) theoretically investigated the trade-off between gains from corporate tax evasion and the associated loss in internal control of the firm when accounting books are 'cooked' to aid tax evasion. Crocker and Slemrod (2005) model how, in a hidden information model, the principal optimally designs the compensation scheme of the manager when the manager makes decisions about corporate tax evasion that benefit

The joint tax efficiency theory is not a complete description of considerations that are likely to affect the response of pay package designers to tax changes though. First, if tax deferral considerations are the only thing that matters, why would companies use any cash pay at all given that options have a tax advantage? The answer probably has to do with riskiness of option pay-offs. Given that executives typically have a much higher exposure to the stock of their own company than what would be optimal under a diversified investment strategy, rather than receiving more options, they may on the margin prefer cash pay that they can invest into the market portfolio even if such strategy involves additional capital gains taxes. Hence the tax advantage of options is traded off against the cost of risk bearing. As discussed before, an increase in the ordinary income tax rate reduces the tax benefit of options, hence shifting the tax benefit versus risk bearing trade-off toward fewer options. However, such tax increase also reduces the riskiness of option grants since the government gets to share a higher fraction of the payout, shifting the trade-off toward more options. The net effect depends on risk attitudes of the executive as well as his overall portfolio. Second, even after incorporating the cost of risk bearing, the joint tax efficiency theory ignores the incentive role of the options. Incorporating the latter also affects the reaction to an increase in the ordinary income tax rate. Preserving the after-tax incentives requires the company to give the executive more options after a tax increase. But the latter leads to an increased marginal cost of incentivization, which in general reduces optimal incentive provision and hence *after-tax* incentives, but the effect on pre-tax incentives is ambiguous (Section 2).

The objective of this article is to shed more light on how companies redesign their compensation packages in response to a variation in the ordinary income tax rate with a special emphasis on the the effect on pay-to-stock-price sensitivity generated by stock option and restricted stock grants. In order to do so, the paper presents empirical evidence on the impact of the ordinary income marginal tax rate increase legislated by the Omnibus Budget Reconciliation Act (OBRA) of 1993 as well as changes in state income tax rates around the same period on the *pre-tax* pay-to-stock-price sensitivity of stock options and restricted stock grants received by executives.[2] The approach offers two important extensions on

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the principal. Desai and Dharmapala (2006) analyze the link between executive incentives and corporate tax sheltering and find that the two are negatively related. Desai et al. (2007) explore the links between corporate governance and corporate tax collection, arguing that there are positive spillovers from improving either of them on the other one.

[2] The reason why I focus on *pre-tax* rather than seemingly more relevant *after-tax* sensitivity is due to the fact that it is not entirely clear what the effective marginal tax rate on restricted stock grant capital gains is due to the 83(b) election discussed in Section 2.

the earlier work of Hall and Liebman (2000). First, apart from stock options, it accounts for restricted stock grants as means of providing incentives. The importance of this extension is in the fact that restricted stock grants are in many respects similar to stock options in providing incentives but the resulting capital gains may be taxed at a (lower) capital gains rate. Second, it features additional and arguably superior dependent variables that directly measure the strength of incentives built into the compensation package. Hall and Liebman use as their dependent variable the share of annual compensation, defined as salary, bonus, and the Black–Scholes value of stock-option grants, that is paid in options. However, a change in the ordinary income tax rate affects after-tax payoffs of both cash compensation and options, so the measure may underestimate the impact on option compensation to the extent that both forms of pay may be substituted for restricted stock or nontaxable compensation such as perquisites after a tax increase. I therefore focus on pay-to-stock-price sensitivity of stock option and restricted stock grants, since these variables directly capture the strength of pay-to-stock-price sensitivity built into the compensation package. For continuity with the work of Hall and Liebman, however, I also examine their dependent variable.

The analysis reveals that an increase in the ordinary income marginal tax rate leads to a statistically significant decrease in the *pre-tax* pay-to-stock-price sensitivity generated by option grants, without any significant impact on the pre-tax pay-to-stock-price sensitivity generated by restricted stock grants. The sign of the result on option sensitivity is preserved even after time-series variation in the tax rate is eliminated, even though the results are no longer statistically significant. These findings are also corroborated using the Hall and Liebman measure of incentives as the dependent variable. The results on option sensitivity show that not only do the companies not increase the pre-tax sensitivity of option grants to preserve their after-tax sensitivity, they in fact reduce it. Because the prediction of the agency theory for the pre-tax sensitivity is ambiguous even without the tax benefit of options over cash pay, this result is not incompatible with agency theory. However, it suggests that provision of after-tax incentives is not only very sensitive to their taxation, but it is even more sensitive that it would be if the option grants were unresponsive to tax changes. The results on the Hall and Liebman measure and on the sensitivity of restricted stock grants suggest though that a significant portion of drop

In both cases, I estimate the elasticity of pre-tax stock-price sensitivity with respect to the net-of-the-ordinary-tax share. The elasticity of the after-tax sensitivity with respect to the net-of-the-ordinary-tax share can then be computed as the latter estimate plus one.

in the pre-tax sensitivity of option grants may be due to a decrease in the tax advantage of options over cash pay or a substitution of options grants by restricted stock grants.

The article proceeds as follows. Section 2 outlines the US federal tax rules that apply to various instruments of executive compensation and also discusses relative tax advantages and disadvantages of various compensation forms. Section 3 describes the identification strategy and data used in the analysis. Section 4 presents the empirical results, which are then interpreted in Section 5. Section 6 concludes.

2 Executive compensation tax considerations

2.1 Tax treatment of executive compensation in the USA

Executive compensation contracts usually consist of the following parts: salary, bonus, restricted stock grants, stock-option grants, and other compensations such as perquisites, signing bonuses, and severance payments ('golden parachutes').[3] Details of tax treatment of these individual pay instruments are summarized in Table 1. On the executive side, any cash compensation (salary, bonuses, severance payments, etc.) and dividend earnings from ownership of restricted or unrestricted stocks are taxable at the ordinary income tax rate at the time of payout. Stock-option grants may be of two types: NQSOs and incentive stock options (ISOs). NQSOs are taxed at the ordinary rate when exercised and the tax base is the

Table 1 US federal taxation rules

Compensation item	Tax rate	When taxable?
Salary	Ordinary	Payout
Bonus	Ordinary	Payout
Dividends	Ordinary	Payout
NQSO gains	Ordinary	Exercise
ISO and acquired stock gains	Capital gains	Sale of the stocks
Restricted stocks, no 83(b) election	Ordinary	Restrictions lapse
Restricted stock grant value, with 83(b) election	Ordinary	Grant date
Restricted stock gains, with 83(b) election	Capital gains	Sale of the stocks
Unrestricted stock gains	Capital gains	Sale of the stocks

[3] Instead of restricted stock grants, companies sometimes award restricted stock units, or 'phantom shares', which mimic the pay-off of restricted stock grants. Similarly, instead of stock-option grants, companies sometimes award stock appreciation rights, or 'phantom stock options', which mimic the pay-off of stock-option grants.

difference between the stock price and the exercise price on the day of the exercise.[4] ISOs are taxed neither at the grant date nor at the time when they are exercised. Subject to satisfying a holding period restriction, all option profits and subsequent capital gains on the acquired stocks are taxed at the capital gains rate when these stocks are eventually sold. However, ISOs are subject to an annual cap of $100 000 on the amount that vests,[5] and as a result they account for a relatively small portion of executive compensation (Hall and Liebman 2000). I am therefore going to assume that all options granted to executives are NQSOs. In the default case, the market value of restricted stock grants is taxed at the ordinary rate when the restrictions lapse.[6] Any subsequent capital gains or losses of (then unrestricted) stocks are taxed at the capital gains rate. However, Section 83(b) of the Internal Revenue Code allows executives to elect to tax the grant value of a restricted stock grant at the ordinary rate at the time of the grant, and tax any subsequent gains as long-term capital gains when the stock is eventually sold. There are also nontaxable forms of compensation such as perquisites and other personal benefits or life insurance premiums, or forms with deferred taxation such as 401k contributions. On the employer side, the company gets a deduction on its corporate income whenever the executive declares the corresponding compensation item as ordinary income.

There are also two additional considerations affecting taxation of executive compensation. First, until 1993 there was an indexed upper income limit for the Medicare tax, with the limit amount being $135 000 in 1993. However, this limit was repealed starting in 1994. Given that almost all executives in publicly traded companies presumably had an income in excess of this limit in 1993, any compensation subject to the ordinary income tax at the same time also became subject to a 2.9% Medicare marginal tax, remitted to the government in equal parts by executives and their employers. On the other hand, the upper income limit for the Social Security tax not exceeding $100 000 remained in place, implying no additional tax on the margin. Note that, unlike in the case of the Social Security tax, higher Medicare tax payments do not correspond to higher benefits, so the Medicare tax is a true marginal tax. Second, executive compensation is also subject to state income taxes. Most states do not have separate capital gains tax, but instead tax capital gains as ordinary income.

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[4] Stock appreciation rights are taxed in a similar fashion.

[5] The $100 000 limit applies to the fair market value of the stocks that can be acquired for these options at the time of the grant. All ISOs above this limit are treated as NQSOs.

[6] Restricted stock units are also taxed at the ordinary rate at the time of payout.

2.2 Joint tax efficiency comparisons

Now consider pure joint tax optimization of an executive and his employer. Assume that at time $t=0$, the company stock price is P_0 and any restrictions on stock options and restricted stocks granted at $t=0$ lapse at $t=1$ when the stock price is P_1. Also assume that $P_1 > P_0$, the stock does not pay any dividends and the tax rates are stable over time. Let τ_P, τ_G, and τ_C be the ordinary income, capital gains, and corporate income marginal tax rates, respectively. Now consider the following four pay packages: (i) a wage of P_0 at time $t=0$; (ii) an option for one share at $t=0$ at the strike price P_0 together with a wage of P_0 at time $t=1$; (iii) one restricted share at $t=0$ for which the executive does not make the 83(b) election; and (iv) a wage of $\tau_P P_0$ and $1-\tau_P$ restricted shares at $t=0$ for which the executive does make the 83(b) election. It is relatively straightforward to demonstrate that the company is indifferent among all four packages. For the first and the fourth package, the cash flow of the company is $-(1-\tau_c)P_0$ at time $t=0$ and 0 at time $t=1$. For the second and the third package, the cash flow of the company is 0 at $t=0$ and $-(1-\tau_c)P_1$ at $t=1$. However, since the company can always trade in its own equity tax-free,[7] the two cash flows are equivalent from the view point of the company.[8]

However, the executive is not indifferent among the four packages. Assuming that all holdings are liquidated at vesting, with the second and the third package, the executive receives 0 at $t=0$ and $(1-\tau_p)P_1$ at $t=1$. With the fourth package, at $t=0$ the executive receives a wage of $\tau_P P_0$, but has to pay an income tax of $\tau_P^2 P_0$ on this wage and $\tau_P(1-\tau_p)P_0$ on the share holdings, giving him a net cash flow of 0. Then at $t=1$ he receives a cash flow of $(1-\tau_P)P_1 - \tau_G(1-\tau_P)(P_1-P_0)$. With the first package, the executive receives $(1-\tau_P)P_0$ at $t=0$ and 0 at $t=1$. However, taking away portfolio diversification incentives by assuming that the company stock price is perfectly correlated with the market index,[9] the executive could get $(1-\tau_P)P_1 - \tau_G(1-\tau_P)(P_1-P_0)$ at $t=1$ by investing this payout at $t=0$ into his company's stock. This reasoning shows that the second and the third package are equivalent for the executive and they dominate the first and the fourth package, which are equivalent, by the amount $\tau_G(1-\tau_P)(P_1-P_0)$ which is the capital gains tax that

[7] Section 1032 of the Internal Revenue Code.

[8] The indifference from the company standpoint among the first three packages has been demonstrated by Hall and Liebman (2000). The indifference between the third and the fourth package has been demonstrated by Knoll (2006).

[9] Recall that this reasoning is concerned purely with tax treatment of various compensation packages, assuming away risk aversion, portfolio diversification, and incentive effects.

the executive has to pay on his share value appreciation at $t = 1$.[10] As a result, from the joint tax perspective of the executive and his employer, stock options and restricted stocks without the 83(b) election dominate cash compensation or restricted stocks with the 83(b) election, and the tax advantage is increasing in the capital gains tax rate and decreasing in the ordinary income tax rate.

Of course, there are also nontax considerations such as riskiness of compensation that explain why we observe cash compensation. It is harder to explain though why it might make sense to use restricted stocks and make the 83(b) election as opposed to not making it. Any desired incentive level and hence riskiness of compensation can be provided by either, but the latter is always more tax efficient. Since the comparisons presented above assumed that the company is not liquidity constrained, one potential explanation might be a lack of internal funds in the company. In such circumstances, the 83(b) election provides an earlier cash flow from the tax deduction, which may outweigh it's tax disadvantage. Unfortunately, there does not seem to be any systematic evidence on whether executives themselves actually do or do not make the election. The choice of making the election may, however, be explicitly restricted or encouraged by employers. Blouin and Carter (2007) find that among 284 firm-year pairs in their sample, 26 explicitly require the election, while 22 explicitly prohibit it. It therefore remains an open question what fraction of executives do in fact make this election.

Given that there are potential nontax advantages of cash compensation and restricted stocks with the 83(b) election, the joint tax efficiency implies that the use of the latter relative to stock options and restricted stocks without the 83(b) election should be increasing with decreases in the capital gains tax rate and increases in the ordinary income tax rate. But since a part of the restricted stocks are likely to be used with the 83(b) election, the overall impact of an ordinary income tax increase on the use of restricted stock grants is ambiguous.

3 Empirical strategy and data

As outlined in Section 2.1, there are two federal taxes that affect executive compensation at the personal level on the margin: the ordinary income plus Medicare tax, and the capital gains tax; in addition, there are state income taxes. Given that all cash pay and NQSO gains are taxed as

[10] The dominance from executive standpoint of the second and the third package over the first one has been demonstrated by Hall and Liebman (2000). The dominance of the third package over the fourth one has been demonstrated by McDonald (2003).

ordinary income, and the same is true of restricted stock grants in the absence of the 83(b) election, this article focuses on the impact on executive compensation of the ordinary income tax, both federal and state, and the Medicare tax, leaving the impact of the capital gains tax for future research.

In order to empirically identify the impact of federal and state ordinary income and Medicare tax rates on the design of executive compensation, this article uses three sources of variation in the combined effective tax rate over the period 1992–1996. The first two sources of variation come from the OBRA of 1993. In 1993, OBRA enacted an increase in the federal ordinary income marginal tax rate for married couples filing a joint return from 31% to 36% for income between $140 000 and $250 000, and from 31% to 39.6% for income in excess of $250 000. In addition, it also abolished the upper income limit ($135 000 in 1993) for the Medicare payroll tax starting from 1994. This resulted in an increase in the effective marginal tax rate of 2.9 percentage points for any income in excess of this limit. As a result, the first source of variation is the time series variation in the top marginal tax rate from 31% in 1992 to 39.6% in 1993 to 42.5% in 1994 and later. The second source of variation is the difference-in-differences variation in the tax rates between the top bracket (above $250 000) and the second bracket (between $140 000 and $250 000). The third source of variation comes from the concurrent variation in the combined federal and state marginal tax rate created by cross-sectional variation as well as time series changes in state income tax rates.

It is also important to mention that during the period 1992–1996, the top statutory federal capital gains tax rate remained constant at 28%, implying that any observed change in the pay-to-performance sensitivity within the timespan of the sample is not driven by the changes in the capital gains tax rate. Table 2 summarizes the details of the US federal personal income tax system over the period 1992–1996.[11]

Another part of OBRA, Section 162(m) of the Internal Revenue Code, or the so-called 'million dollar rule', specified that companies could deduct from their corporate income tax base only up to 1 million dollars per executive for nonperformance-based compensation of the chief executive officer (CEO) and other four most highly compensated executives.

Data on executive compensation come from the Execucomp database provided by Standard and Poor as a part of its Compustat database. These data are collected from proxy statements and 10K forms of publicly traded companies based on US securities regulations. The dataset used in this

[11] The measure of a combined federal and state marginal tax rate (not shown in the table) is generated using the NBER's Taxsim calculator (Feenberg and Coutts 1993).

Table 2 Summary of the US Personal Income Tax System, 1992–1996

	Ordinary income + Medicare tax				Cap. gains tax
Year	Top rate (%)	Top bracket	Second rate (%)	Second bracket	Top rate (%)
1992	31	$86 500			28
1993	39.6	$250 000	36	$140 000	28
1994	42.5	$250 000	38.9	$140 000	28
1995	42.5	$256 500	38.9	$143 600	28
1996	42.5	$263 750	38.9	$147 700	28

Notes: (i) The ordinary income tax rates and brackets are for married taxpayers filing jointly. (ii) In 1992, all earned income under $130 200 was subject to the additional Medicare tax of 2.9%. (iii) The ordinary income tax rate increase of 1993 is due to the OBRA. (iv) The ordinary income tax rate increase of 1994 is due to the removal of the tax base ceiling of $130 200 in 1993 and $135 000 in 1994 for the Medicare tax of 2.9%. (v) Data sources: The Office of Tax Policy Research (2003) and Urban-Brookings Tax Policy Center (2003) (for ordinary income tax rates, payroll tax rates, and brackets), Department of Treasury (2002) (for capital gains tax rates).

article covers companies in the Standard and Poor's S&P 500, S&P Mid Cap 400, and S&P Small Cap 600 for the years 1992–1996. The Execucomp dataset provides a rich source of information on executive compensation. It provides information about executive salaries, bonuses, restricted stock grants, stock-option grants and exercises, long-term incentive payouts, other compensation, and total holdings of company's shares and stock options at the end of a fiscal year. This information is provided for CEOs and four other most highly paid executives of each company. The executive-level information is complemented by a variety of company financial and demographic data.

The Execucomp dataset has been used by many researchers of executive compensation. In tax studies, it has previously been used by, among others, Goolsbee (2000a, 2000b), Hall and Liebman (2000), Perry and Zenner (2001), and Rose and Wolfram (2002). Because this dataset contains information on both relatively smaller companies and non-CEO executives, it contains executives with company-related incomes below the top tax bracket. It therefore allows, among other sources of variation, identification of the tax effect from unequal time variation in the two top tax rates (as opposed to the top rate only), i.e. the difference-in-differences methodology. Goolsbee (2000a, 2000b) uses an analogous design to identify the effect of the 1993 and 1994 increases in the top ordinary income tax rate on the elasticity of taxable income and timing of stock-option exercises.

The raw dataset, after eliminating observations with missing identifiers, contains 51 360 executive-year observations. I make several adjustments to the raw data. First, I exclude observations for which there is missing or inconsistent information on cash- and stock-based compensation items, observations with missing information on the ownership of stocks accumulated in the past, observations where stock and option ownership are not reported separately, and observations on executives who simultaneously work for more than one company. This reduces the sample to 27 603 observations. I further exclude companies whose fiscal year does not coincide with the calendar year. This reduces the sample to 19 293 observations. The purpose of this reduction is to be able to match the compensation report based on the fiscal year to the tax treatment based on the calendar year.[12] Finally, because the identification is based on the difference of the compensation design in 1992 and the subsequent period, I exclude executives for whom there is no observation in 1992 and at least one of the years 1993–1996. The final sample used in the analysis contains 14 229 executive-years. Of these, 3124 describe CEOs and 11 105 non-CEO executives. The final sample contains information on 3501 executives in 899 companies.

Apart from the Execucomp dataset, I use several other sources of data. To evaluate pay-to-performance sensitivity generated by option grants, I use data on Treasury bill and bond yields from the Department of Treasury (2003). Information on book value of companies comes from Compustat. To adjust various quantities into constant 1993 dollars, I use the consumer price index from the Bureau of Labor Statistics (2002). Finally, to control for the strength of corporate governance, I use the Gompers et al. (2003) corporate governance index available from the Investor Responsibility Research Center. This index is a sum of 24 indicator variables, with each indicator being equal to 1 when some shareholder right is limited by various company policies and charter provisions.[13]

In order to utilize the variation in the tax rate due to differential increases in the marginal tax rates in different tax brackets legislated by OBRA, the first step is to assign the executives in the sample to the individual tax brackets. This requires defining their taxable income. For each executive in each year, I compute her taxable income as the sum of salary,

[12] Although the loss of 8310 observations appears to be a high price to pay, very few of the lost executives have the relevant data available for 1992, and so they could not be used in the analysis in any case. This is because the Execucomp coverage is based on enhanced Securities and Exchange Commission reporting requirements for fiscal years ending after 15 December 1992. As a result, very few companies whose fiscal year does not coincide with the tax year have any data available for 1992.

[13] Therefore a higher value of the index represents *weaker* corporate governance.

bonus, long-term incentive payments, stock-option exercises, and dividend income. This measure of income may, however, be itself endogenous to current and anticipated tax rates, as, for example, documented in Goolsbee (2000a) for the timing of stock-option exercises. In order to avoid this year-to-year endogeneity, I convert these annual taxable incomes into 1993 inflation-adjusted dollars, and then average them across all the available observations for each executive so as to arrive at a measure of 'permanent income'. Executives with permanent income over $250 000 are then categorized as being in the top tax bracket, while the other executives are categorized as being in the second tax bracket.[14,15] Of the total number of 3501 executives, 3087 (88.17% of the sample) are in the top tax bracket and 414 (11.83%) are in the second tax bracket.[16]

This income measure may to some extent undermeasure the true permanent income since it does not include spousal and noncompany-related sources of income, for which no measures are available. However, this unobserved income is also offset by various deductions and exemptions that an executive may claim on her tax return. In addition, from the perspective of agency theory, it is not just the marginal tax rate on the last dollar of earnings that matters, but rather the marginal tax rate that applies within the range of income generated by stock and option grants.

The second step is to define dependent variables. As pointed out in the introduction, the focus of this article is on the impact of personal income taxation on pay-to-stock price sensitivity of annual grants of stock options and restricted stocks. In particular, these sensitivities are defined by the change in the value of these grants generated by a 1% increase in the stock price; this is the measure used by Core and Guay (1999, 2002). Other measures often used by researchers include an increase in annual

[14] There are also some executives in the sample whose permanent income falls below the threshold of $140 000. However, they only constitute 1.34% of the total number of executives, and many of them do not receive any stock option or restricted stock grants. For these reasons, they are not treated as a separate tax bracket group.

[15] To the extent that executives with taxable income 'close' to $250 000 are the ones most likely to be misclassified with respect to the two tax brackets, I re-estimated all the specifications reported in Section 4 when executives with permanent taxable income between $225 000 and $275 000 are dropped from the sample. The estimates of the net-of-tax-rate elasticities were numerically similar to the reported results, and none of the principal conclusions of the analysis was affected.

[16] An alternative way to classify executives into tax brackets would be to use year-by-year income instead of the averaged 'permanent income'. There are two problematic issues with this approach, however. First, given the year-by-year variability in income, the bracket classification is changing from one year to another for some executives. Second, because taxable income depends on option exercises, which are sensitive to tax rates (Goolsbee 2000a, 2000b), the year-to-year tax bracket classification is endogenous to year-to-year tax changes. The 'permanent income' approach overcomes the first problem and mitigates the second one.

compensation or total executive wealth generated by a $1000 increase in market value of the company (Jensen and Murphy 1990; Aggarwal and Samwick 1999). However, as pointed out by Hall and Liebman (1998), an executive in a large corporation may have a much smaller sensitivity of compensation (or wealth) to a $1000 increase in company value than an executive in a small corporation, and yet a typical variation in the company stock price generates much higher wealth swings for the first executive compared with the second one. In this respect, measuring the pay-to-performance sensitivity relative to company size is arguably a more meaningful measure. In addition, pay-to-performance sensitivity measures of the Jensen–Murphy type are often measured as regression slope coefficients, and hence they are ex-post measures of incentives. On the contrary, the pay-to-performance sensitivity generated by annual option and stock grants (or entire portfolios of options and stocks) are ex ante measures of incentives, hence more explicitly capturing the motivational impact on executives. Although the latter measures do not take into account implicit incentives from salary and bonus increases following a good performance, Hall and Liebman (1998), using a panel data on CEOs from 1980 to 1994, find that 'changes in CEO wealth due to stock and stock option revaluations are more than 50 times larger than wealth increases due to salary and bonus changes'.

When relying on ex ante measures though, measuring the pay-to-performance sensitivity with respect to the entire current portfolio of stocks and options as opposed to the annual grants only is arguably a superior measure of executive incentives. However, in any given year, the company board has discretion only over the annual grant. In addition, the sensitivity of the entire portfolio may be affected by endogenous responses of executives who hedge the undiversified position in their company by executing some previously owned options and selling the obtained shares as well as other previously owned shares (Ofek and Yermack 2000), or engaging in more sophisticated hedging transactions such as zero-cost collars and equity swaps (Bettis et al. 2001). Given that this article focuses on the behavioral response of corporations, I am going to focus on the sensitivity generated by annual grants only. But to the extent that these grants may depend on the pre-existing amount of incentives originating from previous years' grants (Core and Guay 1999), I control for the lagged portfolio pay-to-stock-price sensitivity in the empirical specifications.

Measuring the stock-price sensitivity of stock and option grants requires valuing these securities. As pointed out by Hall and Murphy (2000, 2002), the market value (the value paid by a diversified investor) of stock and option grants may overestimate the value of these securities to an executive since she usually holds a large undiversified position, and her securities are nonvested and hence nontradable for some time. However, as an

approximation, I use the usual market price of these securities to value them. Computing an increase in executive's wealth originating from a restricted stock grant due to a 1% increase in the stock price is straightforward. It is simply equal to one-hundredth of the market value of the grant. For options, I use the change in the Black–Scholes value of the stock-option grant reflecting a 1% increase in the stock price. In particular, for any individual option grant, this measure is calculated as

$$\frac{\partial \text{ option value}}{\partial P}\frac{P}{100} = e^{-dT}\, N(Z)\frac{P}{100},$$

where

$$Z = [\ln(P/X) + T(r - d + \sigma^2/2]/\left(\sigma\sqrt{T}\right).$$

In this formulation, P is the stock price, $N(\cdot)$ is the cumulative distribution function of the standard normal distribution, X is the option strike price, σ is the annualized standard deviation of stock returns (excluding dividends), T is the option expiration term in years, r is the natural logarithm of one plus the risk-free interest rate matching the option expiration term (defined as the yield of a Treasury bill or bond of a similar maturity[17]), and d is the natural logarithm of one plus the stock's dividend yield [see Core and Guay (2002) for details]. Both the stock and the option sensitivity measure are then adjusted for inflation into constant 1993 dollars.

For continuity with the previous literature, I also examine the dependent variable used by Hall and Liebman (2000), defined as the ratio of the Black–Scholes value of the stock-option grant to the sum of salary, bonus, and the Black–Scholes value of the stock-option grant. I will subsequently refer to this measure as 'the share of compensation paid in options'.

Table 3 summarizes the dependent variables over the sample period 1992–1996. Not surprisingly, compared with the executives from the top tax bracket, the executives from the second tax bracket receive smaller option and restricted stock grants, and they have a lower share of their compensation paid in options. In addition, fewer of them receive any option or stock grants at all. The table also reveals that option grants are both more frequent and more sizeable in terms of creating pay-to-stock-price sensitivity than restricted stock grants are. When focusing on growth of means of these measures over time, conditional on the measure being positive, executives in the top tax bracket experience a higher

[17] Details of the calculation are available from the author upon request.

Table 3 Summary statistics of compensation variables

		Year				
Variable	Sample	1992	1993	1994	1995	1996
Observations	All	3501	3329	2967	2430	2002
Observations	Top bracket	3087	2970	2628	2176	1806
Observations	Second bracket	414	359	339	254	196
Option grant sensitivity						
Median	All	$1523	$2081	$2135	$2763	$3740
Median	Positive grant	$3800	$4488	$4764	$6644	$7676
Mean	Positive grant	$9866	$10 774	$11 625	$18 638	$22 347
Positive grant	All (%)	64.8	68.6	68.1	67.9	71.1
Median	Top Bracket	$1974	$2547	$2691	$3527	$4459
Median	Top bracket, positive grant	$4305	$4886	$5351	$7396	$8527
Mean	Top bracket, positive grant	$10 616	$11 401	$12 562	$19 989	$23 833
Positive grant	Top bracket (%)	67.1	70.4	70.1	70	73
Median	Second bracket	$0	$428	$178	$66	$287
Median	Second bracket, positive grant	$1010	$1213	$1008	$1304	$1293
Mean	Second bracket, positive grant	$2014	$4020	$1867	$2431	$3691
Positive grant	Second bracket (%)	47.8	54	52.2	50	53.6
Stock grant sensitivity						
Median	All	$0	$0	$0	$0	$0
Median	Positive grant	$1423	$1568	$1591	$1636	$2375
Mean	Positive grant	$3666	$3939	$3782	$3825	$6480
Positive grant	All (%)	18.4	19.7	19.6	19.9	21.8
Median	Top bracket	$0	$0	$0	$0	$0
Median	Top bracket, positive grant	$1589	$1749	$1813	$1898	$2758
Mean	Top bracket, positive grant	$3862	$4139	$4005	$4133	$6898
Positive grant	Top bracket (%)	19.6	20.9	20.8	20.4	22.6
Median	Second bracket	$0	$0	$0	$0	$0
Median	Second bracket, positive grant	$168	$198	$238	$224	$282
Mean	Second bracket, positive grant	$448	$388	$396	$402	$398
Positive grant	Second bracket (%)	8.9	9.7	10.6	15.7	14.3
Share of compensation paid in options						
Median	All	0.160	0.188	0.233	0.205	0.246
Median	Positive grant	0.279	0.289	0.340	0.315	0.351
Mean	Positive grant	0.323	0.332	0.369	0.350	0.384
Positive share	All (%)	65	68.7	68.1	68.1	71.1
Median	Top bracket	0.172	0.196	0.250	0.219	0.266
Median	Top bracket, positive grant	0.282	0.290	0.345	0.317	0.359
Mean	Top bracket, positive grant	0.324	0.331	0.374	0.353	0.388
Positive share	Top bracket (%)	67.2	70.5	70.2	70.1	73
Median	Second bracket	0	0.075	0.068	0.027	0.066
Median	Second bracket, positive grant	0.246	0.288	0.254	0.281	0.232
Mean	Second bracket, positive grant	0.310	0.340	0.319	0.308	0.327
Positive share	Second bracket (%)	49	54	52.2	50.4	53.6

proportional growth compared with their colleagues in the second tax bracket. Therefore, using the difference-in-differences logic, the first reading of the data would suggest that a higher marginal tax rate increases the growth rate of pay sensitivity generated by stock and option grants, as well as the share of compensation paid in options.

However, there may be other factors that are changing over the timespan of the sample that may account for the observed patterns in the data. In particular, the effect of the 'million-dollar rule' that became effective in 1994 might have been to reallocate compensation from salary to stocks and options. In order to allow for this possibility, the multivariate analysis presented in the next section controls for a variable called MILLION defined as a minimum of unity and the ratio of the previous year's salary to $1 million for observations in years 1994–1996, and as zero otherwise.[18] That is, MILLION proxies for the likelihood of the million dollar rule being a binding consideration in the design of the compensation contract over the period 1994–1996.[19]

The set of control variables also includes the (natural) logarithm of the company's market value, the logarithm of the market-to-book ratio, the logarithm of the stock price volatility, an indicator variable for CEOs, the index of the strength of corporate governance, the logarithm of one plus the market rate of return on the stock and the lag of this variable, and the logarithm of one plus the rate of return on assets. These variables are commonly used as controls in executive compensation regressions.[20] The company market value proxies for the firm size and a stylized fact in the executive compensation literature is that larger firms pay more in virtually any pay component (Murphy 1999). The market-to-book ratio proxies for firm growth opportunities as firms with higher growth opportunities are expected to provide more incentives to their managers (Core and Guay 1999). Stock price volatility proxies for company idiosyncratic risk and monitoring costs.[21] The indicator variable for CEOs captures a conjecture that CEOs are incentivized more than other managers. The corporate governance index captures the possibility that pay-to-performance sensitivity varies systematically with the strength of

[18] For example, in 1994, for an executive with the 1993 salary of $600 000, MILLION is equal to 0.6, while for an executive with the 1993 salary of more than $1 million it is equal to unity.

[19] The construction of this variable is based on Hall and Liebman (2000) and Perry and Zenner (2001).

[20] See, for example, Core and Guay (1999), Goolsbee (2000a), Hall and Liebman (1998, 2000), or Rose and Wolfram (2002).

[21] Core and Guay (1999) argue that higher monitoring costs will lead to a higher provision of incentives. On the other hand, a standard result from agency theory is that a higher level of idiosyncratic risk is, due to managerial risk aversion, associated with lower incentive provision. Aggarwal and Samwick (1999) provide evidence on the latter effect.

corporate governance (Hartzell and Starks 2003). The remaining market and accounting rates of return proxy for firm performance, and they may capture the fact that some stock-based incentive grants are triggered by a threshold level of performance. All the specifications also include individual executive fixed effects and linear industry-specific time trends.[22]

As documented by Core and Guay (1999) and discussed above, another important set of variables that may influence the pay sensitivity generated by annual stock and option grants is the amount of wealth-to-stock-price sensitivity generated by executive's pre-existing holdings of stocks and options from previous years' grants. The measure of the stock-holding sensitivity to the stock price changes is straightforward and can be calculated analogously to the annual restricted stock grant. The calculation is more challenging in the case of options, since Execucomp does not provide a detailed information, such as strike prices and expiration terms, for the option portfolio originating from past grants. This problem is especially acute for the current empirical application, since it is not possible to go back several years before 1992 to build up the portfolio information. I therefore use the method of Core and Guay (2002) to estimate this sensitivity. A final step in the calculation consists of imputing these sensitivities for 1992 based on the logarithm of market value, the logarithm of market-to-book ratio, the CEO indicator, the logarithm of stock price volatility, and the logarithm of one plus the stock return, as there is no information on previous years' stock and option holdings for observations in 1992.

One notable feature of the annual stock and option grant sensitivities apparent from Table 3 is that they are equal to zero for many executive-years. In order to identify the impact of the tax change on these sensitivities, one possibility is to concentrate only on observations with positive amounts of the grant. However, to the extent that factors influencing the amount of these grants may also influence the decision to provide a grant, an endogenous selection into the sample of positive sensitivities may be an issue. I therefore use a simplified version of the method suggested by Wooldridge (1995) to adjust the estimation for the presence of selection. This method is a panel data extension of the Heckman's (1976) selection model. In the first step, a first-stage probit model using panel means of all explanatory variables as additional regressors is estimated and the inverse Mill's ratio is calculated. The second stage consists of estimating an ordinary least squares (OLS) regression of interest using only observations with positive sensitivities, but including the inverse Mill's ratio and panel means of all the explanatory variables as regressors. In this approach, individual

[22] I use seven industries defined by two-digit SIC codes in the range 10–14, 20–39, 40–49, 50–59, 60–67, 70–89, and other.

executive effects are modeled as correlated random effects (Wooldridge 1995). The variance matrix of the estimated coefficients is adjusted for the sampling variance of the first-stage estimator and for clustering at executive level. In order to avoid relying entirely on the functional form specification built into the first-stage probit, I include the fractions of executives in the particular industry that receive positive option and stock grants as additional explanatory variables in the first stage alongside the variables used in the second stage. These variables proxy for the industry-specific market pressure to incentivize company executives by stock options and restricted stock.

When the share of compensation paid in options is used as the dependent variable, all the specifications are estimated using OLS on the entire sample of available data with the standard errors adjusted for clustering at executive level. A drawback of this approach is that it does not take into account the limited dependent nature of the empirical model. However, the main purpose of this exercise is to provide a continuity with the work of Hall and Liebman (2000), and so the method used in this article is analogous to their estimating approach.

4 Results

Table 4 displays multivariate estimates for the pre-tax pay-to-stock-price sensitivity generated by option grants. Both the dependent and the net-of-tax-share variables are in natural logarithm, so the coefficient of the net-of-tax-share variable is interpreted as an elasticity.[23] Specification (i) utilizes both the time series and the difference-in-differences variation in the federal marginal (ordinary income plus Medicare) tax rate. The estimated net-of-tax-rate elasticity is about two-thirds and it is statistically significant at 1% level. In addition to the two sources of marginal tax rate variation used in specification (i), specification (ii) utilizes the variation in the combined federal and state marginal income tax rate due to cross-sectional and time series variation in state ordinary income tax rates as well. The estimated net-of-tax-share elasticity is 0.448, and it is statistically significant at 10% level. Specifications (iii) and (iv) are similar to specifications (i) and (ii), respectively, except that they omit the difference-in-differences variation in the marginal tax rate at the federal level. The estimates and statistical significance of the net-of-tax-share elasticity are quantitatively similar to the estimates in the previous two specifications.

The estimates of the net-of-tax-share elasticity in the first four columns rely, among other sources of variation, on time series variation in the

[23] Another important reason to use the logarithm transformation is to deal with a large variation in the dependent variable (Table 3) and the ensuing heteroscedasticity.

Table 4 Tax effects on option grant sensitivity

Dependent variable	ln(option grant sensitivity)						
Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Federal tax brackets	Top + second	Top + second	Top	Top	Top + second	Top + second	Top
Tax rate	Federal	Federal + state	Federal	Federal + state	Federal	Federal + state	Federal + state
ln(1 − tax rate)	0.640** (0.219)	0.448^{+} (0.263)	0.604** (0.223)	0.473^{+} (0.268)	1.739 (1.179)	1.370 (1.058)	0.390 (2.389)
ln(market-to-book)	0.178** (0.046)	0.183** (0.053)	0.190** (0.047)	0.217** (0.051)	0.180** (0.046)	0.185** (0.054)	0.224** (0.051)
ln(market value)	0.430** (0.048)	0.411** (0.061)	0.449** (0.053)	0.423** (0.066)	0.435** (0.048)	0.415** (0.062)	0.431** (0.066)
ln(stock price volatility)	−0.051 (0.046)	−0.103^{+} (0.056)	−0.073 (0.049)	−0.132* (0.059)	−0.060 (0.047)	−0.111^{+} (0.057)	−0.143* (0.060)
ln(stock return)	0.313** (0.049)	0.331** (0.061)	0.304** (0.052)	0.313** (0.065)	0.323** (0.050)	0.349** (0.062)	0.335** (0.066)
ln(lagged stock return)	0.020 (0.036)	0.022 (0.041)	0.015 (0.039)	0.009 (0.045)	0.021 (0.038)	0.019 (0.044)	−0.004 (0.048)
ln(return on assets)	0.498** (0.154)	0.074 (0.158)	0.458 (0.336)	−0.812^{+} (0.424)	0.475** (0.155)	0.057 (0.162)	−0.916* (0.434)
Corporate governance index	0.027 (0.027)	0.027 (0.033)	0.037 (0.027)	0.025 (0.034)	0.025 (0.027)	0.024 (0.033)	0.023 (0.034)
CEO	0.162** (0.048)	0.132* (0.058)	0.168** (0.050)	0.157** (0.060)	0.160** (0.048)	0.132* (0.059)	0.154* (0.060)
MILLION	0.392** (0.067)	0.430** (0.080)	0.407** (0.072)	0.438** (0.085)	0.328** (0.088)	0.372** (0.105)	0.351** (0.110)
ln(1 + lagged total option sensitivity)	−0.025* (0.011)	−0.025^{+} (0.013)	−0.027* (0.012)	−0.030* (0.014)	−0.025* (0.011)	−0.026* (0.013)	−0.031* (0.014)
ln(1 + lagged total stock sensitivity)	−0.000 (0.013)	0.016 (0.015)	0.005 (0.014)	0.025^{+} (0.015)	−0.001 (0.013)	0.017 (0.015)	0.025^{+} (0.015)
Linear industry time trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	No	No	No	No	Yes	Yes	Yes
Observations	8612	5792	7977	5405	8612	5792	5405
Executives	2679	1742	2440	1596	2679	1742	1596
R^2	0.549	0.548	0.526	0.521	0.557	0.551	0.524

Notes: (i) Significance at: **1% level, *5% level, $^{+}$10% level. (ii) R^2 corresponds to the second-stage OLS regression.

federal marginal tax rate. In order to examine the estimates when this identifying source of variation is eliminated, specifications (v), (vi), and (vii) are constructed to be similar to specifications (i), (ii), and (iv), respectively, except that they control for year indicator variables that allow for an arbitrary time trend in the option grant sensitivity over time. The estimates of the net-of-tax-share elasticity are still positive, but they are no longer statistically significant at conventional levels. One possible explanation for the large standard errors and hence statistical insignificance is that the difference-in-differences variation in the federal marginal tax rate as well as changes in state income tax rates are relatively small compared with the time series variation in the top federal income tax rate. The coefficient estimates on other variables are broadly consistent with predictions outlined in the previous section throughout all the specifications presented in Table 4.

The overall reading of the results suggests that a higher income tax rate leads to a *lower pre-tax* option grant sensitivity to stock price, but the estimates are statistically significant only when the time series variation in the top federal marginal income tax rate is utilized for identification.

Using the same methodology, Table 5 displays multivariate estimates for the pre-tax pay-to-stock-price sensitivity generated by restricted stock grants. The net-of-tax-rate elasticity estimate is positive in all specifications except for specification (v), but it is not statistically significant at conventional levels in any of the specifications. These results suggest that changes in the ordinary income and Medicare tax rates at the federal or state level do not have a significant impact on the pre-tax pay-to-stock-price sensitivity generated by restricted stock grants.

Table 6 displays multivariate estimates for the share of compensation paid in options. The qualitative conclusions mirror the findings for the option grant sensitivity in Table 4. In particular, the estimated net-of-tax-share semi-elasticity varies between 0.1 and 0.2, and it is statistically significant at 1% or 5% critical level when time series variation in the federal marginal tax rate is used in the identification, but it becomes statistically insignificant once the latter variation is eliminated. These results suggest that statistical insignificance found by Hall and Liebman (2000) when identifying out of time variation in the top federal marginal tax rate may be a consequence of a smaller number of executives in their sample. However, relying on variation in the marginal tax rate originating only from the difference-in-differences variation in the federal tax rate and/or the variation in state tax rates leads to conclusions similar to the findings of Hall and Liebman (2000).

To summarize, option grant sensitivity and the share of compensation paid in options respond positively to the net-of-tax-share increases when time variation of the federal marginal tax rate is used to identify the tax

Table 5 Tax effects on stock grant sensitivity

Dependent variable	ln(option grant sensitivity)						
Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Federal tax brackets	Top + second	Top + second	Top	Top	Top + second	Top + second	Top
Tax rate	Federal	Federal + state	Federal	Federal + state	Federal	Federal + state	Federal + state
ln(1 − tax rate)	0.028 (0.475)	0.234 (0.665)	0.231 (0.474)	0.234 (0.613)	−3.088 (2.653)	1.966 (2.334)	1.451 (5.750)
ln(market-to-book)	−0.148 (0.098)	−0.088 (0.139)	−0.102 (0.100)	−0.056 (0.137)	−0.127 (0.098)	−0.058 (0.133)	−0.009 (0.140)
ln(market value)	0.472** (0.139)	0.432* (0.187)	0.472** (0.148)	0.413* (0.190)	0.477** (0.139)	0.433* (0.181)	0.408* (0.189)
ln(stock price volatility)	−0.068 (0.107)	−0.123 (0.116)	−0.076 (0.119)	−0.176 (0.115)	−0.041 (0.100)	−0.123 (0.104)	−0.173 (0.113)
ln(stock return)	0.247^{+} (0.136)	0.401* (0.195)	0.194 (0.138)	0.405* (0.196)	0.220^{+} (0.129)	0.417* (0.172)	0.415* (0.179)
ln(lagged stock return)	0.206* (0.090)	−0.016 (0.115)	0.151^{+} (0.089)	−0.047 (0.121)	0.142 (0.089)	−0.077 (0.119)	−0.132 (0.129)
ln(return on assets)	0.395 (0.640)	5.297** (1.358)	0.669 (0.732)	5.451** (1.385)	0.478 (0.654)	5.396** (1.444)	5.685** (1.503)
Corporate governance index	−0.021 (0.034)	−0.032 (0.062)	−0.016 (0.033)	−0.028 (0.052)	−0.021 (0.034)	−0.028 (0.056)	−0.024 (0.052)
CEO	0.220* (0.087)	0.333** (0.103)	0.219* (0.088)	0.342** (0.101)	0.214* (0.085)	0.335** (0.100)	0.345** (0.100)
MILLION	0.090 (0.133)	−0.185 (0.153)	0.013 (0.133)	−0.192 (0.148)	0.308 (0.212)	−0.147 (0.258)	−0.130 (0.253)
ln(1 + lagged total option sensitivity)	−0.006 (0.020)	−0.051^{+} (0.029)	−0.010 (0.020)	−0.055* (0.028)	−0.009 (0.019)	−0.053* (0.027)	−0.058* (0.027)
ln(1 + lagged total stock sensitivity)	0.007 (0.032)	0.069 (0.045)	0.011 (0.032)	0.083^{+} (0.047)	0.015 (0.031)	0.078^{+} (0.044)	0.097* (0.049)
Linear industry time trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	No	No	No	No	Yes	Yes	Yes
Observations	2616	1683	2464	1604	2616	1683	1604
Executives	1091	681	1022	644	1091	681	644
R^2	0.406	0.434	0.364	0.379	0.427	0.437	0.385

Notes: (i) Significance at: **1% level, *5% level, $^{+}$10% level. (ii) R^2 corresponds to the second-stage OLS regression.

Table 6 Tax effects on the share of compensation paid in options

Dependent variable	ln(option grant sensitivity)						
Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Federal tax brackets	Top + second	Top + second	Top	Top	Top + second	Top + second	Top
Tax rate	Federal	Federal + state	Federal	Federal + state	Federal	Federal + state	Federal + state
ln(1 − tax rate)	0.107* (0.046)	0.185** (0.051)	0.107* (0.048)	0.191** (0.055)	−0.089 (0.208)	0.083 (0.129)	0.248 (0.477)
ln(market-to-book)	0.012 (0.011)	0.030* (0.013)	0.010 (0.011)	0.021 (0.013)	0.012 (0.011)	0.030* (0.013)	0.022^{+} (0.013)
ln(market value)	0.027* (0.012)	0.023 (0.016)	0.025^{+} (0.013)	0.018 (0.017)	0.028* (0.012)	0.025 (0.016)	0.020 (0.017)
ln(stock price volatility)	0.024* (0.010)	0.016 (0.012)	0.020^{+} (0.011)	0.016 (0.014)	0.022* (0.010)	0.014 (0.012)	0.013 (0.014)
ln(stock return)	−0.059** (0.011)	−0.077** (0.013)	−0.062** (0.012)	−0.076** (0.014)	−0.056** (0.011)	−0.072** (0.013)	−0.072** (0.014)
ln(lagged stock return)	−0.006 (0.008)	−0.013 (0.010)	−0.005 (0.009)	−0.010 (0.011)	−0.012 (0.008)	−0.023* (0.011)	−0.019 (0.012)
ln(return on assets)	0.110** (0.039)	0.139** (0.043)	0.138* (0.070)	0.195^{+} (0.102)	0.111** (0.040)	0.139** (0.042)	0.186^{+} (0.102)
Corporate governance index	0.007 (0.005)	0.009 (0.007)	0.008 (0.005)	0.008 (0.007)	0.007 (0.005)	0.009 (0.007)	0.007 (0.007)
CEO	0.033** (0.008)	0.028** (0.010)	0.033** (0.008)	0.027** (0.010)	0.032** (0.008)	0.028** (0.010)	0.027** (0.010)
MILLION	0.029* (0.013)	0.044** (0.015)	0.025^{+} (0.013)	0.036* (0.015)	0.034^{+} (0.018)	0.055* (0.021)	0.046* (0.022)
ln(1 + lagged total option sensitivity)	−0.009** (0.002)	−0.009** (0.003)	−0.009** (0.002)	−0.009** (0.003)	−0.009** (0.002)	−0.009** (0.003)	−0.009** (0.003)
ln(1 + lagged total stock sensitivity)	−0.001 (0.003)	−0.004 (0.003)	0.000 (0.003)	−0.002 (0.003)	−0.001 (0.003)	−0.004 (0.003)	−0.002 (0.003)
Linear Industry Time Trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Effects	No	No	No	No	Yes	Yes	Yes
Observations	12 524	8461	11 301	7659	12 524	8461	7659
Executives	3161	2087	2821	1864	3161	2087	1864
R^2	0.024	0.025	0.025	0.025	0.025	0.029	0.027

Notes: (i) Significance at: **1% level, *5% level, $^{+}$10% level. (ii) R^2 corresponds to the second-stage OLS regression.

effect, with the estimates retaining the sign but being statistically insignificant when only the difference-in-differences variation in the federal marginal tax rate and/or the state tax rate variation is used in the identification. On the other hand, stock grant sensitivity is found to be unresponsive to changes in the ordinary income and Medicare tax rates.

5 Discussion

The results for stock options presented in the previous section imply that not only companies do not increase the pre-tax pay-to-stock-price sensitivity of their option grants after an ordinary income tax increase so as to preserve after-tax incentives, they actually decrease it. Even in the absence of joint tax efficiency considerations, this result is *not* incompatible with agency theory.[24] However, the result shows that after-tax incentives are very sensitive to changes in the ordinary income tax rate. The joint tax efficiency discussed in Section 2.2 may explain at least some part of this result. Abstracting from incentives and risk-bearing, this consideration suggests an adjustment of compensation away from options and toward cash pay and restricted stocks with the 83(b) election after an ordinary income tax increase. Indeed, this explanation is supported by the results in Table 6 which show that the share of compensation paid in options is decreasing in the ordinary income tax rate. On the other hand, Table 5 shows no significant reaction in the stock-price sensitivity of restricted stock grants. As discussed in Section 2.2, however, this may be due to companies substituting into restricted stocks with the 83(b) election but away from restricted stocks without this election, making the overall impact ambiguous.

Even though joint tax considerations can explain the empirical results, the results still imply that after-tax stock-price sensitivity of executive compensation may be highly elastic in the ordinary income tax rate and hence have important implications for the strength of explicit performance incentives.

6 Conclusion

Personal income taxation affects incentives. Public finance economists have demonstrated this fact theoretically, and measured it empirically in a great variety of settings. However, most of this research deals with

[24] For example, in the linear exponential normal model, whether the impact on an increase in the tax rate on the *pre-tax* slope of the compensation schedule is positive, zero, or negative depends on whether the third derivative of the cost of effort function is positive, zero, or negative. Details are available from the author upon request.

situations where explicit incentive contracting is not present. The current article extends this fundamental line of research into the area of executive compensation by asking to what extent designers of executive compensation contracts adjust these contracts in response to variation in the marginal tax rate affecting the payout of these contracts at the personal level.

The article exploits variation in the US federal marginal (ordinary income plus Medicare) tax rate generated by the OBRA of 1993, as well as variation in the combined federal and state income tax rates during the period 1992–1996 to shed light on the impact of the marginal tax rate on the pay-to-stock-price sensitivity of executive compensation contracts generated by stock option and restricted stock grants. The results show that an increase in the ordinary income marginal tax rate decreases the *pre-tax* pay-to-stock-price sensitivity generated by option grants when time series variation in the federal marginal tax rate is utilized in the identification, with the estimates retaining the same sign but being statistically insignificant when only the difference-in-differences variation in the federal marginal tax rate and/or the state marginal tax rate variation is used in the identification. On the other hand, restricted stock grant sensitivity is found to be unresponsive to changes in the ordinary income and Medicare tax rates.

These results suggest that after-tax pay-to-stock-price sensitivity, particularly its part generated by option grants, responds negatively to an increase in the ordinary income marginal tax rate, and the response combines a mechanical impact together with a decrease in the pre-tax pay-to-stock-price sensitivity. A portion of this drop may be due to joint tax optimization of executives and their employers rather than due to an increased marginal cost of incentivization, though. In particular, the results for restricted stock grants and the share of compensation paid in options suggest that the drop in the pre-tax sensitivity of option grants may be due to a decrease in the tax advantage of options over cash pay or a substitution of options grants by restricted stock grants with the 83(b) election. Despite this partial explanation, however, the results suggest that after-tax incentive provision for executives is quite sensitive to variation in the ordinary income tax rate.

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