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Analyzing the Tax Benefits from Employee Stock Options

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ABSTRACT

Employees tend to exercise stock options when corporate taxable income is high, shifting corporate tax deductions to years with higher tax rates. If firms paid employees the same dollar value in wages instead of stock options, the average annual tax bill for large U.S. companies would increase by $12.6 million, or 9.8%. These direct tax benefits of options increase in the convexity of the tax function. In addition, profitable firms can realize indirect tax benefits because stock options increase debt capacity. Although tax minimization is probably not the main motive for option grants, firms with larger potential tax benefits grant more options.

THIS PAPER ANALYZES the corporate tax implications of using employee stock options versus fixed compensation. A firm's compensation structure matters from a tax perspective because stock options tend to shift tax deductions to more profitable years, where marginal corporate tax rates tend to be higher.[1] In contrast, compensating employees with contractually specified fixed wages provides a uniform tax deduction regardless of the firm's profitability. We focus on the effects of compensation choice on average tax savings and debt policy for S&P 500 and NASDAQ 100 firms in the period 2000–2005.

Understanding the tax implications of employee stock options has become essential following the tremendous growth in stock-based compensation over the past decade. In aggregate, companies in the U.S. granted around $11 billion in stock options to their employees in 1992 and $119 billion in 2000 (Hall and Murphy (2003)). Our estimates for the year 2005 indicate that nonexecutives hold 89% of all outstanding options and tax deductions from stock options average 14.9% of earnings before interest and taxes (EBITs) for S&P 500 firms and 77.9% for NASDAQ 100 firms.

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[1] Employee option exercises increase with recent stock returns (Huddart and Lang (1996), Heath, Huddart, and Lang (1999)), and stock returns are positively correlated with changes in profits (Easton and Harris (1991)).

It is puzzling that broad-based option plans are so popular given that risk averse employees should prefer fixed wages. In addition, stock options have been linked to undesirable managerial behavior, such as excessive risk taking when options are out-of-the money or risk aversion when options are in-the-money (Brisley (2006)), earnings management and misreporting (Burns and Kedia (2006)), and option backdating and repricing (Callaghan, Saly, and Subramaniam (2004), Heron and Lie (2007)). Stock options are often associated with asymmetric benchmarking in compensation (Garvey and Milbourn (2006)) and are blamed for the escalation in managerial compensation. Although stock options do have some benefits, it is not clear whether the benefits associated with option-based compensation outweigh the costs.[2] In this paper, we highlight a significant and previously overlooked tax benefit of option-based compensation relative to fixed wages.

To compare tax bills under alternative compensation schemes, we first use simulations to estimate the tax bills for S&P 500 and NASDAQ 100 firms after stock option tax deductions. Here we use the methodology of Graham, Lang, and Shackelford (2004) (henceforth GLS). We then reestimate the tax bills under the (counterfactual) assumption that companies would provide the same dollar value of compensation through fixed wages instead of stock options. Our results indicate that paying cash salaries would result in an additional $12.6 million of taxes per year for the average firm in our sample (approximately a 9.8% increase in the total tax bill), or more than $6.7 billion per year in aggregate for S&P 500 and NASDAQ 100 firms. Approximately 75% of the firms pay less taxes when they use stock options for compensation, holding the total pay level fixed. The tax savings from options relative to wages are larger for NASDAQ firms, with average annual tax savings of $13.5 million (or 27.9% of the tax bill).

The tax advantage associated with stock options occurs because the relation between income and taxes is convex, that is, the marginal corporate tax rate increases with income. If the tax function were linear, the expected tax bill would be independent of the compensation structure. Consistent with this intuition, we find that the tax advantage of stock options relative to wages is significantly larger for firms facing more convex tax schedules, such as firms with recent losses, more volatile taxable income, and low serial correlation of taxable income.[3] For example, firms in the top quartile of taxable income volatility save,

[2] Stock options can be used to attract, motivate, and retain employees (Core and Guay (2001), Ittner, Lambert, and Larcker (2003), Oyer and Schaefer (2005)) and help to minimize contract renegotiation costs (Oyer (2004), Rajgopal, Shevlin, and Zamora (2006)). Additionally, Bergman and Jenter (2007) suggest that stock option compensation may be beneficial when employees are optimistic and cannot buy options on the open market.

[3] Graham and Smith (1999) find that, on average, Compustat firms face a convex tax schedule (although 25% of firms have a concave tax schedule). They argue that corporate tax convexity primarily arises because of asymmetric tax treatment of profits and losses, and show that convexity is larger for firms with more volatile taxable income that exhibits negative serial correlation, and for firms with near-zero taxable income.

on average, \$26.0 million in taxes per year by using stock option compensation, compared to just \$7.9 million for firms in the bottom quartile.

While a convex corporate tax creates an incentive for a firm to use stock options, a convex individual tax creates a disadvantage to the individual. However, the convexity of the individual income tax is typically small. The main difference between individuals and corporations is that individuals almost always have positive annual income, avoiding convexity associated with asymmetric treatment of profits and losses. Further, many employees holding stock options are consistently in high tax brackets and/or can time the exercise of their options to avoid undesirable changes in their tax brackets.

Stock option tax benefits also depend on the correlation between earnings and the firm's stock price (or stock option deductions). While the average correlation between earnings and stock option deductions is 0.31 in our sample, there are times when it can be negative. For example, start-up firms during the Internet bubble were less likely to benefit from stock options because stock prices did not necessarily move together with their taxable incomes. We find that firms with negative correlations between earnings and stock option deductions would owe more in taxes if they used stock options rather than wages.[4]

In addition to the direct tax savings, stock options may create indirect tax benefits for profitable firms by increasing their debt capacity. To understand this effect, consider a stable profitable firm that maintains constant total compensation. By granting more stock options to employees the firm can reduce their fixed wages. In turn, paying smaller wages increases taxable income in less profitable states and allows the firm to use more debt. In short, the debt capacity increases because stock options shift compensation tax deductions to more profitable states and create more room for debt in less profitable states.

The corporate debt capacity effect suggests that for profitable firms debt and stock options are positively correlated. This may be surprising in light of the argument by DeAngelo and Masulis (1980), who suggest that nondebt tax shields, such as stock option deductions, reduce optimal leverage. However, our logic is not in conflict with that of DeAngelo and Masulis (1980) because we assume that stock options replace some wages. We find support for our predictions in the data. In particular, after controlling for total compensation expense, we find that leverage is positively related to outstanding stock options for highly profitable (top quartile) firms in our sample.

Although tax benefits are unlikely to be the main motive for stock option grants, we do find that companies with greater potential tax benefits grant more stock options. First, using several measures of tax convexity, we find that firms with convex tax schedules grant stock options more intensively. Second, option grants tend to be larger in firms that have a higher correlation between earnings and returns, as well as in firms that have a higher correlation between

[4] Bonuses linked to earnings can create even higher correlation between taxable income and deductions. Although bonuses are becoming an important part of compensation, they are still less common today than stock options perhaps because bonuses create an incentive to privilege the short-term profits (see Holmstrom and Tirole (1993)).

earnings and stock option deductions. The results are economically significant. For example, when the correlation between earnings and stock option deductions increases from the 25th to the 75th percentile, the value of option grants increases by approximately 18.5%.

Our work builds on several recent studies that investigate the tax implications of stock options. Hanlon and Shevlin (2002) find that employee stock options significantly reduce the tax actually owed but do not reduce the tax reported in financial statements. Kahle and Shastri (2005) study empirically the relation between stock option deductions and debt. GLS document that stock option deductions significantly reduce marginal tax rates (MTRs) and, all else equal, the firms with option-reduced MTRs have fewer tax incentives to use debt. They also show that omitting the compensation deductions could lead to an erroneous conclusion that a company's value may be further increased by levering up. GLS do not explore alternative compensation schemes, which is the main focus of our paper.[5] Also, ours is the only paper that examines how the convexity of the tax schedule affects corporate tax incentives to use stock options.

The paper is structured as follows. Section I presents the model and discusses the tax benefit of stock options relative to fixed wages. The data and our simulation procedure are described in Section II. Section III presents the empirical results. Finally, Section IV concludes.

I. Tax Implications of Employee Stock Options

We focus on the tax advantage to the firm of granting nonqualified employee stock options. Hall and Liebman (2000) estimate that nonqualified options account for approximately 95% of all employee stock options. For these options, there are no tax consequences at the time of the grant. At the time of exercise, employees are taxed at their individual income tax rates on the difference between the stock price and the exercise price, while the company can take an equivalent deduction from its taxable income. Much less common qualified (or incentive) stock options are subject to different taxation rules[6]; however, if options become "disqualified" due to the premature sale of stock, they are taxed in the same way as nonqualified options (except that the firm receives a tax deduction when shares are sold).

[5] The tax benefit of stock options that we describe in this paper is also unrelated to the tax deferral effect (Hall and Liebman (2000), Core and Guay (2001)). The tax deferral effect results from the timing of tax deductions, but not from shifting them across different profitability states. Options have an advantage if the value of postponing the individual tax liability exceeds the cost of deferring the corporate tax deduction. Hall and Liebman (2000) assume that employees reinvest at the post-corporate-tax, post-personal-tax rate, in which case stock options create a tax advantage of about 4%.

[6] Incentive (or qualified) stock options do not trigger taxation when the option is exercised. Instead, if an employee holds the firm's shares for 1 year after exercise, he pays long-term capital gains tax (or AMT) on the difference between the exercise and sale price when he finally sells the shares. The corporation does not receive any tax deduction in this case.

To study the effect of taxes on compensation and leverage, we develop a simple model that emphasizes tax minimization. The model is similar to the analysis in Karayan, Swenson, and Neff (2002), with the exception that we allow a convex (as opposed to linear) tax schedule and also model capital structure decisions.[7] Consider a firm that can pay to risk-neutral employees w in a flat wage or the same value in stock options. Assume for generality that stock option payments are made later and must be discounted at rate r. The stock price can be either S_H in the high-profit state, or S_L in the low-profit state, with probabilities p and $1-p$, respectively.

Provided that options are exercised only when the stock price is high, the firm should either pay a wage w or grant n stock options with a strike price K, such that the value of the compensation is the same

$$w = \frac{pn(S_H - K) + (1-p)0}{1+r}. \tag{1}$$

The expected MTR in the high-profit state is T_c, and in the low-profit state is τ_c. For example, the difference in tax rates may be due to positive taxable income in the high-profit state and negative taxable income in the low-profit state. If the compensation deductions do not make the firm switch tax brackets, then the expected tax savings from fixed wages are

$$TX_{\text{wages}} = pwT_c + (1-p)w\tau_c, \tag{2}$$

and the expected tax savings from stock options are

$$TX_{\text{options}} = \frac{pn(S_H - K)T_c + (1-p)0}{1+r} = wT_c. \tag{3}$$

The last equality makes use of the employee participation constraint (1). When tax is levied on the firm's income at a constant rate, that is, $\tau_c = T_c$, the expected tax savings are the same regardless of whether the firm pays with stock options or with wages. However, when the tax schedule is convex $T_c > \tau_c$ (see, for example, Smith and Stulz (1985)), option compensation results in a greater tax shield $TX_{\text{options}} > TX_{\text{wages}}$.[8]

The tax advantage of stock options at the corporate level comes in part at the expense of a larger tax bill for employees (see Appendix A for the formal argument). To the extent that individuals face convex tax schedules, the net tax advantage of options (corporate tax advantage net of the tax disadvantage

[7] Scholes and Wolfson (1992) provide a related example of corporate tax planning where the firm can optimize over the menu of bonus payment strategies contingent on the firm's profitability. We thank Steve Huddart for this reference.

[8] While our analysis uses physical probabilities to value tax deductions, it could also be argued that a dollar of cash (and hence tax deduction) is more valuable to shareholders in the low-profit state if default risk has a systematic component (Almeida and Phillipon (2007)). However, tax deductions are not equivalent to cash. For example, a firm that has negative taxable income will apply the tax deduction only when it becomes profitable again and therefore the deductions are valued less. In addition, in contrast to fixed wages, stock options do not require any cash outflows, therefore effectively leaving the firm with more cash on hand in distress states.

of individuals) is reduced. However, the convexity in individual income tax is typically small. The crucial difference is that individuals receive only positive compensation, while most of the convexity in corporate tax comes from the differential tax treatment of positive and negative income. In addition, it is likely that executives and senior employees holding stock options are in the top tax bracket even before exercising options. Finally, discretionary option exercise allows individuals to smooth out their own taxable income. For these reasons, we argue that in general the corporate tax advantage is larger than the personal tax disadvantage.

A. Optimal Compensation Structure

Having described the tax advantage of stock options over wages, we now find the optimal compensation contract for risk-averse employees. We assume that shareholders design the optimal contract to maximize equity value given fixed leverage and subject to the employee's participation constraint. Note that a risk-averse employee discounts option compensation at a higher rate than wages, thus, absent tax frictions, the shareholders should remunerate the employee with a fixed wage.

The employee has an increasing and concave utility function with constant absolute risk aversion, $U(W) = -\frac{1}{\gamma}e^{-\gamma W}$. Before signing her contract, she compares its value to an outside opportunity that guarantees her a fixed income of $\bar{W}$. We limit the contract space to combinations of fixed wages and stock options and assume that there are no incentives created by the stock-based compensation. The participation constraint of an employee, who receives a fixed wage w and n stock options with a strike price K, is

$$e^{-\rho\bar{W}} = pe^{-\rho w - \rho n(S_H - K)} + (1-p)e^{-\rho w}, \tag{4}$$

where $\rho = (1 - T_i)\gamma$ is a tax-adjusted risk aversion parameter, and T_i is the tax rate on the individual's income. For simplicity, we assume that the individual income tax is flat and set the discount rate to zero.

The firm's cash flow is higher in the high-profit state than in the low-profit state, $CF_H > CF_L$, and is partially shielded from corporate tax by outstanding debt with a tax-deductible coupon $C \leq CF_L$. It follows that wages should optimally be set to shield all taxable income at least in the low-profit state, that is,

$$w^* \geq CF_L - C. \tag{5}$$

Otherwise, paying higher wages would be optimal because it would create tax deductions at the maximum tax rate T_c and minimize the risk premium.[9] Note that because of (5) an additional dollar of wage provides tax deductions at the rate τ_c in the low-profit state and at the rate T_c in the high-profit state, while

[9] A special case with a different solution ($w^* = \bar{W}$) arises if $C < CF_L - \bar{W}$. However, this case does not survive when leverage is chosen optimally.

an additional dollar of stock options always provides a tax deduction at the rate T_c. The optimization function of shareholders (dropping constant terms) is

$$\max_{n,w} \underbrace{pn(S_H - K)T_c + pwT_c + (1-p)w\tau_c}_{\text{Tax benefits}} - \underbrace{w - pn(S_H - K)}_{\text{Compensation cost}}, \tag{6}$$

subject to participation constraint (4). Taking the first-order conditions and incorporating (5), we obtain the optimal compensation contract

$$w^* = \max\left[CF_L - C, \bar{W} + \frac{1}{\rho}\log\left(1 - \frac{p(T_c - \tau_c)}{1-\tau_c}\right)\right], \tag{7}$$

$$n^*(S_H - K) = \frac{1}{\rho}\log\left(\frac{p}{e^{-\rho\bar{W}}e^{\rho w*} - (1-p)}\right). \tag{8}$$

In particular, if $w^* > CF_L - C$, then the optimal amount of option compensation is

$$n^*(S_H - K) = \frac{1}{\rho}\log\left(\frac{1-\tau_c}{1-T_c}\right). \tag{9}$$

Note that the optimal number of options granted increases in tax convexity (the difference between T_c and τ_c), and decreases in the risk aversion parameter ρ. In the next subsection, we extend the model to allow for optimal leverage and the imperfect correlation between stock prices and stock option exercises.

B. Optimal Leverage Policy

We extend the analysis of the previous section by allowing the shareholders to choose optimal leverage. We assume that debt cannot be adjusted immediately after the profit uncertainty is resolved and assume that no agency costs or nontax benefits are associated with debt.

To guarantee a unique solution for leverage, we assume that debt financing is tax advantageous relative to equity financing when the company has positive taxable income. The tax on individual interest income T_i is smaller than the tax on positive corporate income T_c, but larger than the tax on negative corporate income τ_c.[10] If the firm has negative taxable income in at least one state, there is a net tax disadvantage to debt, that is,

$$p(T_c - T_i) + (1-p)(\tau_c - T_i) < 0. \tag{10}$$

Given these assumptions, it is optimal to increase leverage until (5) becomes an equality, or the taxable income in the low-profit state becomes exactly zero. The optimal amount of interest deduction given the compensation structure is

$$C^* = CF_L - w, \tag{11}$$

[10] Here, we assume that MTRs are not defined by the equilibrium. Miller (1977) shows that in equilibrium the tax advantage of selling debt to the marginal investor is equal to zero.

where CF_L is the cash flow before any compensation or interest tax deductions in the low-profit state. Increasing leverage above C^* is suboptimal because additional corporate deductions are not sufficient to offset the increased individual tax liability. Leverage below C^* is also suboptimal because debt is risk-free and an additional dollar of leverage creates a positive net tax benefit without increasing bankruptcy or agency costs.

The negative relation between optimal wages and debt obtains because debt and wages provide identical tax deductions and are substitutes. In contrast, since higher wages imply fewer stock options in the compensation package, debt and options are positively related in the model. The intuition is that stock options shift compensation tax deductions to more profitable years, smoothing taxable income and creating more room for debt in less profitable years. If the firm is profitable, as the model assumes, redistributing its tax deductions from the low-profit to the high-profit state increases the expected MTR, and therefore also increases debt capacity.

Figure 1 illustrates the behavior of optimal leverage in the model. Exhibit A shows taxable income and deductions for a firm that compensates employees with wages. The firm levers up to a point where debt provides tax deductions in both states. Although taxable income is high in the high-profit state, the firm does not increase leverage further because taxable income is zero in the low-profit state. In Exhibit B, stock options replace some wages and shift tax deductions to the high-profit state, making taxable income positive in both states. The average MTR (after compensation deductions) increases, and the firm increases leverage to shield more income from tax.

To relate our results to empirical data, we now briefly deviate from the assumptions of the model and consider a firm with negative taxable income.[11] If taxable income is already overshielded by existing deductions, or if stock option deductions alone push taxable income below zero, stock options may decrease the expected MTR and debt capacity. For example, imagine that existing interest and wage deductions create large negative taxable income in the low-profit state and leave a small positive taxable income in the high-profit state. In this case, replacing some wages with stock options actually decreases debt capacity because shifting tax deductions to the high-profit state will result in negative taxable income in both states. It follows that the effect of stock options on the tax incentives to adjust leverage depends on the profitability of the firm.

The result that stock options tend to increase debt capacity for high-profit firms and decrease it for low-profit firms can also be seen by studying the shape of the MTR function. When used instead of wages, stock options decrease the volatility of taxable income. Therefore, conditional on the magnitude of taxable

[11] Firms may have negative taxable income because their revenues are temporarily below their costs, because they have many nondebt, noncompensation tax shields (e.g., depreciation, tax shelters, investment tax credits, etc.), or because they are unable or too inert to adjust their leverage (Welch (2004)). In 2002, approximately 20% of the firms in our sample had negative taxable income (after stock option deductions). The IRS's *Statistics of Income* for 2002 indicated that approximately 47% of all U.S. corporations reported net losses.

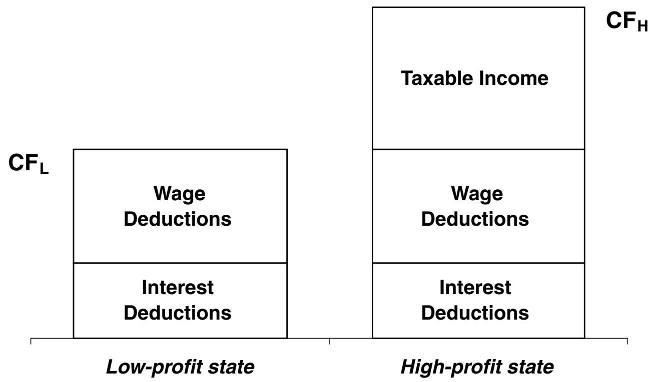

Exhibit A. Taxable income and tax deductions from debt and wages

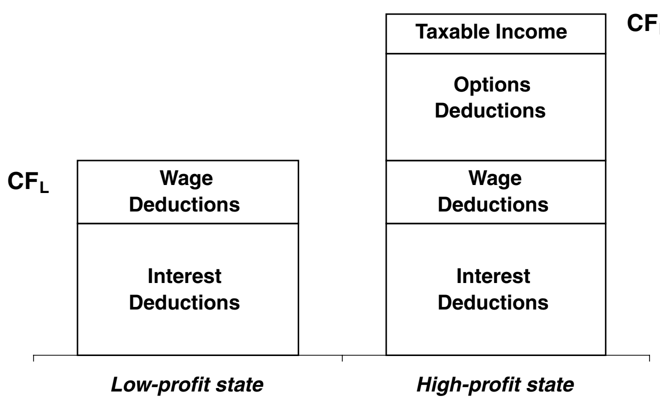

Exhibit B. The optimal leverage when stock options replace some wages

Figure 1. Compensation structure and debt capacity effect. This figure describes how compensation choice affects optimal leverage in the model. We assume that there are two equally likely states of firm profitability, with the corresponding earnings before any tax deductions of CF_H and CF_L. Exhibit A shows the optimal leverage for a firm that compensates employees with flat wages. Exhibit B demonstrates that when stock options replace some of the wages (keeping the total value of compensation constant), optimal leverage increases.

income, they increase the expected MTR and debt capacity if the MTR function is concave. Stock options decrease the expected MTR if the MTR function is convex. Unlike the tax liability function, which is most often convex in its domain, the MTR function can be concave (see Figure 2A). To determine the sign of the second derivative, note that the MTR function must be strictly increasing and positive with low (negative) income, and must be increasing and strictly less than the maximum tax rate with high income. Moreover, between these two extremes, the function is smooth (has no kinks) since the MTRs are averaged over all possible realizations of the future income path. It follows that the MTR function has to paste smoothly to 0% for $TI \downarrow (-\infty)$ and paste smoothly to 35%

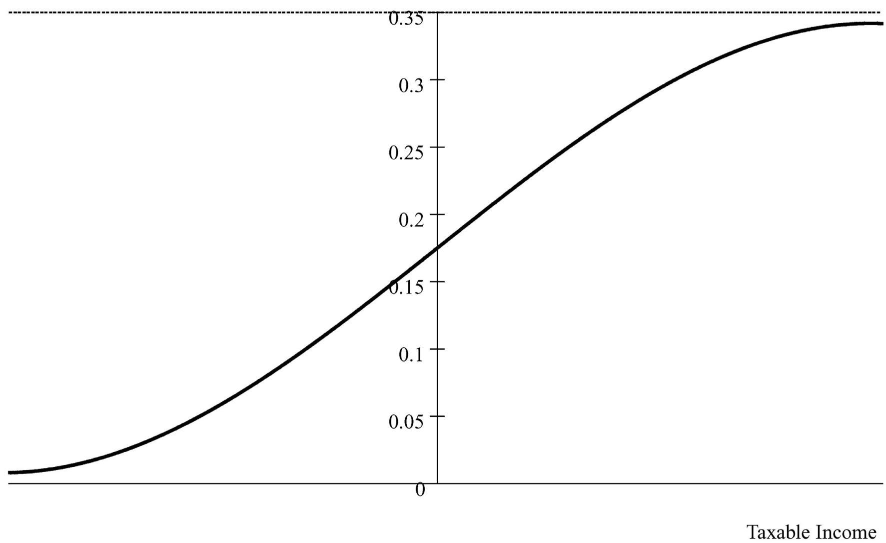

Exhibit A. The shape of the MTR function

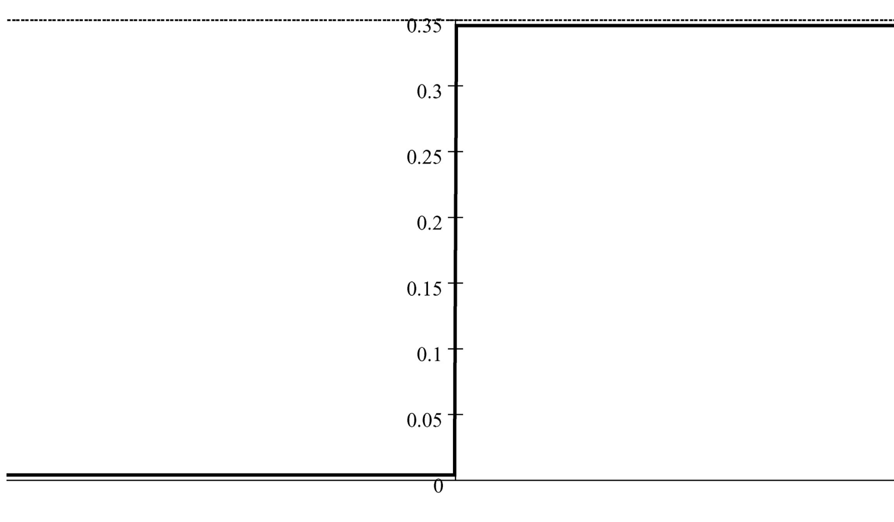

Exhibit B. The MTR function under the assumptions of the model

Figure 2. Corporate MTR function and taxable income. The graphs are illustrative and are not from the simulations. Exhibit A plots the MTR function versus taxable income. The corporate MTR function is smooth, reflecting the averaging over the uncertain realizations of future taxable income. It is assumed that the maximum tax rate is 35%. Exhibit B plots the MTR function under the assumptions of the model, that is, a tax rate T_c on the positive taxable income (assumed 35%) and a tax rate of τ_c on the negative taxable income (assumed 0%).

for $TI \uparrow (+\infty)$, which necessarily means that the second derivative changes its sign and the function is convex on the left and concave on the right.[12]

The model approximates the actual MTR function and assumes that the MTR is smaller for negative taxable income than for positive income (Figure 2B). Therefore, the firm can achieve the higher debt capacity by using stock options if it exploits the concave (right) side of the MTR curve. In contrast, the low-profit firm experiences a reduction in its debt capacity since its taxable income falls on the convex (left) side of the MTR function.

Finally, Appendix B extends the analysis to the more realistic case in which the correlation between stock option exercises and corporate taxable income is positive but not perfect. It is straightforward to show that as the correlation between stock prices and taxable income increases the optimal compensation structure entails a larger number of options.

II. Data and Simulations

A. Data

We obtain data on employee stock options from the Investor Responsibility Research Center (IRRC) for a sample of S&P 500 firms for the years 2002 and 2005.[13] For example, the 2005 data set contains data on stock options granted, exercised, and cancelled for 2003, 2004, 2005, as well as outstanding options for 2005. We also collect stock option data for firms that were in the NASDAQ 100 index on December 8, 2006. The rationale for adding data on NASDAQ firms is that these firms tend to have smaller and more volatile earnings than S&P firms and may therefore have more convex tax functions. All data are adjusted for stock splits and merged with Compustat balance sheet data. Further details on sample selection and calculation of the option values are in Appendix C.

Our sample contains 535 firms for the 6-year period 2000 to 2005, with 444 firms that were in the S&P 500 only, 50 firms that were in the NASDAQ 100 only, and 41 firms that were in both indices. The summary statistics on firm characteristics and option use are presented in Table I. Both S&P 500 and NASDAQ 100 firms tend to be large, with median market capitalization of \$11.1 billion for the S&P 500 firms and \$6.0 billion for NASDAQ 100 firms. S&P 500 companies have higher pre-tax earnings, higher total assets, and higher market leverage than NASDAQ firms. However, NASDAQ companies have more outstanding stock options and receive larger tax benefits, with average stock option deductions in 2005 of approximately \$244.1 million for NASDAQ firms and

[12] It is also possible that the alternative minimum tax (AMT) can introduce concavity in the MTR function for firms with low taxable income due to depreciation and special deductions.

[13] Since some firms are not covered by both data sets, we collect the missing data by hand whenever possible. For example, a firm represented in the 2002 data set may not be in the 2005 sample because it went bankrupt or was removed from the S&P 500 index, delisted, acquired, or taken private.

Table I

Descriptive Statistics of Firm Characteristics

The table presents descriptive statistics separtely for S&P 500 sample firms (Panel A) and NASDAQ 100 sample firms (Panel B), where the sample consists of 485 S&P 500 firms and 50 NASDAQ 100 firms (not in the S&P 500) for which we were able to obtain data. All data are for the year 2005. *Assets* are total firm assets; *Market capitalization* is the value of common equity; *Market debt* is the ratio of book value of debt to the market value of assets; *Earnings* is the dollar value of EBIT; *Earnings volatility* is the absolute coefficient of variation of EBIT; *Serial correlation of earnings* is the first-order serial autocorrelation coefficient of EBIT; *Corr. of earnings and returns* is the correlation coefficient of percentage changes in EBIT and the annual stock returns, estimated over the past 20 years; *Corr. of earnings and deductions* is the correlation coefficient of EBIT and stock option deductions, estimated over 6 years of available data; *Out. options value/market cap* is the Black-Scholes value of outstanding options, normalized by market capitalization; *Nonexec. options fraction* is the ratio of the value of outstanding nonexecutive options to the value of all outstanding options; *Option grants value* is the Black-Scholes value of stock options granted; *Option deductions* are the actual dollar deductions from stock options; and *Option deduction/earnings* are option deductions over the absolute value of EBIT.

	Mean	*SD*	25%	50%	75%
Panel A: S&P 500 Firms					
Assets ($M)	47,931	148,105	4,346	11,524	29,495
Market capitalization ($M)	22,863	39,568	5,684	11,073	21,343
Market debt (%)	23.6	21.4	7.7	16.5	35.3
Earnings ($M)	1,974	4,485	364	768	1,835
Earnings volatility	1.43	1.94	0.59	0.82	1.23
Serial correlation of earnings	0.63	0.32	0.42	0.70	0.90
Corr. of earnings and returns	0.21	0.33	0.01	0.22	0.45
Corr. of earnings and deductions	0.31	0.47	0.00	0.36	0.70
Out. options value/market cap (%)	4.44	4.11	1.98	3.20	5.40
Nonexec. options fraction (%)	89.7	9.7	84.8	92.0	97.3
Option grants value ($M)	106.6	199.4	18.4	48.2	99.4
Option deductions ($M)	131.0	244.5	15.8	53.2	122.7
Option deductions/earnings (%)	14.9	37.5	2.4	6.0	13.2
Panel B: NASDAQ 100 Firms					
Assets ($M)	3,815	3,918	1,419	2,012	3,945
Market capitalization ($M)	12,104	19,483	4,501	5,984	11,824
Market debt (%)	6.8	9.6	0	1.3	10.9
Earnings ($M)	490.5	854.2	119.2	284.2	538.7
Earnings volatility	1.73	1.74	0.82	1.08	2.11
Serial correlation of earnings	0.66	0.35	0.47	0.80	0.94
Corr. of earnings and returns	0.18	0.32	−0.07	0.25	0.38
Corr. of earnings and deductions	0.36	0.50	0.20	0.47	0.67
Out. options value/market cap (%)	5.93	2.94	3.39	6.03	7.42
Nonexec. options fraction (%)	84.4	8.7	81.0	85.4	90.3
Option grants value ($M)	142.0	215.6	22.7	59.8	141.0
Stock option deductions ($M)	244.1	682.0	34.2	78.1	154.5
Option deductions/earnings (%)	77.9	198.5	9.9	21.2	66.8

\$131.0 million for S&P firms.[14] The deductions from stock options comprise, on average, 14.9% of EBIT for S&P firms and 77.9% for NASDAQ firms. However, tax deductions vary by year; for example, these ratios were, respectively, 38.2% and 199.4% in 2000.

Table I shows that the correlation between percentage changes in EBIT and annual stock returns is positive for most firms in the S&P and the NASDAQ indices. The average (median) correlation in the full sample is 0.20 (0.22), which is consistent with the estimates by Easton and Harris (1991). The correlation between earnings and stock option deductions is even higher, with an average (median) of 0.31 (0.38). A large fraction of outstanding options is held by nonexecutive employees in both S&P and NASDAQ firms. For our full sample, the average (median) fraction of the Black-Scholes value of outstanding nonexecutive stock options to the Black-Scholes value of all outstanding options is approximately 89% (91%).

B. Simulation Procedure

To compare the present value of tax paid by the firm under different compensation schemes, in addition to using actual data for 2000–2005, we need to simulate future taxable income and tax deductions. First, future taxable income is needed to account for the effect of carryforwards on the current year's tax rate (Graham (1996)). Second, we would like to generate multiple random paths of future stock prices and the corresponding stock option deductions. Otherwise, by observing, for example, high stock returns for some firm we may erroneously conclude that it always collects more tax benefits through granting stock options than through paying wages. Our simulation procedure, with the exception of equivalent wage calculation and option exercises behavior, is similar to that of GLS. Below, we briefly describe the procedure. Appendix D provides more details and describes our robustness checks.

First, we simulate a firm's future taxable income and stock prices for the next 20 years. The simulated stock prices produce a reasonable income-price correlation of 0.17, consistent with findings of Easton and Harris (1991), who document a 0.18 correlation between annual security returns and deflated earnings levels.

We then project future option grants and model stock option exercise behavior of all outstanding and newly granted options. We assume that stock options are exercised during the 5-year period around the year given by the disclosed expected option life. For example, the options granted in 2005 with an expected life of 5 years are exercised in years 2008 through 2012.[15] In contrast to GLS,

[14] We calculate the tax deduction from options as the number of options exercised multiplied by the difference between the stock price (proxied by the weighted average strike price for options granted in the year of the exercise) and the weighted average strike price of the exercised options.

[15] This strategy is consistent with the common vesting period of 2 years (Bettis, Bizjak, and Lemmon (2005)) and with the fact that more than 90% of employees exercise their options during the first 7 years (Huddart and Lang (1996), Table 3).

we assume that an outstanding option is exercised during the first of these 5 years if it is 75% in-the-money. If this option is "alive" after the first year, it is exercised if 50% in-the-money in the second year, 25% in-the-money in the third year, 15% in-the-money in the fourth year, and barely in-the-money in the fifth year; it is forfeited otherwise.[16] Our strategy produces realistic exercise behavior. For example, the median market-to-strike ratio at the time of exercise is 2.42, consistent with 2.57 found in Bettis, Bizjak, and Lemmon (2005).[17]

Next, we calculate the "equivalent wage" that firms would have to pay if they did not grant stock options. When employees are risk-neutral, the equivalent wage can be approximated by an average Black-Scholes value of past option grants. To ensure a fair comparison, we check that the present value of the deductions from equivalent wage and stock options are approximately equal if averaged over all simulations. If they are not equal, we adjust the wage growth rate. Note that accounting for risk aversion would result in a smaller equivalent wage and therefore would create a tax bias in favor of stock options beyond the tax function convexity effect we study here.

As a last step, we compute the present value at year $t = 2005$ of the total tax bill over $t - 2, t + 20$. First, the tax bill is estimated using taxable income after stock option deductions. Second, we reestimate the tax bill after reducing taxable income by the amount of the equivalent wage instead of stock option deductions. We then compute the differences in the present value of taxes due to stock option and wage deductions during these 23 years and find the annual savings that would produce the equivalent present value. This number is reported in the tables. Using the methodology of Graham (1996), we also compute the MTRs.

III. Results

Central to our theory is the idea that stock option deductions are positively correlated with MTRs (before deductions), reducing a firm's expected tax liability. First, we directly test whether replacing stock option compensation with fixed wages results in a larger tax for firms in our sample. Next, we establish that firms that can benefit more from the tax advantage created by stock options actually use more stock options in their compensation structure. Finally, we test the hypothesis that links stock option compensation to capital structure choices.

A. Average Tax Savings from Stock Options and Equivalent Wages

As a first step, we estimate the average annual tax savings from two different types of compensation: stock options and wages. We are interested in the

[16] This assumption conforms to the results in Hall and Murphy (2002), who find that the threshold price for the early exercise decision is 1.75 of the strike price when the option vests, and that it smoothly declines thereafter.

[17] In addition, Bettis, Bizjak, and Lemmon (2005) document that a 50% increase in stock price volatility decreases the expected time to exercise by about 1.5 years. A similar result holds in our simulated strategy.

economic significance of tax benefits from stock options. How much do firms save in taxes per year by using option compensation relative to wage compensation? To find tax savings from stock options, we translate the actual stock option compensation for firms in our sample into equivalent wages (same dollar value), and compare the expected present value of the tax bill with stock options and wages. The expectation is taken over all possible paths of future taxable income.

As Table II indicates, the average firm in our sample saved $59.1 million in tax annually by paying stock options to its employees. Paying flat wages of the same dollar value would reduce the tax by only $46.5 million per year, thereby resulting in a $12.6 million or 9.8% higher total tax bill than with stock options. These numbers imply that the aggregate annual tax savings from option compensation for 535 firms in the S&P 500 or in the NASDAQ 100 indices exceeded $6.7 billion. The tax savings per average firm in the NASDAQ 100 index alone are even larger, at $13.5 million per year. As a percentage of the average annual tax bill, NASDAQ firms saved 27.9% by using options, while S&P firms saved approximately 7.9%. Table II shows that approximately 75% of the firms in the sample have larger tax savings when they use stock options for compensation rather than wages. Approximately 25% of the firms achieve larger tax savings by paying fixed wages to their employees, which is consistent

Table II

The Average Annual Tax Savings from Options and Equivalent Wages

This table presents summary statistics on the annual tax savings by firms when they use stock options (Tax savings from options) and equivalent wages for compensation (Tax savings from wages). The tax savings from options and wages per year are calculated from the present value of tax savings over all years using the annuity formula. The sample consists of 535 firms that were in the S&P 500 or NASDAQ 100 index and for which we were able to obtain data. Percentage tax savings from options represent the difference in the annual tax savings from options and tax savings from wages, normalized by the average annual tax bill absent any compensation deductions.

	Mean	*SD*	5%	25%	50%	75%	95%
Panel A: All Firms							
Tax savings from options ($M)	59.1	76.4	7.0	19.8	36.3	69.5	175.0
Tax savings from wages ($M)	46.5	99.6	1.0	5.7	15.4	44.0	184.2
Percentage tax savings from options (%)	9.8	17.3	−10.1	−0.1	5.8	16.8	31.7
Panel B: S&P 500 Firms							
Tax savings from options ($M)	61.1	78.9	8.4	20.8	36.9	72.6	176.9
Tax savings from wages ($M)	49.9	103.9	1.6	6.7	16.8	49.6	190.6
Percentage tax savings from options (%)	7.9	15.1	−10.5	−0.2	5.1	15.3	36.4
Panel C: NASDAQ 100 Firms							
Tax savings from options ($M)	65.2	87.6	0	17.2	37.3	71.3	300.8
Tax savings from wages ($M)	51.7	74.8	0	7.4	23.6	56.2	205.7
Percentage tax savings from options (%)	27.9	25.1	−8.3	6.1	22.3	51.3	67.2

with the findings by Graham and Smith (1999) that approximately 25% of the firms in Compustat have a concave tax schedule.[18]

Next, we test the prediction of the model that the tax savings from options relative to the tax savings from wages are larger for firms facing more convex tax schedules. We use measures of tax convexity similar to those developed by Graham and Smith (1999). Since tax convexity is mainly created by treating positive and negative income asymmetrically, Graham and Smith argue that firms with greater volatility in taxable income, negatively correlated taxable income, and near-zero taxable income have more convex tax schedules. To avoid scaling problems, we measure the volatility of taxable income by the absolute coefficient of variation, estimated on a rolling window over the last 20 (or fewer) years, winsorized at 1% and 99% tails. As a second measure of tax convexity, we use the first-order coefficient of serial correlation in taxable income.[19] Finally, we create a dummy variable equal to one if in the most recent 5 years a firm had at least 1 year with negative income.

Table III presents the average difference between the tax savings from options and the tax savings from wages for the subsamples of firms based on the characteristics of their taxable incomes. Firms in the top quartile by the coefficient of variation of taxable income save, on average, \$26.0 million per year by using options (or 14.2% of the tax bill), while, for firms in the bottom quartile, these savings are only \$7.9 million per year (8.8% of the tax bill). Similar results emerge if we sort firms based on the serial correlation of taxable income.[20] The tax savings from options are even higher for firms in the lower quartile by serial correlation and the upper quartile by volatility, with average savings of \$28.9 million (unreported). Finally, the savings from options are much larger for firms that had recent losses. For example, firms that had at least 1 year with negative taxable income in the past 5 years save on average 14.7% of the tax bill, while firms that did not have any losses in the past 5 years save only 7.4% on average.

We also perform regression analysis to investigate how the percentage tax savings from options relative to wages (*SaveOpt*(%)) depend on the characteristics of a firm's taxable income. To ensure robust results we include only three explanatory variables: the absolute coefficient of variation of taxable income (*Volatility*), the first-order coefficient of serial correlation of taxable income (*Rho*), and a dummy variable equal to one if taxable income is between −\$5 million and \$5 million (*Small*). The regression coefficients and Huber–White t-statistics (in parentheses below) are

[18] Option-based compensation may have many disadvantages associated with suboptimal risk sharing, earnings management, misreporting, backdating, repricing, and distorted capital budgeting decisions by managers (see Callaghan, Saly, and Subramaniam (2004), Brisley (2006), Burns and Kedia (2006), Dittmann and Maug (2007), and Heron and Lie (2007)). We focus on the tax effects alone, and show that the stand-alone tax argument is in favor of using stock-based compensation.

[19] Due to short time series (5–20 years) for the estimation of serial correlation, we cannot reject the existence of a unit root for approximately 30% of firms in our sample.

[20] Sorting by volatility and the serial correlation of taxable income results in substantially different subsamples.

Table III

The Average Annual Tax Savings from Options and Equivalent Wages for Firms with Different Income Characteristics

This table presents summary statistics on the relative tax savings (in millions of dollars) when firms use stock options over fixed wage compensation. *Relative tax savings* measures the tax benefit of stock options relative to wages and is equal to the difference between the annual *Tax savings from options* and the annual *Tax savings from wages*. The measure *Percentage tax savings from options* is equal to the *Relative tax savings*, normalized by the average annual tax bill absent any compensation deductions, and multiplied times 100. *High (Low) TI volatility* refers to the subsamples of firms that have an absolute coefficient of variation of their taxable income greater than 1.3 (smaller than 0.6), respectively. *High (Low) serial correlation* refers to the subsamples of firms that have serial correlation of taxable income greater than 0.9 (smaller than 0.4), respectively. Each subsample has 134 firms (25% of the original sample). *Firms with (without) losses* refers to the subsamples of firms that had at least one (no) year with negative taxable income in the past 5 years. There are 172 firms with losses. The columns show the mean and standard deviation across all firms, as well as the 5th, 25th, 50th, 75th, and 95th percentiles.

	Mean	*SD*	5%	25%	50%	75%	95%
High TI Volatility							
Relative tax savings ($M)	26.0	52.8	−38.0	1.2	20.6	46.1	124.3
Percentage tax savings from options (%)	14.2	21.1	−12.5	1.2	14.7	25.4	60.7
Low TI volatility							
Relative tax savings ($M)	7.9	41.9	−91.6	−0.2	10.1	23.7	60.1
Percentage tax savings from options (%)	8.8	14.8	−4.9	−0.1	4.5	14.3	44.0
Low serial correlation							
Relative tax savings ($M)	27.7	49.6	−21.6	5.2	23.7	47.4	119.2
Percentage tax savings from options (%)	16.0	19.9	−10.1	3.5	14.7	25.1	53.2
High serial correlation							
Relative tax savings ($M)	4.8	57.5	−95.4	−5.2	8.9	27.9	84.5
Percentage tax savings from options (%)	6.6	13.6	−8.7	−0.8	2.8	10.9	34.4
Firms with losses							
Relative tax savings ($M)	19.3	52.5	−40.6	−0.2	17.4	39.3	107.2
Percentage tax savings from options (%)	14.7	21.3	−12.5	0.0	14.6	25.3	56.2
Firms without losses							
Relative tax savings ($M)	9.3	77.0	−85.5	−0.2	10.9	30.1	85.8
Percentage tax savings from options (%)	7.4	14.4	−8.4	−0.1	4.5	13.2	34.0

$$\begin{array}{l} \textit{Save Opt}\ (\%) = \underset{(5.83)}{12.60} + \underset{(2.26)}{1.79} \cdot \textit{Volatility} - \underset{(-3.01)}{7.91} \cdot \textit{Rho} + \underset{(1.81).}{8.93} \cdot \textit{Small}. \end{array} \tag{12}$$

The adjusted-R^2 of the regression is 5.0%. As expected, the percentage tax savings from options is larger when taxable income is near zero, is more volatile, and has low serial correlation. This analysis is designed to help other researchers identify firms with the largest potential tax benefits from options without having to do the simulations and/or without access to time-series data on tax deductions from options.

B. Determinants of Stock Option Grants

Next, we investigate whether firms adjust their compensation policy in a manner consistent with tax minimization. If managers realize that the tax benefits from offering stock options depend on a firm's characteristics, then we should expect firms with more convex tax schedules and with a higher correlation between stock option deductions and taxable income to grant more stock options.

Since firms with low profits use options instead of wages to save cash and to improve liquidity (Core and Guay (2001), Yermack (1995)), we need to be careful in separating the tax effect from the liquidity effect. Following Yermack (1995), we include the dividend yield as an explanatory variable. Firms that pay dividends may have lower liquidity problems, but do not necessarily have a less convex tax structure. In addition, when we directly proxy for financial constraints with either the Kaplan-Zingales (1997) index of financial constraints or the Whited-Wu (2006) index, we find that coefficients retain their signs and statistical significance. Since firms with small or negative free cash flow may not have enough funds to pay cash compensation, we control for the free cash flow of the firm. Finally, we control for other important determinants of stock option grants, such as the need to provide incentives (by including R&D expense), differences in corporate governance across firms (by including Gompers, Ishii, and Metrick's (2003) G-index), and differences in industry norms.

Table IV presents the results. The dependent variable in all regressions is the Black-Scholes value (adjusted for dividend payout) of stock options granted, normalized by the market value of equity at the fiscal year-end. The results are very similar if we use the value of options outstanding divided by the market value of equity as our dependent variable. The independent variables for the first three columns are taxable income volatility, serial correlation in taxable income, and the convex tax dummy.[21] We construct the convex tax dummy similarly to Graham and Smith (1999). Specifically, the dummy is equal to one if doubling taxable income volatility increases the present value of tax on after-option-deductions income.

Stock option grants tend to be larger in companies that have high earnings volatility and low serial correlation of earnings (columns (1) and (2)), which is consistent with the view that companies that have a more convex tax function choose to grant more stock options. Similar results emerge when we use the convex tax dummy (column (3)), with firms facing convex tax functions granting 21.4% more stock options. The effect of tax convexity on option grants is statistically and economically significant. For example, an increase in earnings

[21] We use the convex tax dummy instead of an indicator of losses in the past 5 years because of the difficulty in distinguishing tax and liquidity-driven explanations when past losses is the explanatory variable. Unreported results show that firms with past losses grant significantly more options.

Table IV

Option Grants and Characteristics of Taxable Income

The dependent variable is the Black-Scholes value (adjusted for dividends) of stock options granted divided by the market value of equity. *Earnings volatility* is the absolute coefficient of variation of EBIT; *Serial corr. earnings* is the first-order coefficient of serial correlation in EBIT; *Corr. earnings returns* is the correlation between annual stock returns and the percentage change in EBIT; *Convex dummy* is equal to one if increasing volatility in simulations increases the tax bill on the actual (after option deductions) taxable income; *Corr. earnings deduct.* is the correlation between EBIT and option deductions; *% tax savings* is the tax savings with options relative to wages as a percentage of the tax bill. The control variables are the logarithm of sales; *FCF/sales,* defined as after-tax earnings, plus depreciation, less capital expenditures, all divided by sales; *R&D/sales,* equal to research and development expense normalized by sales; *Dividend yield,* equal to the annual dividends divided by the market value of equity; *CAPEX/sales*, equal to capital expenditures normalized by sales; *G-index*, defined as in Gompers, Ishii, and Metrick (2003); and *Compen./sales*, equal to labor expense normalized by sales (set to the median industry value if missing). All regressions include intercept, year dummies, and industry dummies defined by one-digit SIC codes. *P*-values based on Huber–White standard errors (that allow for serial correlation of errors within firms) are in parentheses. The number below the *p*-value is the percentage change in option grants (relative to the mean) when an independent variable increases from the 25th to the 75th percentile. Significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Earnings volatility	0.001***						0.001**
	(0.009)						(0.047)
	7.3%						6.2%
Serial corr. earnings		−0.006***					−0.000
		(0.004)					(0.962)
		−25.6%					−0.4%
Convex dummy			0.003**				0.001
			(0.013)				(0.465)
			21.4%				6.3%
Corr. earnings returns				0.004***			0.003**
				(0.006)			(0.041)
				14.8%			10.9%
Corr. earnings deduct.					0.003***		0.001
					(<0.001)		(0.117)
					18.5%		7.1%
% tax savings						0.017***	0.011**
						(0.002)	(0.021)
						22.1%	14.8%
FCF/sales	−0.011***	−0.010**	−0.011***	−0.019***	−0.012***	−0.009**	−0.014**
	(0.004)	(0.017)	(0.009)	(<0.001)	(0.004)	(0.025)	(0.017)
G-index	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Dividend yield	−0.171***	−0.204***	−0.209***	−0.177***	−0.192***	−0.209***	−0.161***
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
R&D/sales	0.012**	0.014**	0.014**	0.016*	0.014**	0.018***	0.021**
	(0.048)	(0.026)	(0.024)	(0.066)	(0.021)	(0.008)	(0.011)
CAPEX/sales	−0.017***	−0.019***	−0.018***	−0.011*	−0.018**	−0.019***	−0.010
	(0.010)	(0.009)	(0.009)	(0.100)	(0.010)	(0.006)	(0.131)
Log(sales)	−0.002***	−0.002***	−0.002***	−0.002***	−0.002***	−0.001***	−0.002***
	(<0.001)	(<0.001)	(0.001)	(<0.001)	(<0.001)	(0.001)	(<0.001)
Compen./sales	−0.003	−0.006	−0.005	−0.005	−0.004	−0.002	−0.000
	(0.800)	(0.620)	(0.691)	(0.634)	(0.715)	(0.889)	(0.988)
Adj.-R^2	0.269	0.264	0.259	0.295	0.261	0.273	0.316
Observ.	2,433	2,438	2,438	2,306	2,433	2,438	2,299

volatility from the 25th to the 75th percentile is associated with a 7.3% increase in option grants.

The results in columns (4) and (5) demonstrate that firms grant more stock options when their taxable income is strongly correlated with annual stock returns, or when their taxable income has a larger correlation with stock option deductions. For example, when the correlation of taxable income and stock option deductions increases from the 25th to the 75th percentile, the value of option grants increases by approximately 18.5%. Finally, when we directly use the simulated percentage tax savings with options relative to wages as an explanatory variable (column (6)), we see that firms with potentially larger option savings grant more stock options. Including all variables together (column (7)) shows that the tax savings variable has the highest statistical significance.

While we cannot directly establish that the relation between a firm's taxable income characteristics and stock option grants is causal, overall our results lend support to the hypothesis that firms with larger potential tax benefits from stock options use them more intensively.

C. Implications for a Firm's Debt Policy

In this section, we investigate the relation between leverage and stock options in our sample. The model develops different predictions for leverage depending on a firm's profitability. When low-profit firms use stock options instead of fixed wages, their expected MTR and debt capacity decrease. In contrast, option use increases the expected MTR and debt capacity for high-profit firms. In addition, firms that adopt stock option compensation free up some of the cash that was formerly used to pay wages, which can decrease the probability of distress or bankruptcy. This effect increases the incentives for leverage even if MTRs remain the same.

When testing this relation, it is critical to distinguish between firms that pay different total compensation. DeAngelo and Masulis (1980) demonstrate that nondebt tax shields decrease optimal leverage. Therefore, if firms that use more stock options also pay more to their employees in total compensation, we are likely to see that stock options are negatively correlated with leverage. The goal of our study is different—we compare the value of tax deductions under the premise that options and wages are substitutes. We control for total compensation by including administrative expense normalized by the firm's assets (*SG&A / assets*) and labor expense normalized by the firm's assets (*Compensation / assets*) in our specifications. Since only 16% of firms in our sample report their total labor expense in Compustat, we proxy for the missing data with the median industry values.[22]

[22] The reporting of labor expense is voluntary, and firms in different industries report with different frequency. For example, in our sample, approximately 55% of finance and insurance companies (standard industrial classification, SIC 6000-6999) report labor expense in Compustat, while only 7% of manufacturing firms (SIC 2000-3999) report this figure. The table available as an Internet Appendix in the "Supplements and Datasets" section at http://www.afajof.org/supplements.asp shows that the results of the leverage regression hold when we proxy for total compensation using Execucomp data.

It is also important to control for the characteristics of a firm's taxable income because they can simultaneously affect both the choice of compensation and the leverage policy. To address this concern, we include in our specifications *High earnings volatility dummy*, which is equal to one if the firm's absolute coefficient of variation of pre-tax (pre-interest and pre-options deductions) earnings is above its sample median value, and is equal to zero otherwise, as well as the first-order coefficient of *Serial correlation in earnings*. To proxy for a firm's growth options, we include research and development expense normalized by the firm's assets (*R&D/assets*).

We control for standard determinants of debt policy. As a proxy for nondebt tax shields, we include the sum of depreciation and investment tax credits, normalized by a firm's assets (*NDTS/assets*), and we generally expect to see a negative sign.[23] We also include *Firm size*, proxied by the natural logarithm of total assets, and expect larger firms to have greater leverage because these firms tend to have better access to corporate debt markets and may have smaller debt issuance costs. To proxy for a firm's ability to provide collateral for its debt, we add to our specifications net plant, property, and equipment, normalized by the firm's assets (*PPE/assets*). We expect to find that debt is positively related to *PPE/assets*. To minimize endogeneity issues, we lag all independent variables (except *BS value of options outstanding*) by 1 year.

We define *Market leverage* as the ratio of long-term and short-term debt to the total market value of a firm's assets and *BS value of options outstanding* as the ratio of the Black-Scholes value of outstanding options to market capitalization. Since leverage ratios can be left-censored at zero (approximately 7% of firms have zero leverage in the data), we use the Tobit model to avoid bias in coefficients.

The capital structure results are presented in Table V. Column (1) shows that in the full sample, when we control for total compensation, there is no significant relation between leverage and options use. We next separate our sample into two groups of firms: high-profit firms, that is, firms with pre-tax pre-interest earnings above the 75^{th} sample percentile, and all other firms, which we call low-profit firms.[24] We can observe that market leverage and stock options are strongly positively correlated for the subsample of firms that have consistently high profits (see column (2)). This confirms our prediction that stock options tend to increase the debt capacity of high-profit firms.[25] Moreover, when we interact the stock options variable with the correlation between

[23] However, Graham (1996) shows that this measure of nondebt tax shields is weak. Nondebt tax shields may be positively related to leverage because such tax shields are positively correlated with profitability and investment, and profitable firms tend to invest by issuing debt.

[24] Note that since our sample consists of S&P 500 and NASDAQ 100 firms, our low-profit firms are still profitable on average, with average EBIT of approximately \$250 million. However, they have much lower profitability than high-profit firms, which have an average EBIT of approximately \$4.9 billion.

[25] Our findings that options may increase the incentives to issue debt are not inconsistent with the argument of GLS that debt and options are substitutes. All else equal, more option deductions discourage debt as in GLS. However, options that replace wages may increase debt capacity. We find support for this hypothesis in profitable firms when controlling for total compensation.

Table V

Leverage Ratios and Stock Options Use

The dependent variable is the *Market leverage ratio*, defined as the sum of short-term and long-term debt, divided by the market value of total assets. *BS value of options outstanding* is the Black-Scholes value (adjusted for dividends) of stock options outstanding divided by the market value of equity at the fiscal year-end. The control variables are the logarithm of assets (*Firm size*); *Compensation / assets*, equal to labor expense (set to the median industry value if missing for the firm) normalized by assets; *R&D / assets,* equal to research and development expense normalized by assets; *CAPEX / assets*, equal to capital expenditures normalized by assets; *SG&A / assets*, equal to selling, general, and administrative expenses normalized by assets; *PPE / assets*, equal to net plant, property, and equipment normalized by assets; *NDTS / assets*, equal to the sum of depreciation and investment tax credits normalized by assets; *High earnings volatility dummy*, equal to one, if the absolute coefficient of variation of EBIT is above its sample median value; and *Serial correlation in earnings*, defined as the first-order coefficient of serial correlation in EBIT. The regressions are estimated by Tobit model with year dummies and industry dummies defined by one-digit SIC codes. High-profit (low-profit) firms are firms that have an EBIT above and below the 75^{th} sample percentile, respectively. Marginal effects are displayed with *p*-values in parentheses. *P*-values are based on the maximum likelihood standard errors. Significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	Full Sample	High-Profit Firms	High-Profit Firms	Low-Profit Firms
BS value of options outstanding	0.069	0.918***	0.303	−0.137**
	(0.336)	(<0.001)	(0.351)	(0.050)
BS value ∗ Correlation of earnings and deductions			1.403***	
			(0.003)	
Compensation/assets	−0.457***	−0.628***	−0.610***	−0.111
	(<0.001)	(<0.001)	(<0.001)	(0.210)
R&D/assets	−0.394***	−1.488***	−1.511***	−0.162***
	(<0.001)	(<0.001)	(<0.001)	(0.006)
High earnings volatility dummy	−0.013**	−0.010	−0.010	−0.009
	(0.049)	(0.504)	(0.483)	(0.180)
CAPEX/assets	−0.566***	−0.278	−0.231	−0.619***
	(<0.001)	(0.202)	(0.289)	(<0.001)
SG&A/assets	−0.124***	−0.113*	−0.132**	−0.082***
	(<0.001)	(0.072)	(0.037)	(<0.001)
PPE/assets	0.142***	−0.070	−0.089*	0.206***
	(<0.001)	(0.195)	(0.100)	(<0.001)
NDTS/assets	0.080	−0.084	−0.051	0.051
	(0.394)	(0.830)	(0.896)	(0.562)
Firm size	0.041***	0.057***	0.055***	0.052***
	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Serial correlation in earnings	−0.115***	−0.138***	−0.140***	−0.093***
	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Correlation of earnings and deductions			−0.029	
			(0.124)	
Number of observations	2,369	593	589	1,776

earnings and stock option deductions (column (3)), we see that the positive relation between debt and options obtains only when the deductions resulting from options are positively correlated with taxable income. Intuitively, if this correlation is low, stock options create tax deductions when taxable income is small, and therefore debt capacity does not increase.

For the low-profit firms, debt and stock options are negatively related (column (4)), consistent with our theory. However, we note that we cannot distinguish between our hypothesis and the idea that low-profit firms are unable to raise debt on attractive terms and use options as a form of borrowing from employees. Our results in Table V are very similar (both qualitatively and quantitatively) if we use book debt instead of market debt as a dependent variable.[26]

The untabulated MTR estimates lend additional support to the results of the leverage regressions in Table V.[27] In particular, we find that MTRs of low-profit firms are significantly smaller after option deductions than after wage deductions. For the high-profit firms in our sample, the average and median MTRs with stock options and with fixed wages are very similar, and are often higher with stock options. This suggests that high-profit firms have higher incentives for leverage if they use more stock options, while low-profit firms actually have lower incentives for leverage if they use stock options.

IV. Conclusion

We investigate the corporate tax implications of compensating employees with stock options versus flat wages. The compensation structure matters from a tax perspective because stock options tend to shift tax deductions to years with high taxable income and high MTRs. Our results indicate that stock option deductions reduced taxes by $59.1 million per year for the average firm in the S&P 500 and NASDAQ 100. Paying flat wages of the same dollar value would reduce taxes by only $46.5 million per year, thereby resulting in a $12.6 million or 9.8% higher total tax bill than with stock options.

Since options create tax deductions in more profitable years, a company that compensates employees with stock options is able to smooth its income and create a bigger tax advantage for debt. Thus, the use of options may encourage the use of debt. We find that, for the highly profitable firms in our sample, leverage is positively related to outstanding stock options, which is consistent with the view that stock options increase a firm's debt capacity.

We also find that companies with higher potential tax benefits from stock options use them more intensively. In particular, firms that have a more convex tax function and firms that have a higher correlation between earnings and stock option deductions issue more options to their employees. Future empirical

[26] However, the results are not statistically significant for high-profit firms if we use debt net of cash as a dependent variable (Bates, Kahle, and Stulz (2007)). The table available in the Internet Appendix on http://www.afajof.org/supplements.asp provides the results of regressions using book debt and debt net of cash.

[27] We check that our MTRs before and after option deductions are similar to those reported in GLS. They find that in 2000 the median MTR of 35% for S&P 100 and 31% for NASDAQ 100 firms changed, respectively, to 35% and 5% after accounting for stock option deductions. Our results for 2002 indicate that the median MTR of 35% for S&P 500 and 32% for NASDAQ 100 firms declined to 34% and 19%, respectively. Our results are somewhat different because fewer options were exercised in 2002 than in 2000 and also because a decrease in grants in 2001 and 2002 prompted us to assume that option grants would grow more slowly in the future.

work that focuses on the benefits and disadvantages of compensating employees with stock options (or bonuses directly linked to earnings) should account for the additional tax benefits associated with option compensation.

Appendix A: Convex Tax on Individual Income

Since individual tax functions can be convex, employees may find the income uncertainty associated with stock options to be undesirable and demand higher salaries. In particular, if employees are subject to the average tax rate τ_i on wage income and a higher average tax rate T_i on the income from option exercises, then the participation constraint (1) becomes

$$w(1-\tau_i) = \frac{pn(S_H - K)(1-T_i)}{1+r}. \tag{A1}$$

Since the firm maximizes the value of tax shield net of total compensation, stock options are tax-efficient relative to wages if

$$\frac{1-\tau_i}{1-T_i} < \frac{1-pT_c-(1-p)\tau_c}{1-T_c}. \tag{A2}$$

Clearly, if there were much tax convexity at the individual level, that is, if T_i is high relative to τ_i, options are tax disadvantageous.

Appendix B: Imperfect Correlation between Stock Prices and Option Exercises

Here, we extend our analysis to the case in which the correlation between stock option exercises and corporate taxable income is less than one. Stock prices tend to correlate positively with earnings (Easton and Harris (1991)). To capture this relation in simple form, we assume that the stock price is high with probability q when the firm's profits are high, and that the stock price is high with a smaller probability z when the firm's profits are low. To avoid corner solutions for the optimal compensation, we impose a cap on z:

$$z < \min\left\{\frac{pq(T_c-T_i)}{(1-p)(T_i-\tau_c)}, \frac{(T_c-T_i)}{(1-p)(T_c-\tau_c)}\right\}. \tag{B1}$$

This condition ensures that the probability of options being exercised in a low-profit state is sufficiently small. The optimization problem of shareholders can be written as

$$\begin{aligned}\max_{n,w,C}\ & \underbrace{(pqn(S_H-K)+w+C)T_c+(1-p)zn(S_H-K)\tau_c}_{\text{Tax benefits}} - CT_i \\ & -\underbrace{w-(pq+(1-p)z)n(S_H-K)}_{\text{Compensation cost}}, \\ \text{s.t. } & n(S_H-K) = \frac{1}{\rho}\log\left(\frac{pq+(1-p)z}{e^{-\rho\bar{W}}e^{\rho w}-p(1-q)-(1-p)(1-z)}\right).\end{aligned} \tag{B2}$$

The first term in (B2) represents the tax benefit of stock options. Since stock option exercises and taxable income are imperfectly correlated, stock options provide a tax benefit of pqT_c when exercised in the high-profit state and a tax benefit of $(1-p)z\tau_c$ when exercised in the low-profit state. The solution to (B2) is given by

$$\begin{aligned} w^* &= \bar{W} + \frac{1}{\rho}\log\left(\frac{A(1-T_i)}{1-T_i-B}\right) \\ n^*(S_H - K) &= \frac{1}{\rho}\log\left(\frac{1-A}{A}\right)\left(\frac{1-T_i-B}{B}\right) \\ C^* &= CF_L - w^*, \end{aligned} \tag{B3}$$

where

$$\begin{aligned} A &= p(1-q) + (1-p)(1-z) \\ B &= pq(1-T_c) + (1-p)z(1-\tau_c). \end{aligned} \tag{B4}$$

It is straightforward to show that as the correlation between stock prices and taxable income increases ($q \uparrow$ or $z \downarrow$) the optimal compensation structure in (B3) entails a larger number of options.

Appendix C: Sample

Until recently, stock options were not included on the firm's income statement. In December 2004, FASB issued a new set of standards, SFAS 123R (effective June 15, 2005), which requires all share-based payments to employees to be expensed in financial statements.[28] Importantly, SFAS 123R does not affect the actual amount and timing of stock option tax deductions. However, Compustat taxable income can already be adjusted for option deductions if firms voluntarily expensed options prior to SFAS 123R. To address this issue, we calculate taxable income (before stock option deductions) as pre-tax income minus deferred taxes adjusted by the statutory tax rate plus stock compensation expense (Compustat item 398). Our results are not affected if we do not add back this item.

The value of stock option grants is calculated using the Black-Scholes formula adjusted for dividend payouts. We use the disclosed expected option life, which takes into account early exercise, to estimate the maturity and calculate volatility as the standard deviation of stock returns over the past 60 months. The dividend yield is equal to dividends paid in the prior year divided by the market value of equity. Risk-free rates are taken from the Board of Governors of the Federal Reserve System for 1-, 2-, 3-, 5-, and 10-year constant maturity

[28] A public entity initially measures the cost of an award based on the current fair value; the fair value is recalculated at each subsequent reporting date until the settlement date. Changes in the fair value during the vesting period are recognized as compensation costs, while excess tax benefits are added to paid-in capital.

U.S. Treasury issues. For each firm-year, we choose a risk-free rate for the issue with the maturity closest to the expected option life at the fiscal year-end.

Appendix D: Simulation Details

Our simulation procedure largely uses the methodology developed by Graham, Lang, and Schakelford (2004). First, we simulate paths of future taxable income for the next 20 years using a simple random walk model[29]

$$TI_{t+1} = TI_t + \mu + \sigma \varepsilon_{t+1}, \tag{D1}$$

where the error term is normally distributed $\varepsilon_t \sim N(0, 1)$. The drift μ and volatility σ of taxable income are estimated using 20 years of historical data. We winsorize the top and bottom 5% of drift and volatility and further constrain the drift to be nonnegative.

Future stock prices are assumed to be correlated with changes in taxable income and are given by the discrete-time representation of the lognormal stock price model

$$S_{i,t+1} = S_{i,t} \exp\left(\left(\mu_i - \sigma_i^2/2\right) + \sigma_i\, dW(t, t+1)\right) \tag{D2}$$

where μ_i is the expected stock return, σ_i is the stock return volatility calculated using 60 months of daily data, and $W(t)$ is a geometric Brownian motion.

Expected stock return μ_i is calculated using Capital Asset Pricing Model (CAPM) with the risk-free rate from the Federal Reserve, market beta from Center for Research in Security Prices (CRSP), and a market risk premium of 2.55% (Fama and French (2002)), and then decreased by the firm-specific dividend yield. To capture the correlation between stock prices and taxable income, we assume that the expected stock return μ_i is higher than that predicted by the CAPM model if taxable income grows by more than expected. For example, if the realization of taxable income is 20% higher than expected, the expected stock return in the same year is also increased by 20%. We bound expected returns (within each simulation) between [−50%, +100%] and further adjust stock prices for dilution from the exercised stock options.

To avoid extreme values of expected stock returns, we use a procedure that differs from GLS for firms with taxable income drift below 1% (148 firms). For these firms, the change in stock price is equal to the change in taxable income divided by the appropriate interest rate times the number of outstanding shares plus the noise term. This method relies on the assumption that shocks to earnings or taxable income are permanent and can be evaluated as perpetuities.

We set future grants equal to the average number of options granted net of options cancelled over the past 3 years; we assume that all options are granted at-the-money with the expected option term as disclosed in the most recent

[29] Graham (1996) shows that the simulated MTR that uses a forecasting random walk model for future taxable income is the best available proxy for the "true" MTR. Additionally, Graham and Mills (2008) find that simulated MTRs based on financial data are highly correlated with simulated rates based on tax return data.

financial statement.[30] If we introduce the grants' growth factor (as in GLS), our base tax savings increase by 15.3%.

Our option exercise strategy is different from that in GLS. However, we conduct several sensitivity analyses. First, we assume no exercise in years when the option is in-the-money by 15% or less. Options that are more than 15% in-the-money are exercised smoothly over time and are otherwise exercised at expiration if they are barely in-the-money. This reduces our estimate for tax savings by approximately 21% relative to our base tax savings in Table II. Second, we check that a qualitatively similar result is produced if one assumes that options can only be exercised in the year given by the disclosed expected option life.[31]

When estimating the tax deductions from equivalent wages, we do not treat executive and nonexecutive stock options separately. In 1993 Congress issued the new legislation Internal Revenue Code Legislation 162(m), which put a $1 million cap on the tax deductibility of nonperformance-related executive compensation (Perry and Zenner (2001)). The tax benefits under stock options should be even larger if we were to cap the deductibility of fixed wages of executives at $1 million in our experiment.

Since tax liabilities are positively correlated with stock prices, the appropriate discount rate must be higher than the risk-free rate, but probably lower than the equity rate.[32] In our simulations, we discount the tax liabilities, after deducting the wage or options expenses, using a firm-specific equity rate. Using a single discount for the tax liabilities with wage and options is conservative because stock option deductions are positively correlated with stock prices. If we use a risk-free rate for wage and stock option savings, the present value of tax savings increases by 22.1% over what we report for our base case.

The procedure for calculating the present value of tax is very similar to that in Graham (1996).[33] We reestimate the net operating losses (NOLs) using 2-year carryback and 20-year carryforward features of the tax law since Mills, Newberry, and Novack (2003) find that the accounting NOLs reported by Compustat may not coincide with losses that can be used to offset taxes in future years. Our procedure for the estimation of NOLs does not take into account a

[30] Huddart and Lang (1996) find that firms make four to nine grants per year. Therefore, we use the average fiscal year stock price to estimate the strike price for granted options, but setting it equal to the fiscal year-end stock price does not change our results.

[31] Average tax savings under this alternative exercise strategy decrease by approximately 35%. Stock options are still tax beneficial because, although the year of exercise is fixed, the tax deductions are still linked to stock prices.

[32] See GLS for a discussion of the appropriate discount rate for tax liabilities. We rely on the assumption that a positive correlation of tax liabilities and stock prices implies that tax liabilities are correlated with a systematic component in stock prices and are not entirely driven by an idiosyncratic component.

[33] To keep the procedure simple, we ignore state taxes. The state tax rates for corporations range from 0% in South Dakota to 9.975% in the District of Columbia (Federation of Tax Administrators, 2007 report). Importantly, the state corporate income tax rates are flat for all but 11 states. And even in the states with a progressive corporate state tax rate, the upper brackets do not exceed $250,000. Therefore, including state tax in our estimation is not likely to affect the results.

temporary change in the tax law in 2002, retroactive to 2001 and abolished in 2003, that temporarily made the carryback period 5 years.

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