Effect of Personal Taxes on Managers' Decision to Sell Unrestricted Equity

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Abstract

We examine how personal taxes affect CEOs' decision to sell their vested equity and compare it against diversification, managerial overconfidence and other determinants of CEOs' sale of equity. While CEOs frequently sell large amounts of their unrestricted firm equity, we find that the tax burden associated with the sale deters CEOs from selling their equity. The effect of taxes remains significant even after controlling for other determinants of CEOs' sale of equity. We also find that taxable institutional investors and CEOs both respond to taxes in their selling of equity, although the CEOs appear to be less tax-sensitive. Other determinants affect CEOs' selling decisions largely as predicted in the existing literature.

Keywords:

Executive Compensation, Taxation, Overconfidence, Behavioral Finance, Institutional investors

1. Introduction

In the United States, management ownership of equity (through stock and option compensation) is the principal means of aligning CEOs' incentives with those of shareholders (see Hall and Liebman, 1998, and Core, Guay, and Verrecchia, 2003). The annual grants of stock and options vest over a multi-year period and, over time a CEO typically accumulates a large portfolio of vested or unrestricted equity. The composition of this portfolio alters through time with new grants of equity, exercise of options, and sale of equity.

Our study has two objectives. First, we present descriptive evidence on CEOs' (net) selling of equity. CEOs of large US corporations frequently sell substantial amounts of stock in their own firms, the value of which often exceeds that of new equity grants. This goes counter to the conventional wisdom that CEOs don't sell their equity for fear of a negative market reaction.[1]

Second, we examine how personal taxes affect CEOs' decision to sell their vested equity. Previous research identifies and empirically explores numerous determinants of a CEO's sale of equity (e.g., Huddart and Lang, 1996, and Ofek and Yermack, 2000). The determinants include diversification, implicit and explicit contracts between shareholders and manager, the CEO's liquidity needs, managerial opportunism (i.e., trading on insider information), and managerial overconfidence.[2] Surprisingly, however, with the exception of Goolsbee (1998 and 2000),

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[1] The press often states that CEOs are reluctant to sell large amount of company shares, as doing so might dampen stock prices. For example, Jacqueline Doherty in her article "Dirty Little Secrets" in Barron's, December 18, 2000, states "The sales pitch from their bankers [for borrowing against holdings of company shares rather than selling them] was simple: Selling shares in your own company would send a bad signal to the market; it also would make you liable for those nasty capital gains taxes. Borrowing against the shares, on the other hand, meant you could diversify without spooking the gullible folks investing in the highflying shares of your own company."

[2] Examples of theoretical and empirical research on the various determinants are: diversification is discussed in Lambert, Larcker, and Verrecchia (1991), Hall and Murphy (2000), Ingersoll (2002), Kahl, Liu, and Longstaff (2003), Meulbroek (2001), and Jin (2002); equity ownership and selling attributable to implicit and explicit labor contracts is discussed in Core and Guay (1999) and Ofek and Yermack (2000); insider trading and managerial opportunism are examined in Seyhun (1986) and a large subsequent literature; managerial overconfidence is studied in Heath, Huddart, and Lang (1999), Core and Guay (2001) and Malmendier and Tate (2004 and 2005).

personal taxes have received little empirical attention as a factor governing the timing of CEOs' selling of equity.[3] We are not aware of any study that systematically examines the effect of personal taxes and tax overhang on a CEO's decision to sell equity.

We believe an analysis of CEOs' equity-selling patterns informs us of executive incentive alignment and retention via stock and option compensation. In addition, an understanding of managers' selling behavior is helpful in optimal design of the composition of CEO pay, i.e., the mix of cash and equity. If CEOs aggressively undo the risk and incentive from equity grants by selling their vested equity, then further equity grants would fail to increase the incentive. Our results demonstrate that many CEOs sell equity *above and beyond* their stock and option grants such that their exposure to firm risk actually declines.

While existing literature provides ample evidence that corporations rationally respond to tax incentives (see, e.g. Auerbach (2002) and Gordon and Hines (2002) and the citations therein), relatively little is known about the role taxes play in CEOs' personal investment decisions. Individuals, the literature documents, exhibit a disposition effect (see Odean, 1998), i.e., they sell winning investments too soon and thus forego tax deferral, but hold on to losing investments too long. This raises the question whether CEOs behave like the typical individual investor, and thus ignore or under-react to tax incentives in their personal portfolio choices. If they did, then it would seem surprising that CEOs would be sufficiently tax sensitive in their corporate decisions. Our examination of how taxes influence CEOs' selling of vested equity can reveal CEOs' degree

[3] Using compensation data from 1991 to 1995, Goolsbee (1998) shows that taxable income declined sharply following higher marginal rates of 1993. The decline is almost entirely a short-run shift in the timing of compensation rather than a permanent reduction in taxable income, and reflects a large increase in the exercise of stock options by the highest-income executives in anticipation of the rate increases. Goolsbee (2000) shows that falling capital gains rates in 1997 increased the probability of executives exercising options early to get future stock gains treated as capital gains. Overall, the evidence shows that CEOs are tax-sensitive in the timing of their option exercise.

of tax sensitivity, which indirectly sheds light on the hypothesis about the effect of taxes on corporate decisions.

Background. Many factors determine CEOs' proclivity towards selling vested equity. First, an important motivation for CEOs to reduce their investment in vested equity is diversification. Specifically, since a CEO's financial wealth in the form of equity ownership and her human capital are both tied to a single firm's performance, such a portfolio is under-diversified (see, for example, Hall and Murphy, 2002). Unless compensated for bearing substantial amounts of idiosyncratic risk that lowers their reward-to-risk ratio, CEOs will want to sell some of their vested equity to lower their firm-specific risk exposure.[4] We focus on the diversification benefit foregone by a CEO from holding on to the equity for one year compared to selling it immediately, which is estimated to be on average about 4% of the value of equity using risk-aversion and other parameters in Hall and Murphy (2002), Meulbroek (2001), and others.

Second, implicit or explicit clauses in the employment contract and labor market expectations might constrain the manager from divesting her equity ownership.[5] Third, liquidity needs and a temptation to trade on insider information can also influence the amount and timing of managers' equity sales. Fourth, managerial overconfidence has recently been identified as an important determinant (see Malmendier and Tate, 2004 and 2005). The profession's interest in managerial overconfidence is not limited to understanding how it affects their equity selling, but

[4] However, it might not be easy to document the positive relation between lack of diversification and CEOs' selling of vested equity. CEOs could potentially offload some of the firm risk through hedging, to avoid any negative market reaction to selling and to avoid paying capital gains taxes.

[5] The labor market for top management imposes an implicit constraint on the manager from selling her ownership stake in the firm for fear that it might send the wrong signal of pessimism and trigger an adverse stock-price reaction. As seen from the evidence below, this does not appear to be a serious concern. Each year many mangers sell large dollar amounts of their stock.

more importantly because of the concern that overconfidence manifests also in managers' value-destroying firm level investment decisions.

Finally, a personal tax liability incurred upon selling equity is likely to influence CEOs' decision to sell vested equity. Managers who sell appreciated equity realize a capital gain and an associated immediate tax liability that could otherwise be deferred indefinitely or avoided altogether. Managers exercising options typically pay ordinary income tax on the gain, which they could defer until the option maturity date. Previous research suggests that savings from efficient tax planning can be substantial.[6] Using plausible parameter values, we estimate the average benefit of deferring the tax liability by a year to be about 1-2% of the value of equity for vested stock and options. While this is smaller than the diversification benefit foregone by not selling the equity, we observe considerable cross-sectional variation in the potential tax savings from efficient tax management, and for many CEOs even conservative estimates of the tax effects are substantial. Thus, an incentive to optimize on taxes is a first-order consideration for many CEOs.

Since the tax liability is an increasing function of past performance, managers' reluctance to sell equity is likely to strengthen with the firm's prior performance. Superior performance also implies a relatively large dollar amount of ownership of a manager's financial capital in the firm. Thus, the discouraging impact of the immediate tax liability on the manager's selling decision is likely to be most significant in circumstances when the manager faces a relatively high under-diversification cost of holding on to the firm equity. Therefore, in the empirical analysis we carefully disentangle the impacts of the two.

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[6]See theoretical analyses in Constantinides (1983 and 1984), Dammon, Spatt, and Zhang (2001a and 2001b), and Gallmeyer, Kaniel, and Tompaidis (2005), and empirical research in Ivkovich, Poterba, and Weisbenner (2004), Chay, Choi and Pontiff (2005), and Jin (2005).

In addition, past performance is likely to be a factor contributing to managerial overconfidence and therefore will affect the equity selling decision. It is hypothesized that successful managers become overconfident with superior past performance because "individuals expect their behavior to produce success, they are more likely to attribute good outcomes to their actions…" Malmendier and Tate, 2004, p. 2, and Miller and Ross, 1975, Gervais and Odean, 2001). Thus, whether a manager's decision about selling equity signals their overconfidence or merely a tax-optimizing decision or concern about diversification becomes an empirical issue. Obviously, it is possible that all the reasons are important in explaining managers' equity ownership decisions.

In our analysis of the determinants of a CEO's equity sales, we evaluate the relative importance of diversification, overconfidence, and tax motivations. While most of the tests entail straightforward regression analysis with proxies for each included, assessment of the tax effect controlling for the overconfidence, and vice versa, is complicated because overconfidence and tax considerations both discourage managers from selling equity. In this respect, a key innovation in our study is that we focus on investors who are not managers, but face the tax liability, i.e., tax on capital gains. Since an outside investor's selling decision is unlikely to be attributable to managerial overconfidence, it likely reflects tax and other considerations. The outside investor's behavior thus serves as a benchmark for the influence of taxes on a CEO's selling behavior. This enables us to estimate the incremental impact of overconfidence on a manger's equity ownership decision. We also include numerous other firm and manager characteristics to control for their respective effects on a manager's proclivity to sell equity.

Summary of results. We first present descriptive evidence on the pattern of selling of unrestricted equity by the CEOs of large US corporations. We next examine the determinants of

the sale of unrestricted equity. Specifically, we evaluate the relative importance of the tax-induced motivation for their decision and other considerations like diversification and overconfidence. In this comparison, we find that while all are statistically relevant, influence of tax incentives on a manager's decision to sell vested equity is highly significant. We also compare a CEO's selling decision with that of a tax-sensitive institutional investor, who also faces an immediate tax liability on realized capital gains upon selling a security. We find that both the CEO and financial institution respond to tax incentives. However, the CEO's response is weaker, about half as sensitive as an institutional investor. Taken together, our results suggest that in their selling decisions CEOs exhibit a first-order influence of tax considerations.

Notwithstanding the *a priori* lesser importance of taxes compared to diversification, our results suggest that taxes affect CEOs' selling decision as much, if not more, than diversification. The evidence suggests either (i) managers are excessively concerned about the immediate tax consequence of selling equity, and/or (ii) they are less risk-averse than previously believed to be in the literature and thus do not value diversification nearly as much as the models might suggest, and/or (iii) labor contracts require CEOs to hold stock for incentive reasons and that these incentives are highly correlated with the tax burden (which seems implausible to us); or (iv) instead of selling equity to achieve better diversification, those CEOs facing the highest under-diversification costs might privately hedge their exposure through capital market transactions, which achieves diversification without sacrificing the tax advantage of holding vested equity.

Our findings have important implications for firms' compensation policy as it relates to CEOs' incentive level, and firms' investment and financing policies. Specifically, i) Firms with tax overhang might want to tailor the compensation package to avoid excessive incentive to the

CEO by giving more cash instead of new grants of stock and options (see Core and Guay, 1999). ii) Unless a firm adjusts its compensation policy, the excessive incentive from tax overhang might distort the firm's investment and financing policies.

Outline of the paper. Section 2 reviews the literature on the determinants of equity selling by CEOs. This includes a discussion of how taxes, diversification, and overconfidence might affect a CEO's decision to sell her equity. In section 3 we describe the data, sample, and measurement of all the variables employed in the empirical analysis. The results are discussed in section 4. Section 4.1 contains a discussion of the descriptive evidence of CEOs' selling behavior and section 4.2 provides evidence on the determinants of the CEOs' selling of their equity. Section 5 summarizes the paper and offers concluding remarks.

2. Determinants of equity selling

Two streams of research examine investors' equity selling behavior, but neither of which focuses on taxes as a determinant of CEOs' equity selling. First, some research examines individual investors' stock trading and its determinants. For example, Barber and Odean (2000) conclude that individual investors' trading behavior compellingly exhibits "overconfidence" by trading too frequently and "disposition effect" by holding on to their losing investments while selling winners too soon (Shefrin and Statman, 1985, and Kahneman and Tversky, 1979, for the behavioral biases of individuals). Barber and Odean (2004) also examine whether personal tax considerations influence individual investors' trading behavior, and conclude that taxes do matter. However, it is tenuous to draw conclusions based on this research about the determinants of insiders' selling behavior because insiders face a host of other trade-offs. Specifically, insiders possess private information, they have implicit and explicit contracts about holding

equity for incentive reasons, they might be more tax savvy than the average investor, and as successful managers they might exhibit different personality traits.

Second, a huge body of research examines insiders' trades of their own equity (see Seyhun, 1986, and others), but this research is largely silent with respect to taxes as a determinant of CEOs' sale of their equity.[7] Instead, the focus is on diversification, liquidity, employment contracts, and insider information as motives for selling equity. We expand the set of determinants to include personal taxes and overconfidence. Below we briefly describe the determinants individually, which leads us to the empirical specification of the determinants of equity selling by CEOs.

Diversification. Lambert, Larcker and Verrecchia (1991), Hall and Murphy (2000), and Meulbroek (2001) explain that a CEO with a portfolio that is over-weighted in the firm's equity, i.e., a less than well-diversified portfolio, would have an incentive to sell some equity. Shareholders also bear some of the consequences of under-diversification in the form of diminished incentive-alignment, i.e., pay-performance sensitivity. Therefore, firms tend to lower the equity-based incentive in CEOs' compensation contracts when the cost of under-diversification is high. Consistent with this argument, Aggarwal and Samwick (1999), Jin (2002), and Garvey and Milbourn (2003) find that the idiosyncratic risk of the CEO's portfolio, ceteris paribus, weakens pay-performance sensitivity.

As an operational measure of the cost of under-diversification, we calculate a CEO's under-diversification cost of deferring the sale (exercise) of vested stock (options) by one year.

[7] A substantial literature examines how employees, in general, and top executives, in particular, exercise options (e.g., Huddart and Lang, 1996). We make a distinction between option exercise and sale of equity, and we do not expect a perfect correspondence between the reasons for a CEO's option exercise and for the sale of equity. Carpenter (1998) models exercise pattern for executive options, and shows that a simple extension of the ordinary American option model, which introduces random, exogenous exercise and forfeiture, predicts actual exercise pattern very well.

We calculate the cost in two ways. First, we use the Hall and Murphy (2002) approach by calculating a "certainty equivalent" of the benefit of receiving the restricted stock or options, based on a constant relative risk aversion utility function. Following Hall and Murphy, we further assume a relative risk aversion parameter of three. The second approach follows Meulbroek (2001). She calculates a deadweight loss associated with under-diversification in a non-utility based way. The approach assumes that CEOs assign the same risk-return tradeoff (or Sharpe ratio) as outsiders, except that CEOs (due to lack of diversification) bear some of the firm-specific risk, whereas diversified outsider investors only bear systematic risk. In both approaches, we further assume that the weight of a CEO's firm-specific wealth fluctuates with the firm's stock price performance. Because the two approaches generate under-diversification costs of comparable magnitudes, we report results using only the Hall and Murphy measure.

Implicit and explicit labor market contracts. Corporations use stock and options to incentivize managers and align their interests with the shareholders'. Core and Guay (1999) theorize that the optimal portfolio of incentives from stock and options varies with hypothesized economic determinants such as firm size, growth opportunities, and proxies for monitoring costs. Core and Guay (1999) and Li (2004) find that, as predicted, the corporation and the manager actively rebalance the equity portfolio through equity grants and sale of equity toward the optimal level of equity incentives. Complementary to these results, Ofek and Yermack (2000) find that high-ownership managers negate much of the impact of stock and option grants by selling previously owned shares. Collectively, the results suggest that once executives reach the target level of incentives through equity ownership, they offset further efforts to increase incentives by selling equity.

In addition to the optimal incentive consideration, CEOs might be reluctant to sell equity because such sales might be construed as insiders having bad information about the firm's prospects. Such an inference by market participants would adversely affect the stock price. Thus, to maintain investor confidence, CEOs might retain their unrestricted equity.

Insider information. A long-standing body of research examines corporate insiders' purchase and sale of company stock to exploit insider information. Early studies, e.g., Seyhun (1986), provide evidence that insider trades are profitable. Recent research, e.g., Lakonishok and Lee (2001) and Jeng, Metrick and Zeckhauser (2003), suggests asymmetric informativeness of insider trades. Specifically, insiders' stock purchases, but not sales, predict future price performance. Because the selling decision might be an involuntary consequence of portfolio rebalancing following option exercise and equity grants, the sales might be motivated by liquidity needs rather than insider information. In contrast, purchases of stock are more discretionary, and therefore are more likely to reflect a desire to exploit private information.

Overconfidence. The social psychology literature has long recognized that individuals in general and managers in particular tend to be overconfident that they have superior abilities than their peers (see Malmendier and Tate, 2004 and 2005, and references therein). Overconfidence in managers tends to be manifested as excessive optimism about the future of the firms they manage. Malmendier and Tate (2005) hypothesize that managers might retain their vested equity due in part to their more optimistic and confident assessment (hereafter, "overconfidence" to mean the combination of optimism and confident assessment) of the firm's prospects than the market as reflected in the current stock price.[8] Managers therefore might expect a high rate of

[8] The term "overconfidence" is pejorative. It suggests the management's optimistic beliefs about the firm value are irrational. Our analysis does not hinge on whether such beliefs are in fact rational or irrational because both predict the same managerial behavior with respect to ownership of vested equity. We therefore prefer to label the beliefs as "optimistic," but for reasons of consistency with prior literature, we label it overconfidence.

return on investment in the firm. The high expected return biases upward the manager's subjective estimate of the reward-to-risk ratio, thus off-setting the under-diversification disadvantage of investing their personal (unconstrained) financial capital in the firm.

If managerial overconfidence resulted only in managers owning vested equity beyond the optimal implied by portfolio theory, we suspect this would not be an important issue for academics and practitioners of corporate finance. However, the primary concern stems from the implications of managerial overconfidence for the firm's investment and financing decisions. This has long been recognized in the literature (see, for example, Roll, 1986). Specifically, managerial overconfidence can distort a firm's investment and financing decisions. The distortions include overpayment for acquisitions, overinvestment using internal sources of funds, underinvestment using external sources of funds, etc. (see Roll, 1986, DeMeza and Southey, 1996, Boehmer and Netter, 1997, Heaton, 2002, Malmendier and Tate, 2004 and 2005, and Bertrand and Schoar, 2003). Overconfident managers' optimism about their firm's prospects can translates into their willingness to invest in firm equity perhaps beyond the warranted optimal level of incentive, and in their corporate investment decisions. Because managers might be bullish about their own firm's performance, their decision to invest their own financial wealth in the firm's equity also underestimates the resulting disadvantage of under-diversification.

Direct evidence on the effect of overconfidence on equity ownership or sale of equity is lacking in the literature. Previous research (e.g., Malmendier and Tate, 2004 and 2005) infers overconfidence from the extent of a manager's ownership of firm equity. In the context of option exercise, however, a causal role of psychological factors has been documented. Heath, Huddart and Lang (1999) and Core and Guay (2001) find that, controlling for economic factors, psychological factors influence managers' option exercise behavior.

Taxes. As discussed in the Introduction, personal taxes discourage individuals from selling a stock if it triggers capital gains tax. The capital gains tax liability is increasing in the stock-price performance prior to the sale date, so stocks that have performed well are less likely to be sold, *ceteris paribus*. A back-of-the-envelope calculation indicates a non-trivial magnitude of tax savings if the CEO delays the sale of equity by one year. Assume a 20% capital gains tax rate and a 40% ordinary income tax rate, and that the capital gain is half the stock price. Further, assuming a 10% discount rate, the saving from (i) deferral of stock sale by one year would be approximately 1% of the value of the stock today and (ii) deferral of the exercise of options by one year would be approximately 2% of the value of options. These savings represent the return the CEO earns on the tax she would have paid otherwise. Using these assumptions, for the typical CEO in our sample, the tax savings from a one-year deferral are on average (median) 900 (111) thousand dollars, compared to the average (median) CEO cash pay of 1,315 (928) thousand dollars. For 11.2% of the observations, CEOs' tax savings from a one-year deferral exceed their cash pay (salary and bonus combined). The savings estimates are conservative because they ignore issues like the tax-timing option with respect to tax rate change, the opportunity to offset gains with losses elsewhere, and the step-up of capital gains tax at death[9].

The tax savings computed above, while conservative, amount to 1-2% of the value of the firm-specific equity portfolio of the CEOs. On the other hand, the CEO's under-diversification cost of postponing by one year the sale of equity or exercise of vested options is about 4%. Both measures have a large cross-sectional variation. Hence, in some cases, the tax savings from

[9] For the CEOs in our sample, with average age of 57 (58) at the median (mean), likelihood of death can be a concern. As an alternative measure, we directly incorporate the likelihood of CEO death using Social Security life actuarial estimates (available online at http://www.ssa.gov/OACT/STATS/table4c6.html) and the actual age of the CEO. This on average increases the tax savings by about 10%. The analysis below is qualitatively unaffected by this alternative measure of the tax savings.

deferring could dominate the under-diversification cost. In addition, while the average tax benefit is smaller than the cost of under-diversification, it is still of the same order of magnitude. Thus, a priori, taxes and under-diversification both might play a role in CEOs' decision to sell vested equity. Empirically, tax as a determinant of CEOs' selling of equity has not been carefully examined in the literature, especially in a multivariate analysis.

Because the dampening effect of taxes on equity selling increases in past performance, unless the tax effect is controlled for, the managers' unwillingness to sell equity following superior past performance can be easily misconstrued as managerial overconfidence, vice versa.[10] The reason is that the firm's past performance might be a factor contributing to the manager's overconfidence. In contrast, past performance accentuates the manager's under-diversification cost, and she is more likely to sell equity following good performance. Therefore, it's important to examine the effects of taxes, overconfidence, and under-diversification all in a multivariate analysis.

CEO hedging on the side. CEOs might privately hedge their equity exposure stemming from stock and option compensation. Such hedging lowers CEOs' exposure to the firm without triggering the tax associated with selling, but accomplishing the diversification objective. Hedging on the side is generally not reflected in CEOs' stock holding reported in Execcomp. In

[10] Some suggest that superior past performance as a deterrent to selling might not be due to taxes, but because of incentive-alignment and implicit labor contracts. We believe it's unlikely that the latter reasons would fully explain managers' reluctance to sell. First, superior firm performance means managers' wealth is even more concentrated in the firm than before. This increase in within-firm wealth relative to outside wealth leads to more severe under-diversification, i.e., motivates managers to sell. Second, optimal incentive alignment reasons suggest that managers' dollar exposure to the firm should increase. As a result of superior firm performance, managers' dollar exposure to the firm increases even if some equity is sold. Our analysis is performed in manager's percentage ownership of firm equity. Optimal incentive alignment does not suggest the manager should hold greater percentage ownership in the firm following superior performance. Thus, selling of equity is consistent with both diversification (i.e., risk-sharing) and incentive alignment, although we acknowledge that the manager might not rebalance the portfolio back to the original dollar holding in the firm. Evidence in Huddart and Lang (2003) and Bartov and Mohanram (2004) is consistent with our conjectures.

fact, the activity might not be reported at all. Hedging by CEOs is frowned upon, as it reduces the incentives of CEOs and thus defeats the original purpose of granting equity in the firm.

Unobservable CEO hedging on the side impairs our ability to detect the importance of under-diversification in CEO equity sales. If hedging increases in CEOs' cost of under-diversification, then the hedge is a substitute for equity selling. Thus, the CEO holding data from Execucomp do not fully capture CEOs' response to their under-diversification costs – via equity selling or via hedging on the side.

In contrast, hedging on the side reinforces the tax explanation. Specifically, hedging enables CEOs to avoid direct selling of the vested equity, and thus avoid paying taxes. That is, hedging accomplishes the dual objective of diversification and reduced tax liability

Empirical model. Based on the preceding discussion, CEO overconfidence, estimated tax liability, and positive insider information would discourage CEOs from selling their unrestricted equity. Impact of implicit and explicit labor contract might be captured in average level of holdings of vested equity by the CEOs of the peer firms in the industry. The higher the average level of vested equity holdings of peer CEOs, the less likely is the CEO to sell her equity. Finally, under-diversification (as measured by the CEO's wealth invested in the company and the idiosyncratic risk of the company) would prompt the CEO to sell equity. Therefore, a CEO's selling of vested equity can be modeled as:

Equity Sales = f (expected tax liability from selling, level of under-diversification, CEO overconfidence, average level of vested equity holdings by industry peer CEOs, future performance of firm) (1)

where holdings of industry peer CEOs proxies for holdings attributable to implicit and explicit labor contracts and the firm's future performance is a proxy for the manager's insider information. In the following sections we describe how we measure each determinant and

estimate the model empirically. The estimated model also includes control variables besides the determinants discussed above.

3. Data and variable measurement

In this section we describe the data and data sources employed in conducting the empirical analysis, and the measurement of all the variables used in the study. We use data on CEO compensation, security risk and returns, institutional ownership, and clientele of institutional investors. The data come from various sources.

Compensation data for CEOs is from Standard & Poors' ExecuComp database. ExecuComp contains compensation information for the five most-highly compensated executives of about 1,500 firms annually from 1992-2002. The firms are those in the S&P 500, S&P mid-cap 400, and S&P small-cap 600 indexes. The compensation information includes current year's salary, bonus, and stock and option grants, and also information about the executives' holdings of stocks and options, albeit in lesser detail.

We use the CRSP security return data to calculate the beta risk and return volatility as well as the risk-adjusted stock price performance. Institutional ownership data is obtained from the Spectrum 13F institutional investor holding database. We further supplement the institutional ownership data with characteristics of the institutions' clients from the Investment Adviser Public Disclosure (IAPD) data obtained from the Securities & Exchange Commission. The IAPD database contains investment advisors' self-reported clientele, broken down into 10 categories: individuals (other than high net worth individuals); high net worth individuals; banking or thrift institutions; investment companies (including mutual funds); pension and profit sharing plans (other than plan participants); other pooled investment vehicles (mostly hedge funds); charitable organizations; corporations or other businesses not listed above; state or

municipal government entities; and "other," such as non-US government entities. Investment advisors are required to report the percentage of business represented by each clientele category.

Variable measurement. The preceding section describes some of the key variables used in the analysis. In addition, we employ numerous control variables. Below we describe precisely how each variable is measured for our empirical analysis.

CEO equity ownership. CEO ownership of stock and options is an input into the measurement of variables like tax liability and the manager's exposure to firm risk, etc. While ExecuComp provides accurate information on the stock and option grants to CEOs each year and CEOs' stock holdings, information that would enable a researcher to infer CEOs' precise stock and option positions (e.g., information the grant date, stock price on the grant date, vesting period and expiration date) is not reported on ExecuComp. We estimate CEOs' stock and option positions at various points in time using two methods. First, we estimate the option positions using the Core and Guay (2002) measure. Second, as a robustness check, we adopt a detailed measure developed in Jin and Meulbroek (2004) and Hall and Knox (2004), which in theory gives a more precise estimate of the option positions. We find that the two measures are highly correlated ($\rho > 0.95$). We tabulate all the results in the paper using the Core and Guay (2002) measure, but the alternative measure produces qualitatively similar results.

Equity selling. To derive the net number of shares sold by a CEO in a year, we take last year's stock holding from ExecuComp, add the number of new shares acquired through option exercises and stock grants, and then subtract the current stock holding. If the resulting number is positive, then the CEO sold shares on the open market. Our procedure closely resembles that of

Jenter (2005). In all our calculations, we treat missing share ownership as a missing observation, rather than treating it to be zero ownership.[11]

While the above is a precise measure of the actual shares sold on the open market, a part of the selling might be attributed to selling in response to option excises. Ofek and Yermack (2000) document that CEOs frequently sell all of the stock acquired through option exercise. Such selling, while it still reduces the CEO's incentive, might not be perceived by the market as "information revealing," and therefore a CEO might feel less constrained in selling the shares. As a robustness check, we therefore construct an alternative measure of selling that excludes the sales linked to option exercise and restricted stock grants.

Exposure to firm risk. We measure a CEO's exposure to firm risk as the sum of exposures from her stock and option positions. Following Yermack (1995) and Hartzell and Starks (2003), we measure the exposure from options using the option delta. For the combined exposure from stock and options, the aggregate delta is the delta of options multiplied by the number of options granted, plus the number of shares. Therefore, the CEO's wealth rises by the aggregate delta for every dollar increase in the firm's share price.[12]

Cost of under-diversification. To measure the cost of a one-year deferral in the selling and exercising of the vested stock and options, (i) we treat these as if they are still restricted for

[11] A missing value of stock ownership in ExecuComp does not necessarily mean zero ownership, as it could be a misreport of the company proxy statement or an error by ExecuComp. We hand-checked some of the missing values. For example, Jack Michaels, CEO of HNI Corporation, has a missing value in his Shares owned for fiscal year 1999. Upon checking the Proxy Statement, the actual number of shares owned in this case is reported in the "INCUMBENT DIRECTORS" section as 208,012. Thus, this is an error in the company's financial reports. We exclude all such missing data rather than inferring them to be zero.

[12] The aggregate delta measure enables us to calculate various "derivative measures." For example, if we divide the aggregate delta by the number of shares outstanding at the beginning of the year, and multiply it by 1,000, this gives us the familiar dollar change in managerial wealth per $1,000 change in shareholder wealth. Alternatively, if we want to measure how much the executive's wealth will increase for a 1% change in share price, it is the aggregate delta dividend by the share price. As another example, if we want to measure how many percentages the executive's within-firm wealth change for a 1% change in share price (the "elasticity" of executive wealth to firm value), it is $1/$P * delta / $V, where $V is the total dollar value of executive wealth in firm (both stock and options value).

another year, and (ii) use Hall and Murphy's (2002) utility-function based approach to estimating a CEO's cost of under-diversification. They assume a specific utility function (constant relative risk aversion with a relative risk aversion parameter of three) and make specific assumption about the amount of CEO wealth invested in the firm's stock and options. Although the utility function, the risk aversion parameter, and the CEO wealth are all unobservable to the researcher, the Hall and Murphy (2002) approach is being used in the literature (see, for example, Malmendier and Tate, 2004 and 2005) with robustness being tested using a range of firm-specific CEO wealth and risk aversion parameters.

In the original approach of Hall and Murphy, the CEOs' firm specific wealth in any given year is assumed to be fixed at 50% (or 67%) of the CEO's overall wealth. Since we analyze panel data spanning multiple years, we can adjust the CEO's proportion of firm specific wealth according to firm performance. Specifically, we assume that in the first year the CEO appears in our sample, the firm-specific wealth is 50% of the CEO's total wealth. In subsequent years, we assume that the firm-specific wealth grows at the rate of firm performance, whereas the CEO's remaining wealth grows at the market return under the assumption that it is invested in the stock market.[13] There are two advantages of our modification of the Hall and Murphy assumption. First, we believe that allowing the level of under-diversification to be related to firm's past performance is internally more consistent with all of our other assumptions. Second, since past performance is likely related to the CEO's tax burden, ignoring the effect of firm performance in measuring our proxy for the cost of under-diversification might have imparted a bias against it. Our modification explicitly captures the effect of firm performance, but we note that we obtain similar results without the modification.

[13] Results are insensitive to different assumptions about the performance of the CEO's outside wealth.

We calculate the cost of under-diversification (i.e., the discount a CEO might apply for holding firm equity in her portfolio) as a percentage of the fair market value of the firm equity owned by the CEO. Each year we rank this percentage cost of under-diversification across all CEOs and use the rank as the cost of under-diversification.[14]

Our tests merely control for the potential (indirect) impact of under-diversification cost on CEOs' selling of vested equity. Extant literature documents that under-diversification costs should reduce the incentives provided by CEOs' total holding of all equity -- both vested and non-vested. Our tests focus on the selling (rather than holding) and on vested equity (rather than total equity). Thus, the tests here do not constitute a test for or against the hypothesis that under-diversification would negatively affect levels of total incentives.[15]

Managerial overconfidence. We adopt Malmendier and Tate (2005) measure of managerial overconfidence, which is based on indications of a CEO's overconfidence as reported in financial press. Specifically, Malmendier and Tate (2005, p. 14) define their measure as:

> "We also collect data on how the press portrays each of the CEOs during the sample period. We search for articles referring to the CEOs in *The New York Times, Business Week, Financial Times*, and *The Economist* using LexisNexis and for articles in the *The Wall Street Journal* using Factiva.com. For each CEO, we record four statistics: the total number of articles; the number of articles containing the words "confident" or "confidence;" the number of articles containing the words "optimistic" or "optimism;" and the number of articles containing the words "reliable," "cautious," "conservative," "practical," "frugal," or "steady." We hand-check each article to be sure that the terms are used to describe the CEO in question. In the process of scanning the search output, we separate out any articles specifically describing the CEO as "not confident" or "not optimistic"."

[14] Alternatively, Meulbroek (2001) proposes a measure that does not depend on a specific utility function. We also conduct analysis using the Meulbroek approach and find that the results are similar to those reported in the tables.

[15] In unreported tests, we do find that the total holding of incentives in our data still is significantly negatively affected by the under-diversification cost.

We follow the Malmendier and Tate (2005) procedure in measuring the financial press-based measure of a CEO's overconfidence, but expand the media sources to include *Fortune*, *Forbes,* and the *Time* magazine.[16] We also employ an alternative measure of overconfidence using the CEO's "net buying of stocks," as in Jenter (2005), and find similar results.

CEO overconfidence should not be confused with lower CEO risk aversion. Both could be operative, but the two are subtly different. Overconfidence is a behavioral attribute that is at odds with a (Bayesian) rational model. In contract, a less risk-averse CEO, if rational, would behave differently compared to an overconfident CEO. Specifically, less risk-averse CEOs would still not hold firm equity when given the choice between firm equity and the market portfolio because the latter represents a better risk-return tradeoff. That is, for the same level of risk, the market portfolio gives a higher expected return than the (un-diversified) firm stock.

Tax liability or tax burden. An intuitive measure of the incentive to defer tax is the potential tax savings from deferring the selling of equity or exercising of options by one year. To estimate the incentive, we start by measuring the total tax liability assuming the CEO would sell/exercise her entire vested (i.e., unrestricted) stock and option portfolio.[17] The tax liability is the product of taxable income and the tax rate. Taxable income is the difference between the sale price in excess of the tax basis, i.e., cost at which the CEO acquired the security. Stocks and options are typically taxed at different rates. Stock sales attract capital gains tax, which is

[16] Malmendier and Tate (2003) also use another measure that is based on a CEO's persistent holding of options after vesting. However, we are less confident that this really captures overconfidence: the practice might be (almost) rational, if the cost of lost diversification is small relative to the cost of early exercise of the options. This might happen, for example, if the firm has low idiosyncratic risk (so the cost of lost diversification is low), or if the firm has high systematic risk and low dividend yield (so that there is more time value of the options).

[17] The tax saving from a one-year deferral equals the calculated total tax liability times the one-year after-tax return on investment. To see this, assume the pre-tax wealth today is W, the (weighted average) tax rate is τ, and the one-year pre-tax investment return is r. Then, if CEO pays all of the tax today and invests the after-tax proceeds at the after-tax return for the next year, the total after-tax payoff is $W(1-\tau)(1+r(1-\tau))$, whereas if she defers all of the tax till next year, the total after-tax payoff is $W(1+r)(1-\tau)$. The difference is $W\tau * r(1-\tau)$.

typically lower than the tax on ordinary income. Since most of the options granted to executives are non-qualified stock options, they trigger an ordinary income tax at the time of exercise.

To calculate the effective tax rate on the combined stock and options position, we first compute the total tax if the CEO were to sell all of her vested stock and options. The tax calculation uses the appropriate tax rate for stock and options.[18] To convert the calculated total tax liability into a per share amount, we recognize that the sale of one share of the stock or one option changes the CEO's exposure by different amounts. We therefore transform the options position into equivalent stock position by each option as δ shares, where δ is the hedge ratio or the "delta" of options. We then calculate the tax liability "per share equivalent" as the total tax liability divided by the total number of share-equivalent holdings. The appendix contains a detailed description of the procedure we use to estimate the per share effective tax liability.

Using the tax liability per share, we compute the "percentage tax liability" as (Current Price – Average Effective Tax Basis) / Current Price. This measure informs the CEO's tax liability for one dollar sale of her equity holdings. While intuitive, it can have significant outliers on the downside, because the measure is unbounded from below. To derive a measure that is less susceptible to the outlier problem, we construct an alternative defined as the natural log of (Current Price / Average Effective Tax Basis). This measures the continuously compounded rate of price appreciation of a CEO's holdings, and it is more symmetrically distributed. We perform analysis using both the measures with qualitatively very similar results. For parsimony we report the results using the log price appreciation measure.

[18] We assume all the CEOs are at the maximum marginal tax rate for their ordinary income and capital gains tax. We use the applicable historical tax rate for each year during our sample period.

Control variables. We include a series of control variables designed to remove their impact on a CEO's decision to sell firm equity that might otherwise be spuriously inferred as due to tax, overconfidence, or other economics determinants discussed previously.

CEO and corporate governance characteristics. A number of CEO characteristics and corporate governance variables affect executive compensation, which in turn affects CEOs' equity positions and thus might also affect their selling of equity. We therefore include CEO and the firm's governance characteristics as control variables. The variables we consider are: CEO tenure, as longer tenure might lead to the CEO acquiring more power and pay (Chen, 2004); joint CEO/chairman title, as the duality these titles can lead to board decisions biased in the management's favor (Jensen, 1993); institutional ownership, which is often linked to the strength and quality of corporate governance (Hartzell and Starks, 2003, and Chidambaran and Prabhala, 2003). However, the impact of institutional ownership on the CEO's equity holdings and selling behavior is ambiguous: institutional investors might require the CEOs to retain vested equity as a motivator for superior firm performance, but institutional monitoring might be effective in mitigating the agency problem and thus inducing high powered incentives via equity ownership might be less warranted. In our regression specifications, we control for tenure, dual CEO-chairman title, and the level of institutional ownership.

Mechanical relation between selling and grant. CEOs' sales of vested equity could be a predictable function of the company grants in the current year (Ofek and Yermack, 2000). We control for new grants, appropriately normalized. For the options, we use the option delta to convert the exposure to a share-equivalent exposure. Since we have detailed information about the exercise price and maturity of the options grants, the delta is estimated quite precisely.

Implicit and explicit labor market contracts. Implicit and sometimes explicit labor market contracts might dictate the CEOs to hold certain amount of equity. If such contracts are related to industry characteristics, e.g., human capital specificity in different functions, then industry fixed effects would control for their confounding effect on the CEOs' selling of equity. We include additional firm- and CEO-specific control variables, e.g., the book-to-market ratio and firm size, CEO tenure and age, to control for the impact of implicit labor market contracts.

CEOs potentially timing the sale of equity. Noe (1999) and Ke, Huddart, and Petroni (2003) suggest that even though CEOs' equity selling is unrelated to immediate future earnings, it might be associated with the firm's longer-term profitability. In particular, if the firm's long-term prospects are promising, they might be disinclined to sell their equity. We proxy for this behavior using one-year-ahead realized earnings deflated by price. Ideally, it would have been desirable to also include three-to-five-year-ahead realized earnings, but since our panel only spans seven years, losing 3-5 years of data would have rendered the results meaningless.

Past firm performance. We additionally control for the firm's past performance, measured by the past three-year market model-adjusted return. Past performance is (i) positively, but imperfectly, related to the CEO's tax burden[19]; (ii) it contributes to overconfidence; and (iii) it raises the CEO's under-diversification cost. In addition, it might subtly affect the implicit and explicit labor market contracts as better performing CEOs might be less subject to the scrutiny of the board and have more freedom to dispose off shares in the firm.

Additional control variables. We include two additional control variables: i) the CEO's age and ii) the CEO's tenure, both to proxy for entrenchment, risk aversion, outside wealth, and

[19] Past performance is not perfectly correlated with the tax burden measure, both because (i) our measure of past performance filters out the market return component, and (ii) the tax burden depends on the appreciation of the manager's portfolio rather than the firm, and is affected by both (overall) performance and the timing of the acquisition of the portfolio.

to control for the mechanical effect of accumulated stock and options in CEO's portfolio on the selling behavior. In addition, career concerns related to CEO age and tenure might affect the optimal incentive level (Gibbons and Murphy, 1992). The difficulty we encounter in using the two variables is that they are missing for a large number of observations in the ExecuComp database. We decided against sacrificing the sample size, so we present results using the two variables only as robustness checks.

4. Descriptive statistics and Results

In this section we begin with the descriptive statistics for the data used in the empirical analysis (section 4.1). In section 4.2 we discuss descriptive evidence on CEOs' selling behavior, which reveals that selling of equity by the CEOs is quite prevalent. Section 4.3 examines the economic determinants of CEOs' selling of equity.

4.1 Descriptive statistics and cross-correlations

Table 1 reports descriptive statistics for the main variables used in the empirical analysis. The vested equity and many other variables contain outliers, as evidenced by a very large skewness in the data. To ensure that our inferences are not unduly affected by the outliers, we truncate the following control variables at 1% and 99% level: new grant, institutional holding, past performance, assets, book-to-market, and future EPS.[20] The tabulated results are based on outlier-truncated data, but we do not find a qualitative change in the results due to truncation.

We report statistics based on all the firm-year observations available individually for the variables. Therefore, there is considerable variation in the number of observations with far fewer data points for tenure and age variables. CEOs on average own 3.16% vested equity, which is

[20] Our main independent variables of interest, the tax burden, the cost of lost diversification and the overconfidence measures are not truncated, because they have few outliers and the skewness is in general pretty low.

the share-equivalent ownership of vested stock and options. Not surprisingly, CEO ownership is right-skewed, with 75th percentile ownership being only 2.46% whereas the maximum ownership is 35.1%. Average tax burden is a substantial 26% continuously compounded with a wide range of values across the sample. Since the cost of under-diversification is a ranked measure, its distributional properties are set mechanically with a mean of 0.50. The two overconfidence dummies show that 13 and 29% of the CEOs are characterized as overconfident on the basis of press mentions and the CEOs' purchase of firm equity in the open market. New grants of equity on average are 0.174% of the firm's outstanding shares, but this variable also exhibits considerable right skewness. Institutional investors own over half of the equity of the typical firm in the sample. Average tenure of the CEO with the firm is almost 17 years, but the high number is because not all of the tenure is as the CEO.

[Table 1]

Table 2 reports Pearson product-moment correlations among the main set of variables. CEO equity ownership has a significant 0.06 correlation with tax burden, which is consistent with CEOs not selling appreciated equity to defer taxes. CEO ownership's correlation with the overconfidence proxies exhibits mixed evidence. When overconfidence is proxied for on the basis of whether the CEO has purchased firm shares on the open market, it's positively correlated with ownership, but the overconfidence proxy on the basis of press mentions is not significantly correlated. Similarly, the cost of under-diversification is not significantly associated with ownership. CEOs' ownership decision does not seem to be particularly influenced by the diversification consideration. Both past performance and the dummy for CEO-Chairman dual title are significantly positively correlated with CEO ownership, which is not surprising. CEOs with good past performance are rewarded with equity and also are more likely

to assume the dual title. Tax burden has a positive correlation of 0.45 with past performance, which suggests CEOs do not sell appreciated equity that had generated a tax overhang.

[Table 2]

4.2 Descriptive evidence on CEOs' selling behavior

Selling of stock. Table 3 Panel A reports the results focusing only on the sale of unrestricted stock by the CEOs. On average, a little more than 40% of the CEOs sell their vested stock each year. The median (mean) sale is 15% (24%) of the existing stock position that includes the current year's stock grant. Using the traditional measure of pay-for-performance sensitivity, the selling significantly affects CEOs' incentives: the median (mean) sale would have affected the CEO's wealth by $1.02 ($5.08) per $1,000 change in shareholder value if the CEO had held on to the shares. The sale represents a median decline in the CEO's share ownership in the firm of 0.10% (0.51%), which is a sizable fraction of the CEO's total stock ownership. Recall that the median (mean) CEO ownership from table 1 is 0.79% (3.16%).

[Table 3]

Even though selling of shares lowers a CEO's incentive, the net change in the CEO's incentive from the previous year might still be positive because of new stock grants and option exercise during the year. The second measure in table 3 excludes the stock sales that immediately follow option exercises. The results show that 28% of the CEOs sell their stock, which amounts to a median (mean) decline of 7% (15%) in their existing equity position. This represents a decline in the median (mean) pay-for-performance sensitivity by $0.70 ($5.53) of CEO wealth per $1,000 change in shareholder value.[21] Taken together, many CEOs sell their stock annually and that the amount sold represents a non-trivial fraction of their stock ownership.

[21] We also adjusted the CEOs' equity sales for the amount of restricted stock grants. The tenor of descriptive statistics is unchanged. This is not surprising because restricted stock grants are relatively infrequent.

Analysis of stock selling with controls for options. A weakness of the previous analysis is that even after selling her stock, a CEO's total exposure from stock and options might not decrease. Since options during the period of analysis of this study account for a large proportion of both new grants and total equity (i.e., stock plus options) holdings of a CEO, excluding the effect of changes in option holdings could potentially lead to erroneous inferences. Below we examine the change in a CEO's total exposure from stock and option ownership as a result of stock selling. We measure total exposure somewhat crudely by simply summing the number of shares and the number of options owned by a CEO. This overstates the exposure because the option delta is strictly less than one. However, measuring the exposure to firm risk from options as the number of options times the delta of the options introduces a complication: option delta changes with the stock price, so that even without the CEOs actually selling or exercising anything, the CEO's exposure to firm risk will fluctuate.[22] Since we overstate the CEO's exposure from her equity holdings, the estimated change in the exposure as a result of any sale of shares is understated.

At the end of each year t, we add the restricted stock and option grants for the current year t to a CEO's total reported holding of stock and options at the end of year t-1. From this calculated gross equity position we subtract the *reported* stock and options position of the CEO at the end of year t. A positive difference implies the CEO sold stock in year t. Using this definition of selling, table 3, panel B reports that 42% of CEOs sell stock during a year. The median ratio of selling to the total combined holding of stock and options inclusive of the current

[22] A "third approach," which addresses the fact that option delta is less than one, but does not allow the exposure from options to fluctuate with stock prices, is to assume a "constant delta" for the options. Previous research, e.g., Ofek and Yermack (2000), assume an average delta of about 0.6. This approach yields results that fall between the results reported in panels A and B of table 3.

year grants of stock and options is 8% and the mean is 13%. This is equivalent to a median (mean) reduction of incentives of $1.23 ($6.02) per $1,000 change in shareholder value.[23]

4.2 Determinants of equity selling behavior

Determinants of the sale of vested stock. We estimate the following model based on equation (1) of the determinants of the sale of vested stock by CEOs:

$$\text{Sale of stock} = a_0 + a_1 \text{ Tax liability} + a_2 \text{ Cost of under-diversification} + a_3 \text{ Overconfidence} + \text{Control variables} + \text{error} \quad (2)$$

where the control variables are: lagged ownership of vested equity, current year's grant of stock and options, past stock return performance measured as the three-year market-model-adjusted cumulative abnormal performance up to the end of the previous fiscal year,[24] the natural logarithm of market value of equity, the book-to-market ratio, the one-year forward looking EPS per share deflated by the share price at the end of the fiscal year, the proportion of firm equity held by institutional investors, a dummy for dual CEO-Chairman title, and, in some specifications, CEO tenure and CEO age. We include lagged ownership of vested equity because the level of ownership itself might affect the extent of selling of stock by the CEO in the current period. The reason for excluding CEO tenure and age in some specifications is to avoid losing many observations for which tenure and age are unavailable.

Eq. (2) is estimated annually from 1996-2002 using only the observations where a CEO has sold stock. We also include industry-level fixed effects using two-digit SIC codes to address

[23] Further adjustments that assume sale of stock in response to new grants of options and restricted stock slightly lower the magnitude of stock selling, but leave the tenor of the results unchanged.

[24] There is a mechanical relation between past performance and our measure of tax burden, as better performing firms will have more appreciation and thus higher tax burden. However, this should work against finding evidence supporting our tax-burden hypothesis. Past performance should not be perfectly correlated with tax burden for at least two reasons: one, we use risk-adjusted past performance whereas tax burden is based on raw performance; two, managers acquire equity in their firms at different points in time, thus even the same price appreciation over a given past period would result in different tax consequences. The mix of stock and options varies across managers, which matters because gains on stock and options are taxed at different rates.

the concern that implicit labor market constraints might be industry-specific. We report time-series averages of the estimated coefficients for each variable and Fama-MacBeth (1973) standard errors corrected for first-order autocorrelation (see Pontiff, 1996).[25]

Table 4 reports the regression results. The results show that the tax burden significantly discourages CEOs from selling their stock. The coefficient on the tax burden variable, -0.21 (t-statistic = -3.05) is economically large. For a one standard deviation change in tax burden (0.65 from Table 1), the CEO's stock selling will reduce her exposure (i.e., pay-for-performance sensitivity) by 0.14% of shares outstanding (see the second column in table 4). The reduction is a nontrivial fraction of the mean (median) selling of a CEO at 0.51% (0.10%) reported in table 3. By comparison, the overconfidence proxy is much smaller and statistically less significant. Specifically, the coefficient on overconfidence is -0.09 (t-statistic = -1.28). This implies a reduction in the CEO's exposure by 0.03% of shares outstanding when overconfidence shifts by one standard deviation. Results for the control variables show that the amount of current grant of stock and options, past stock return performance, and the extent of institutional ownership all (marginally) significantly increase the amount of stock a CEO sells in a year.

Somewhat surprisingly, under-diversification cost does not appear to be a significant factor determining the selling of vested equity. There might be various reasons for the result. First, as mentioned earlier, we do not perform a direct test of the impact of under-diversification cost on total CEO equity holding (both vested and non-vested). The variable is included primarily as a control for under-diversification in the regression to explain CEOs' selling of vested equity. Second, as suggested in the literature, CEOs might be overconfident, and they

[25] We also tried other approaches. For example, we used a regression clustering at the industry level, and controlling for yearly fixed effect. The panel data in our study is likely to exhibit both time-series and cross-sectional correlations. The regression with clustering at industry level and yearly fixed effects would account for bias due to the correlations (see Petersen, 2005). The regression results, not reported, are qualitatively similar to those in the paper.

might also be less risk averse. Thus, the discount they apply to their under-diversified positions might be lower than that predicted by models like Hall and Murphy or Muelbroek. Third, and perhaps most important, our estimate of the under-diversification discount might contain significant error for multiple reasons, including hedging by the CEOs.

The error in measuring the under-diversification cost, however, is unlikely to explain the significance of the tax variable. The error, in fact, is likely to bias against finding a significant tax coefficient. This inference follows from an errors-in-variables analysis in a simplified setting of equity selling regressed on tax burden and under-diversification cost. In this case, the two independent variables are positively correlated and under-diversification positively affects the CEO's propensity to sell equity. Therefore, measurement error in the under-diversification cost variable would positively bias the coefficient on tax burden (see Levi, 1973, and Greene, 2000, pp. 377-378). We caution, however, that inferences about the direction of bias are muddled if multiple variables in the regression contain measurement error.

[Table 4]

We briefly discuss how our evidence squares with that in previous research. Our results on the relation between current equity grant and CEO selling are broadly consistent with those in Ofek and Yermack (2000) that higher-ownership managers negate much of the increase in the incentive effect by selling previously owned shares. Our results show that past performance positively affects selling and negatively affects holding of vested equities, although the effect is not always significant. Our findings are also consistent with Huddart and Lang (2003) and Bartov and Mohanram (2004) that CEOs time the selling/exercise after stock run-up. In addition, our results suggest that future EPS, measured using one year forward-looking EPS normalized by the current share price, decreases the selling of vested equities. The result is

broadly consistent with their interpretation, and with the result of Noe (1999) and Ke et al. (2003). Like Huddart and Lang (1996) and Core and Guay (2001), we find that option exercise is positively related to stock returns during the preceding month and negatively related to returns over longer horizons. This might be reflective of a behavioral bias on the part of managers, but we refrain from such an interpretation because we have separately included at least one proxy for the manager's behavioral bias, namely overconfidence.

Results in the last two columns of table 4 show that including controls for CEO tenure and age do not alter the findings qualitatively. The importance of tax burden in discouraging a CEO from selling her stock rises considerably. This is also true of the current grant of stock and options, past return performance, and of institutional ownership. The total number of observations, unfortunately, is only about 25% as large as that without requiring CEO tenure and age data.

Determinants of the sale of vested stock and options. Preceding analysis focused only on the changes in a CEO's stock holdings. However, the CEO derives incentives from stock as well as options, which account for a large fraction of the total equity portfolio of a typical CEO. Moreover, as a CEO exercises her options and receives shares as a result, the incentive rises mechanically because option delta is strictly below one. It is possible that the CEO's decision to sell stock is due in part to undo the increase in the incentive from her exercise of options, or from an increase of the option delta as the stock price rises. Therefore, we examine the effect of taxes, overconfidence, and other determinants on a CEO's decision to sell equity (i.e., stock and options). Table 5 reports the results of estimating Equation (2) except that the dependent variable is the annual change in vested equity of a CEO. The results are similar to those in table 4 using CEOs' selling of vested stocks.

[Table 5]

4.2.3 Discriminating between overconfidence and taxes

Previous analysis shows the importance of taxes in CEOs' decision to sell equity. However, a potential criticism is whether our proxies for overconfidence and taxes truly measure the distinct motivations affecting the CEO's decision to sell equity. Specifically, one source of managerial overconfidence is likely to be managers' biased attribution of past superior performance to their own skill, which could make managers overconfident. Since superior performance typically translates into a stock price run up and thus generates tax burden, our proxy for taxes could also be serving as a proxy for overconfidence. Therefore, the results in tables 4 and 5 cannot unambiguously inform us about the importance of taxes. We use the behavior of institutional investors to remedy the weakness.

If tax and overconfidence are so intertwined, such that the tax variable merely proxies for overconfidence, then a comparison between managers and tax-sensitive institutions can uncover the incremental impact of overconfidence on managers' equity-selling decisions. Assuming that the tax measure also proxies for overconfidence, we expect managerial selling to be more sensitive to such a tax measure than institutional selling. Both taxes and overconfidence should discourage managerial equity selling, whereas only tax considerations should discourage institutions selling the equity. Thus, we predict a negative coefficient of larger magnitude on the tax variable for CEOs than for institutions in a matched sample.

Table 6 reports results of comparing the selling behavior of CEOs with those of taxable institutions. Institutions with mainly taxable clientele are identified using the approach developed in Jin (2005). In particular, using the investor profiling information obtained from the Investment Adviser Public Disclosure (IAPD) data maintained by the SEC, we classify as tax-

sensitive those institutions whose clientele consists primarily (>=50%) of tax-sensitive investors such as high net worth individuals. Institutions are classified as non-tax-sensitive if non-taxable clients such as pension funds, state and local governments, and charitable organizations account for more than 50% of their clientele. The analysis is conducted using a matched sample of CEOs selling equity and matching institutions that have also engaged in stock selling during the year. Specifically, for CEO selling equity, we identify all institutions with taxable clientele and selling the same stock during the year, and randomly choose one institution. If a matching institution cannot be identified, we drop the CEO observation from the regression.

The estimated regression model is:

$$\begin{aligned}\text{Sale of stock} = {} & a_0 + a_1 \text{ Manager dummy} + a_2 \text{ Tax liability} \\ & + a_3 \text{ Manager Dummy x Tax liability} \\ & + a_4 \text{ Manager Dummy x Cost of under-diversification} \\ & + a_5 \text{ Overconfidence} + \text{Control variables} + \text{error} \qquad (3)\end{aligned}$$

where manager dummy variable equals one for the CEO observations, and zero for the matching institutional investor observations; overconfidence for the institutional investors is set equal to zero, whereas for managers it is estimated as described previously, and all other variables are also as described earlier in the paper. In Equation (3), the manager dummy is interacted with the tax liability and cost of under-diversification. The latter implies that the cost of under-diversification for institutional investors is zero. The coefficient on manager dummy interacted with tax burden estimates whether managers' propensity to optimize on taxes via their selling behavior is greater or less than that exhibited by institutional investors.

Table 6 reports the regression results with the first pair of columns using the CEO's stock selling behavior as the dependent variables, and the last two columns using the share equivalent of both stock and options holding of a CEO. For the institutional investor, selling refers only to stock selling in both sets of regressions. For the CEO and institutions, selling is expressed as a

percentage of the respective CEO's and institution's stock holding, and not as a percentage of the shares outstanding for the firm. The reason is that the amount of ownership for institutions and CEOs is likely to be of different orders of magnitude.

[Table 6]

The results in table 6 clearly demonstrate the importance of taxes on managers' and institutions' decision to sell stock. The coefficient on tax burden, -0.09, is highly significant in both sets of regressions. The tax burden variable interacted with manager dummy is significant and positive, which suggests that managers are not as sensitive to tax implications of selling as institutional investors with taxable clientele. The decline in managers' sensitivity is far more salient when their selling behavior is examined using their entire equity portfolio (i.e., stock and options), not just the stock portfolio. The coefficient estimate in the last column suggests managers are only one-third as sensitive as institutional investors to tax burden in their decision to sell equity.

In table 6, the managerial overconfidence variable in the first column has a marginally significant coefficient, -0.02 (t-statistic = -1.86) when stock sales are measured as a percentage of the CEO's stock portfolio, and the coefficient in the third column is not significant when stock sales are a percentage of the CEO's stock and option holdings. Recall that the overconfidence is assumed to be zero for the institutional investors included in the regressions. Overall, the results for the tax variable and the overconfidence variable together suggest; (i) taxes significantly influence managers' and institutions' decision to sell equity, whereas overconfidence plays only a limited role; and (ii) managers exhibit a less tax-savvy behavior compared to institutional investors. However, the usual caveats obviously apply: we might not have measured overconfidence accurately, and under-diversification and other considerations that are likely to

be critical to CEOs, but not to institutional investors, might be confounding the results and leading to a muted effect of overconfidence on the managers' stock-selling decision.

4.3 Additional tests and robustness checks

In this section, we summarize the results of a number of additional tests and a series of robustness checks all of which are aimed at demonstrating the stability of the findings in the previous sections. Two additional tests are reported. The first test examines whether the level of stock and option holdings is influenced by tax burden, overconfidence, and other economic determinants. The second test uses a different proxy for overconfidence, namely a CEO's purchase of the firm's stock, to test whether the level of stock and option holding is determined in part by tax burden, overconfidence, and other factors. We summarize these additional tests below followed by a discussion of robustness checks.

Explaining the level of equity holdings. Sale of stock by a CEO may not reduce the CEO's incentive because of new stock and option grants and option exercise. Therefore, while selling of stock is informative and of interest, the CEO might be optimizing on her level of equity holdings and the sale of stock is only a byproduct of that optimization. In addition, only about 40% of the CEOs sell stock in any given year, which means the sample size more than doubles when we explain the level of their equity holdings.

Table 7 reports results of explaining CEOs' level of stock and option holdings. Because stock holding levels are sticky through time, we include lagged holdings as a control variable. We also include current period's grants of stock and options as a control variable. The results show that tax burden is a significant positive determinant of a CEO's stock holding. Overconfidence also comes in significant, but its economic importance is considerably less than tax burden. One standard deviation increase in tax burden has about one and a half times as big

an impact on the CEO's level of equity holding as overconfidence. Cost of under-diversification also has a big impact on holding of vested equity, but the effect is economically less salient. Many of the control variables explain CEO's equity holdings as predicted. For example, CEO's lagged holdings are highly significant and cause the average cross-sectional explanatory power to be 84.0%. In addition, CEO's percentage holdings in a firm decline steeply with firm size (see Baker and Hall, 2004 and Schaefer, 1998) and CEOs with the dual title of chairmanship hold more equity. The latter result suggests that the relatively more successful and longer tenure CEOs hold the dual title and, not surprisingly, such CEOs have greater equity ownership accumulated over time. Unreported results using only the stock holdings of the CEOs yield results similar to those reported in table 7. Overall, the evidence underscores the importance of taxes as a determinant of CEO ownership and sale of equity.

[Table 7]

CEO's stock purchase as an alternative measure for overconfidence. The measure of overconfidence used in the analysis so far is constructed from press reports on CEOs and their firms, which follows the Malmendier and Tate (2003) methodology. An alternative measure of overconfidence is a dummy variable that defines a CEO as overconfident if she purchases stock on the open market. Since the CEO's stock purchase is in addition to the stock grants and option exercise during the year, such purchases cannot be motivated by tax considerations and they are unlikely to be due to concerns about under-diversification. We attribute the buying behavior to CEO overconfidence. However, this measure suffers from one serious problem. Since CEOs purchasing stock are designated as overconfident, the measure is mechanically positively correlated with the manager's level of equity holding. Therefore, the coefficient on the overconfidence dummy variable is expected to capture the marginal impact of overconfidence as

well as the mechanical increase in the CEO's equity holdings as a result of the buying. Therefore, our goal in using this alternative measure of overconfidence is primarily to examine whether taxes continue to play a role in the manager's decision about the level of equity holding. More importantly, the estimated effect of tax burden is likely to be conservative because of the mechanical relation between the new measure of overconfidence and the level of equity holding.

Results in Table 8 show that tax burden remains a significant determinant of the CEO's level of equity holdings. Not surprisingly, overconfidence is a stronger determinant of equity holdings than tax burden for the reasons discussed above. Lagged holdings and other control variables explain CEOs' equity holdings as in Table 7. The takeaway from Table 8 is that, notwithstanding a mechanical relation between overconfidence and equity holdings, tax burden continues to impact the CEO's level of equity holding.

[Table 8]

Other robustness tests. The following robustness tests produce qualitatively similar results as reported in the tables. All the tables present results using Fama-MacBeth regressions with a fixed industry effect to control for implicit industry-level labor-market contracts that might affect CEO's equity selling decisions as well as compensation practices across industries. We believe these results are most conservative in controlling for various confounding effects and in gauging the statistical significance of the estimated coefficients. We repeat the analysis using OLS regressions with industry and year fixed effects and using clustering regressions at firm or industry level to calculate standard errors.

We experiment with alternative methods to estimate a CEO's options position through time. The tabulated results are based on the Core and Guay (1999) method. We repeat the

analysis using options positions estimated with a detailed method to account for each batch of options using the grant-date information, as developed in Jin and Meulbroek (2004).

We measure past performance as three-year market-model-adjusted return up to the end of the previous fiscal year. We experiment with performance measured over five years and other methods to estimate abnormal returns (e.g., the Fama-French three-factor model). We also experiment with higher order terms of the past performance.

5. Summary and conclusions

CEOs accumulate large amounts of firm equity because of equity-based compensation and their own decision to invest in the firm's equity. The investment declines as they sell the firm's stock. We present evidence on CEOs' (net) selling of equity. We find that CEOs frequently sell large amounts of their vested equity, which runs counter to the conventional wisdom that CEOs avoid selling firm equity for fear of an adverse stock market reaction.

We also examine the determinants of CEO selling behavior. In particular, we focus on assessing the relative importance of taxes, under-diversification and managerial overconfidence in a CEO's decision to sell her equity in a given year. CEO ownership of firm equity beyond the levels justified by efficient portfolio considerations (i.e., diversification) is often attributed to managerial overconfidence (see, for example, Malmendier and Tate, 2004). However, an immediate tax liability associated with selling equity that has appreciated might also discourage managers from selling firm equity. In contrast, under-diversification cost would motivate the CEO to sell equity. Our in-depth analysis suggests that taxes swamp overconfidence as a factor influencing CEOs' decision to sell, or not sell, their vested equity. Taxes also appear to be a stronger motivation than the under-diversification cost. The importance of taxes in a CEO's

decision to sell firm equity remains significant even after controlling for a wide range of other economic determinants of the CEO's stock selling behavior.

CEO's reluctance to sell equity because of taxes and thus the downplaying of the under-diversification cost seems surprising. The evidence suggests either (i) CEO's are less risk-averse than previously assumed in the literature, or (ii) labor contracts require CEOs to hold stock for incentive reasons and that these incentives are highly correlated with the tax burden (which seems implausible to us); or (iii) CEOs hedge their exposure, which achieves diversification without sacrificing the tax advantage. We do not discriminate among these alternative explanations, but leave it for future research.

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Appendix: Measuring tax burden

We combine the tax liability from selling stock and exercising options to determine a CEO's the total potential tax liability from selling vested stock. This requires separate estimates of the tax burden for stock and options. Because the tax treatment of stocks and options differ, we begin the discussion below with the applicable tax code on the taxation of stocks and options. This is followed by the measurement of tax burden.

Taxation of restricted stock and options grants. Under current US tax law the receiver of restricted stock or non-vested options grant doesn't owe any tax at the time the grant is made, because the grant is still subject to forfeiture and thus risky. The receiver owes ordinary income tax at the time the options or stock vests. This triggers a big tax liability if the stock has appreciated significantly from the time of grant. As an alternative, employees can elect to be taxed within 30 days of the grant date under Internal Revenue Code section 83(b) at the ordinary income tax rate, and subsequently they only pay (lower) capital gains tax on any further appreciation. However, in most cases invoking an 83(b) treatment is not optimal (see McDonald, 2003), and empirically we are not aware of CEOs systematically invoking the treatment. We therefore assume that CEOs never invoke the 83(b) treatment.

Tax burden of stocks. Given our assumptions, a stock enters the tax calculation only when it becomes vested. At vesting, the executive owes ordinary income tax, and subsequent appreciation accrues capital gains tax. We collect from Execucomp detailed information on CEO's holdings of unrestricted stock at the end of each fiscal year from 1992 to 2002. From these, we estimate the tax basis, with the simplifying assumption that all shares acquired during a year were acquired at the end of the fiscal year at the fiscal-year-end stock price. We also experiment with other assumptions about acquisition price (e.g., trading volume weighted

average price during the year), but the results are qualitatively unchanged. If any vested stock is sold, we assume that CEOs sell first the shares with the highest tax basis, in order to minimize realized capital gains or maximize realized capital losses. We use the previous five years' holding and grant information to estimate the first tax burden measure, thus, with our data starting in 1992, our first year of observation for the tax burden is 1996. The unrestricted stock held by a CEO in her first year of data availability on Execucomp is assumed to have been acquired five years earlier. This introduces noise in the tax burden measure, which is likely to reduce its explanatory power.

Tax burden for options. The tax treatment on different types of executive stock options varies (see Hall and Liebman. 2000). The most widely used stock options are the non-qualified stock options (NQSOs). Executives are taxed at the personal income tax rate on option profits (the difference between that stock price and the exercise price times the number of options) when the options are exercised. If the executive continues to hold the shares after exercise, any subsequent appreciation is taxed at the capital gains rate upon sale of the stock. Two other types are Incentive Stock Options (ISOs) and Stock Appreciation Rights (SARs). ISOs are untaxed at grant and exercise, and only taxed at selling of the underlying stock for capital gains. ISOs account for about 5% of all option grants. Stock Appreciation Rights (SARs) are essentially the same as NQSOs except the exercise is cash-settled. These are rarely used. ExecuComp database provides no information about the type of options granted. For simplicity we assume all stock options are NQSOs. Therefore, at any point, the tax liability on a vested option is the ordinary income tax rate times the option's intrinsic value, i.e., the difference between current stock price and exercise price.

Total tax burden. The total tax burden from both stock and options is the sum of the burden from stock and options. This is the total tax the CEO will pay should she decide to sell all of her unrestricted equity. We divide the total tax burden by the sum of the number of shares of stock and delta times number of options, (N_{stock} + delta * $N_{options}$), to calculate a "per share equivalent tax burden." This represents the average tax burden on the CEO from selling one share equivalent of exposure to firm risk. The average effective taxable profit is calculated as the average tax burden per share equivalent exposure divided by the current year tax rate on long term capital gains, and the average effective tax basis is measured as the difference between current stock price and the average effective taxable profit.

Table 1: Summary Statistics of Main Variables from 1996-2002

Variable Name	No. of Obs.	Mean	Median	Std. Dev.	Skewness	Min	Quartile 1	Quartile 3	Max
Holding of vested equity [1]	13,536	3.16	0.79	6.20	0.32	0.00	0.28	2.46	35.15
Tax burden [2]	11,123	0.26	0.17	0.65	0.42	-5.13	-0.01	0.54	4.62
Cost of under-diversification	13,536	0.04	0.04	0.02	0.48	0.00	0.03	0.06	0.10
Overconfidence dummy 1 [3]	12,055	0.13	0.00	0.33	2.23	0.00	0.00	0.00	1.00
Overconfidence dummy 2 [4]	13,536	0.29	0.00	0.46	0.91	0.00	0.00	1.00	1.00
New grant [5]	13,536	0.17	0.08	0.28	0.33	0.00	0.01	0.20	1.75
Institutional holdings	13,536	0.52	0.55	0.20	-0.01	0.06	0.32	0.68	0.94
Past performance [6]	13,536	0.21	-0.06	1.06	2.84	-0.91	-0.39	0.43	5.93
Future EPS/price [7]	10,649	-0.01	0.05	0.28	-6.32	-2.20	0.02	0.07	0.19
Tenure [8]	7,005	16.64	14	12.22	0.54	0	6	26	60
Age [9]	6,795	57.59	57	7.82	0.46	34	52	62	90

Notes:

(1) Number of vested options times option delta, plus the number of vested stocks, divided by total shares outstanding, multiplied by 100.

(2) Cost of under-diversification is the Hall and Murphy (2002) measure of the percentage discount that managers place on the executive stock and options, assuming a relative risk aversion parameter of 3 and that CEOs have 50% of their wealth invested in the firm's equity.

(3) Overconfidence dummy 1 is the dummy for press mentioning of overconfidence, constructed following Malmendier and Tate (2004).

(4) A dummy for CEO buying stocks on the open market in a year.

(5) The new award of options multiplied by option delta, plus the new award of shares, dividend by shares outstanding, multiplied by 100.

(6) The three year market model adjusted cumulative abnormal performance for the stock, up to the end of the last fiscal year.

(7) The next fiscal year's earnings per share divided by price per share.

(8) The number of years since the CEO joined the company.

(9) The age of the CEO.

Table 2: Pearson Correlation Coefficients Between Main Variables of Interest: Data from 1996-2002

	Vested Equity Holding [1]	New Grants (total share equivalent)	Tax Burden	Institutional Holding	Due-CEO Chairman	Cost of Lost Div.	Overconfidence Dummy 1	Overconfidence Dummy 2	Past Performance
New grants of stock and options (total share equivalent) [2]	0.02 0.03								
Tax burden [3]	0.06 <.0001	-0.09 <.0001							
Institituional holding	-0.07 <.0001	0.02 0.00	0.16 <.0001						
Dummy for dual-CEO Chairman	0.09 <.0001	-0.06 <.0001	0.08 <.0001	0.06 <.0001					
Cost of under-diversification [4]	0.09 <.0001	0.02 0.06	0.16 <.0001	-0.02 0.02	-0.02 0.05				
Overconfidence measure 1 [5]	-0.01 0.18	-0.02 0.01	0.05 <.0001	0.02 0.04	0.03 0.00	-0.07 <.0001			
Overconfidence measure 2 [6]	0.05 <.0001	-0.02 0.00	0.04 <.0001	0.05 <.0001	0.03 0.00	-0.39 <.0001	0.02 0.06		
Past performance [7]	0.05 <.0001	0.02 0.01	0.45 <.0001	0.10 <.0001	0.03 <.0001	0.05 <.0001	0.03 0.00	0.03 <.0001	
Future EPS/price [8]	-0.02 0.0699	-0.09 <.0001	0.09 <.0001	0.08 <.0001	0.07 <.0001	0.05 <.0001	-0.01 0.34	-0.01 0.19	0.04 0.00

Notes:

(1) Share equivalent vested equity divided by shares outstanding, multiplied by 100. The share equivalent of the options is calculated as the number of options times the average delta of the options.

(2) The award of new equity divided by shares outstanding, multiplied by 100.

(3) The natural log of the ratio of the current price and the effective tax basis of the CEO's equity.

(4) The ranked measure of the Hall and Murphy (2002) measure of the percentage discount that managers place on the executive stock and options, assuming a relative risk aversion parameter of 3 and assuming that CEOs have 67% of their wealth invested in the firm's equity.

(5) The overconfidence measure 1 is based on the frequency of press mentions suggesting managerial overconfidence as a fraction of total press articles for the firm. This measure is constructed as in Malmendier and Tate (2004).

(6) The overconfidence measure 2 is a dummy variable set equal to 1 if the CEO bought stock on the open market in the year of the observation.

(7) Three-year market-model cumulative abnormal performance for the stock measured up to the end of the previous fiscal year.

(8) The next fiscal year's reported earnings per share divided by price per share.

Table 3: Selling of Vested Stocks By Chief Executives: Data from 1996-2002

Panel A: Stock Only Calculation

Variable Name	As a percentage of Whole CEO sample	Mean	Std. Dev	1%	Quartile 1	Median	Quartile 3	99%
Selling (all inclusive)	40.87%							
Selling / total holding [(1)]		0.24	0.25	0.00	0.04	0.15	0.37	0.97
Selling / Shares Outstanding x 100 [(2)]		0.51	1.82	0.00	0.02	0.10	0.38	6.78
Selling (not including selling due to option exercises)	28.38%							
Selling / total holding [(1)]		0.15	0.20	0.00	0.02	0.07	0.20	0.91
Selling / Shares Outstanding x 100 [(2)]		0.55	2.12	0.00	0.01	0.07	0.33	7.78
Selling (not including selling due to option exercises or to offest current year restricted stock grants)	24.17%							
Selling / total holding [(1)]		0.15	0.20	0.00	0.02	0.06	0.19	0.92
Selling / Shares Outstanding x 100 [(2)]		0.62	2.28	0.00	0.01	0.08	0.39	8.99

Panel B: Stock and Options Combined Calculation

Variable Name	As a percentage of whole CEO sample	Mean	Std. Dev	1%	Quartile 1	Median	Quartile 3	99%
Reduction of combined positions in stocks and options	41.92%							
Reduction / total holding [1]		0.13	0.16	0.00	0.02	0.08	0.18	0.82
Reduction / shares outstanding x 100 [2]		0.60	2.01	0.00	0.03	0.12	0.44	8.01
Reduction of combined stock and option positions (not including reduction to offest current year option grants)	20.72%							
Reduction / total holding [1]		0.13	0.18	0.00	0.02	0.06	0.16	0.87
Reduction / shares outstanding x 100 [2]		0.88	2.67	0.00	0.04	0.18	0.65	12.59
Reduction of combined stock and option positions (not including reduction to offset current year option and stock grants)	19.21%							
Reduction / total holding [1]		0.13	0.18	0.00	0.02	0.06	0.16	0.87
Reduction / shares outstanding x 100 [2]		0.92	2.74	0.00	0.04	0.19	0.69	12.96

Notes:
(1) Selling / total holdings is the selling as a percentage over total holdings, where total holdings is defined as last periods' shares owned, plus this periods' new shares acquired through either new shares granted or options exercised.
(2) Selling / Shares Outstanding x 100 is the ratio of shares sold and total shares outstanding, multiplied by 100.

Table 4: Regression of Selling of Vested Equity: Stock Alone from 1996-2002 [1]

Independent Variables [3]	Dependent Variable: Selling of vested stocks [2]				
	Predicted Sign	Regression Coefficients	Economic Significanc	Regression Coefficients	Economic Significanc
Tax burden	-	-0.21 -(3.05)	-0.14	-0.20 -(3.32)	-0.13
Cost of under-diversification	+	0.05 (1.18)	0.01	0.09 (1.14)	0.02
Overconfidence	-	-0.09 -(1.28)	-0.03	-0.24 -(2.37)	-0.08
Lagged holding of vested equity		0.01 (4.14)		0.01 (2.82)	
Current grant of stock and options		0.06 (6.30)		0.10 (6.70)	
Past performance		0.08 (2.27)		0.11 (2.48)	
Size		0.01 (0.62)		0.01 (0.14)	
Book to market ratio		-0.03 -(1.33)		0.03 (0.78)	
Future EPS/price		-0.30 -(0.63)		-0.57 -(0.80)	
Institutional ownership		0.26 (1.26)		0.39 (1.38)	
Flag for CEO being Chairman		-0.08 -(0.87)		-0.03 -(0.18)	
CEO Tenure				-0.01 -(2.20)	
CEO Age				0.00 (0.22)	
Number of Observations		4,307		1,117	
Average Adjusted R-squared		0.2423		0.2122	

Notes:

(1) Fama-MacBeth (1973) cross-sectional regressions are estimated each year from 1996-2002. The standard errors of the time-series of the estimated coefficients are adjusted for potential serial correlation using Pontiff (1996) and assuming an AR(1) process on the residual terms. t-statistics are reported under each coefficient in paranthesis.

(2) The dependent variable, selling of vested stocks is the net reduction of vested stocks, after accounting for vesting of restricted stocks and exercising of stock options, divided by the total shares outstanding of the firm, and then multiplied by 100.

(3) Independent variables are as defined in Table 1.

Table 5: Regression of Total Share-Equivalent Reductions From Vested Stock and Options from 1996-2002 [1]

	Dependent Variable: Reduction of vested equity [2]				
Independent Variables [3]	**Predicted Sign**	**Regression Coefficients**	**Economic Significance**	**Regression Coefficients**	**Economic Significance**
Tax burden	-	-0.33 -(4.28)	-0.21	-0.50 -(3.03)	-0.33
Cost of under-diversification	+	0.07 (1.25)	0.02	0.09 (0.86)	0.02
Overconfidence	-	-0.17 -(1.46)	-0.06	-0.35 -(2.88)	-0.12
Lagged holding of vested equity		0.02 (4.20)		0.01 (2.68)	
Current grant of stock and options		0.05 (5.51)		0.13 (6.44)	
Past performance		0.06 (1.85)		0.22 (2.82)	
Size		0.05 (1.69)		0.05 (0.49)	
Book-to-market ratio		-0.01 -(0.79)		0.08 (0.69)	
Future EPS/price		-0.34 -(0.72)		-0.52 -(0.58)	
Institutional ownership		0.35 (0.62)		0.20 (0.50)	
Flag for CEO being Chairman		-0.25 -(1.19)		-0.08 -(0.28)	
CEO Tenure				-0.01 -(1.55)	
CEO Age				0.00 (0.13)	
Number of Observations		2,131		561	
Average Adjusted R-squared		0.2632		0.206	

Notes:

(1) Fama-MacBeth (1973) cross-sectional regressions are estimated each year from 1996-2002. The standard errors of the time-series of the estimated coefficients are adjusted for potential serial correlation using Pontiff (1996) and assuming an AR(1) process on the residual terms. t-statistics are reported under each coefficient in paranthesis.

(2) The dependent variable, reduction of vested equity is taken as the first difference of the change in the vested equity (both stock and options), divided by the total shares outstanding of the firm, then multiplied by 100.

(3) Independent variables are as defined in Table 1.

Table 6: Managerial and Institutional Sellings Combined Regressions from 1996-2002 [1] [2]

	Dependent Variables			
	Selling of Stock As a Percentage of Existing Stock Holdings		Selling of Stock As a Percentage of Total Equity (Stock and Options) Holdings	
Independent Variables [3]	**Coefficient Estimates**	**Economic Significance**	**Coefficient Estimates**	**Economic Significance**
Manager dummy	-0.06 -(0.59)		-0.29 -(8.43)	
Tax burden	-0.09 -(22.12)	-0.06	-0.09 -(29.06)	-0.06
Manager dummy x Tax burden	0.02 (1.89)	0.01	0.06 (3.04)	0.04
Manager dummy x cost of under-diversification	0.09 (1.75)		0.05 (1.65)	
Manager dummy x overconfidence	-0.02 -(1.86)		-0.02 -(1.31)	
Past performance	0.02 (3.44)		0.01 (2.73)	
Size	0.00 (0.07)		0.00 -(0.61)	
Book to market ratio	0.00 (1.32)		0.00 (1.19)	
Future EPS/price	-0.07 -(3.12)		-0.07 -(2.52)	
Institutional ownership	0.05 (1.12)		-0.01 -(0.24)	
Number of Observations	3,288		3,288	
Adjusted R-Squared	0.1238		0.2856	

Notes:

(1) Fama-MacBeth (1973) cross-sectional regressions are estimated each year in 1996-2002. The standard errors of the time-series of the estimated coefficients are adjusted for potential serial correlation using Pontiff (1996) assuming an AR(1) process on the residual terms. t-statistics are reported under each coefficient in paranthesis.

(2) For each CEO selling we find a matching selling of the taxable institutional investors, and we only retain those CEOs for which we have a matching institutional selling.

(3) Independent variables are as defined in Table 1.

Table 7: Regression of Holding of Vested Equity: Stock and Options Combined from 1996-2002 [1]

	Dependent Variable: Holding of vested equity [2]				
Independent Variables [3]	**Predicted Sign**	**Regression Coefficients**	**Economic Significance**	**Regression Coefficients**	**Economic Significance**
Tax burden	+	0.21 (3.85)	0.13	0.24 (2.97)	0.16
Cost of under-diversification	-	-0.79 -(1.52)	-0.23	-0.86 -(1.67)	-0.25
Overconfidence	+	0.25 (4.15)	0.08	0.30 (3.74)	0.10
Lagged holding of vested equity		0.84 (6.30)		0.88 (8.74)	
Current grant of stock and options		0.03 (7.54)		0.02 (6.86)	
Past performance		-0.08 -(3.78)		-0.10 -(1.76)	
Size		-0.15 -(5.27)		-0.17 -(6.82)	
Book to market ratio		0.00 -(0.26)		-0.02 -(0.62)	
Future EPS/price		0.23 (1.90)		0.38 (1.33)	
Institutional ownership		-0.22 -(1.17)		-0.15 -(1.44)	
Flag for CEO being Chairman		0.10 (2.80)		0.08 (0.75)	
CEO Tenure				0.01 (1.68)	
CEO Age				-0.01 -(0.52)	
Number of Observations		7,435		1,883	
Average Adjusted R-squared		0.9038		0.9112	

Notes:

(1) Fama-MacBeth (1973) cross-sectional regressions are estimated each year from 1996-2002. The standard errors of the time-series of the estimated coefficients are adjusted for potential serial correlation using Pontiff (1996) and assuming an AR(1) process on the residual terms. t-statistics are under each coefficient in paranthesis.

(2) Dependent variable is as defined in Table 1.

(3) Independent variables are as defined in Table 1.

Table 8: Regression of Holding of Vested Equity: Stock and Options Combined, Using Buying Ordering As Measure of Overconfidence: Data from 1996-2002

	Dependent Variable: Holding of vested equity [2]				
Independent Variables [3]	**Predicted Sign**	**Regression Coefficients**	**Economic Significance**	**Regression Coefficients**	**Economic Significance**
Tax burden	+	0.19 (4.24)	0.13	0.21 (2.36)	0.13
Cost of under-diversification	-	-0.65 -(1.62)	-0.19	-0.53 -(1.81)	-0.15
Overconfidence	+	0.43 (6.34)	0.20	0.63 (4.83)	0.29
Lagged holding of vested equity		0.84 (6.22)		0.89 (10.39)	
Current grant of stock and options		0.03 (7.90)		0.03 (5.96)	
Past performance		-0.06 -(3.31)		-0.03 -(0.47)	
Size		-0.11 -(4.58)		-0.12 -(5.75)	
Book to market ratio		-0.01 -(0.48)		-0.03 -(0.98)	
Future EPS/price		0.19 (1.73)		0.30 (1.26)	
Institutional ownership		-0.21 -(1.15)		-0.13 -(0.84)	
Flag for CEO being Chairman		0.10 (2.96)		0.07 (0.69)	
CEO Tenure				0.01 (2.24)	
CEO Age				-0.01 -(0.49)	
Number of Observations		7,435		1,883	
Average Adjusted R-squared		0.9046		0.9123	

Notes:

(1) Fama-MacBeth (1973) cross-sectional regressions are estimated each year from 1996-2002. The standard errors of the time series estimates of the coefficients are further adjusted for potential serial correlation using Pontiff (1996) with AR(1) on the residual terms. t-statistics are under each coefficient and in paranthesis.

(2) Dependent variable is as defined in Table 1.

(3) Independent variables are as defined in Table 1. Overconfidence measure is dummy for CEO buying stocks on the open market.