

Determinants of Management Ownership of Unrestricted Equity: Overconfidence versus Tax Explanations

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Abstract

We document frequent and large selling of equity by CEOs. Such selling is designed not simply to offset the current year grant of options and stock. We find that the tax burden associated with the sale and (various measures of CEO) overconfidence both decrease CEOs' propensity to sell their vested equity. However, the effect of taxes on a CEO's decision to sell equity is far more pronounced than overconfidence. We also find that taxable institutional investors and CEOs both respond to taxes, although the CEOs appear to be less tax-sensitive. . Other determinants affect the selling decisions largely as predicted in the existing literature.

Keywords:

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

1. Introduction

In the United States equity-based compensation and management ownership of equity (i.e., stock and options) are the principal means of rewarding managerial performance and aligning management's incentives with those of shareholders (see Hall and Liebman, 1998, and Core, Guay, and Verrecchia, 2003). Due to restrictions accompanying the annual grants of stock and options, vesting of equity occurs over a multi-year period. Over time, top managements often accumulate large portfolios of vested or unrestricted equity. 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 evidence of CEOs' (net) selling of equity. CEOs of large US corporations frequently sell large amounts of stock in their own firms, the value of which often exceeds that of new equity grants. Thus, the conventional wisdom that CEOs don't sell their equity for fear of a negative market reaction does not appear to deter CEO's equity sales¹.

Second, we examine the determinants of a CEO's decision to sell vested equity. Examples of research that explores the factors affecting a CEO's selling of equity include Huddart and Lang (1996) and Ofek and Yermack (2000). The determinants identified and explored empirically include diversification, implicit and explicit contracts between shareholders and manager, the manager's liquidity needs, managerial opportunism (i.e., trading on insider information), and managerial overconfidence.² Managerial overconfidence has only recently

¹ The press often states that CEOs are reluctant to sell large amount of company shares, as doing so might dampen stock prices. As mentioned in an article "dirty little secrets" by Jacqueline Doherty, published on Barron's, December 18, 2000, "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), Meulbroek (2001), and Jin (2002); equity

been identified as a factor, but it has quickly become an important determinant because overconfidence is shown to be associated with value-destroying real investment decisions (see Malmendier and Tate (2004 and 2005). Surprisingly, however, personal taxes have received little empirical attention as a factor governing the timing of managers' selling of equity. We are not aware of any study that documents the effect of personal taxes and tax overhang on a CEO's decision to sell equity.

Diversification is an important motivation for a CEO to reduce her investment in vested equity. 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, managers will want to decrease their firm-specific risk exposure by selling off some of their vested equity.³

Obviously, implicit or explicit clauses in the employment contract and labor market expectations might constrain the manager from divesting her equity ownership.⁴ In addition, liquidity needs and a temptation to trade on insider information can also influence the amount and timing of managers' equity sales. Finally, the literature hypothesizes at least two other factors that influence a manager's equity-selling decision: managerial overconfidence and income taxes, which we discuss below.

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).

³ 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.

⁴ 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 managers sell large dollar amounts of their stock without causing a huge stock price decline.

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.⁵ Managers therefore might expect a high rate of 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 distorts firms’ investment and financing decisions. The distortions include overpayment for acquisitions, overinvestment using internal sources of funds, underinvestment using external sources of funds, and so forth. (see Roll, 1986, DeMeza and

⁵ 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.

Southey, 1996, Boehmer and Netter, 1997, Heaton, 2002, Malmendier and Tate, 2004 and 2005, and Bertrand and Schoar, 2003).

Taxes. Managers' decisions about ownership of vested equity are influenced by significant personal tax liabilities incurred upon selling such equity. Managers who sell equity realize a capital gain and an associated immediate tax liability that could otherwise be deferred indefinitely or avoided altogether. Managers exercising options often have to pay ordinary income tax on the gain. In many contexts, tax savings from more efficient tax planning have been shown to be substantial.⁶ In the context of CEO compensation, we observe considerable cross-sectional variation in CEOs' potential tax savings from efficient tax management, and for many CEOs even conservative estimates of the tax effects would be non-trivial.⁷ Thus, an incentive to optimize on taxes could be a first-order consideration for many CEOs.

Since the tax liability is an increasing function of past performance, managers' reluctance to disinvest their ownership in firm 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 potential 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

⁶See 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).

⁷ A back-of-the-envelope calculation indicates non-trivial magnitude of tax savings. Assuming a 20% capital gains tax rate and a 40% income tax rate, and that the capital gain is half the stock price, the tax saving from a one-year deferral is on average (median) 899.98 (110.96) thousand dollars for the CEOs, compared to the average (median) CEO cash pay of 1314.95 (927.86) thousand dollars. For 11.2% of the observations, CEOs tax savings from a one-year deferral exceed their cash pay. The above calculations are conservative: 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.

to the firm equity. Therefore, in the empirical analysis we carefully isolate the impacts of the two.

Disentangling overconfidence and tax effects. Preceding discussion suggests that managerial overconfidence and tax considerations both influence a manager's decision about continuing to own or selling her vested equity. A firm's superior prior performance exacerbates the tax motivation for not selling firm equity, but it is also likely to be a factor contributing to managerial overconfidence. Successful managers might be overconfident in part 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 see Miller and Ross, 1975). Such biased attribution by managers suggests that superior past performance might lead to managerial overconfidence. Thus, whether managerial ownership signals their overconfidence or merely a tax-motivated reluctance to sell equity becomes an empirical issue. Obviously, it is possible that both 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 overconfidence and tax motivations. The key innovation here is in teasing out the portion of the equity ownership decision that is motivated by managerial overconfidence while controlling for the tax-induced motivation. To estimate the latter, we focus on investors who are not managers, but face the tax liability, i.e., tax on capital gains. We follow the methodology developed in Jin (2005), who examines the sensitivity of an investor's decision to sell a security to the magnitude of capital gain that would be realized upon the sale of the security. Since an outside investor's selling decision is unlikely to be attributable to managerial overconfidence, it likely reflects the tax considerations we discussed above. The outside investor's behavior thus serves as a benchmark for the influence of taxes. This is used as a control in estimating the

incremental impact of overconfidence on a manager's equity ownership decision. We also include numerous other firm and manager characteristics to control for their respective effect on a manager's proclivity to sell or retain ownership.

Summary of results. We first present descriptive evidence on the pattern of selling of unrestricted equity by the CEOs of large US corporations. As noted earlier, CEOs sell large amounts of their equity quite frequently, and these amounts often are greater than the value of new equity grants to the managers. We next examine the determinants of the sale of unrestricted equity. Specifically, controlling for various other determinants of a manager's decision to (or not to) sell equity, we compare the relative importance of overconfidence and tax-induced motivation for their decision. In this comparison, we find that while both are statistically relevant, tax incentives influence a manager's decision to sell vested equity far more than overconfidence. 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 some overconfidence, or related behavioral bias, but those decisions reflect a first-order influence of tax considerations.

Contribution to the literature. We believe an analysis of CEOs' equity-selling patterns furthers our understanding of executive incentive alignment and retention via stock and option compensation. In addition, managers' selling behavior can inform us about how shareholders should structure the composition of CEO pay, i.e., the mix of cash and equity. If CEOs aggressively undo the risk and incentive associated with 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.

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 composition of 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 the 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 overconfidence and taxes 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

Empirical research on CEOs' behavior of equity selling is almost non-existent, and research directly examining the determinants of CEO selling of equity is also absent.⁸ Some research examines individual investors' stock trading and its determinants. For example, Barber

⁸ 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.

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, i.e., perhaps more overconfidence.

As noted earlier (see footnote 2), a huge body of research examines insiders' trades of their own equity, but this research is largely silent with respect to taxes as a determinant of the selling behavior, and fails to disentangle overconfidence from taxes as a motive for a CEO selling (or not selling) her equity. Instead, previous research focuses on diversification, liquidity, employment contracts, and insider information as motives for selling equity. We expand the set of determinants to separately include overconfidence and personal taxes. 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 offload some of the firm 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 load less incentives on CEO's compensation contract when the cost of under-diversification is potentially higher (see Aggarwal and Samwick, 1999, Jin, 2002, and Garvey and Milbourn, 2003, who find that the idiosyncratic risk of the CEO's portfolio, ceteris paribus, weakens pay-performance sensitivity).

Implicit and explicit labor market contracts. Corporations use stock and options to incentivize managers and align their interests with the shareholders'. Economic theory suggests that there exists an optimal level of incentive, as dictated by implicit or explicit labor market contracts. Consistent with this view, Core and Guay (1999) find 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 as well as the manager actively rebalances the equity portfolio through equity grants and sale of equity in part to move closer to the optimal level of equity incentives. In addition, Ofek and Yermack (2000) find that, while equity compensation succeeds in increasing incentives of lower-ownership managers, high-ownership managers negate much of its impact by selling previously owned shares. Specifically, when executives exercise options to acquire stock, they sell nearly all of the 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 in their firm because such sales might be construed as insiders having bad information about the firm's prospects. Such an inference on the part of market participants would generate an adverse

stock price reaction. Thus, to maintain investor confidence in the firm, CEOs might hold on to 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.

Liquidity. While no study explicitly tests the importance of managerial demand for cash as a reason for the selling of firm equity, it is implicit in the literature that CEOs sometimes have to sell off company shares to obtain cash.

Overconfidence. As discussed in the Introduction, managers tend to be overconfident in their abilities and believe they possess superior abilities than their peers. As a result, managers are optimistic about their firm's prospects. This overconfidence translates into their willingness to invest in firm equity perhaps beyond the warranted optimal level of incentive and in their investment decisions for the corporation. Because managers might be bullish about their own firm's performance, their decision to invest their financial capital 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, the 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. Option exercise is positively related to stock returns during the preceding month and negatively related to returns over longer horizons. Consistent with psychological models of values that include reference points, employee exercise activity roughly doubles when the stock price exceeds the maximum price attained during the previous year.

Taxes. As discussed in the Introduction, personal taxes discourage individuals from selling a stock when the sale would trigger capital gains tax. The capital gains tax liability is an increasing function of the stock-price performance prior to the sale date, so stocks that have performed well are less likely to be sold, *ceteris paribus*. Empirically, this determinant of CEOs' selling of equity has not been examined in the literature, especially in a multivariate analysis.⁹ Because the dampening effect of taxes on equity selling increases in past performance, unless its effect is controlled, the managers' unwillingness to sell equity following superior past performance can be easily misconstrued as managerial overconfidence. The reason is that the firm's past performance might be a factor contributing to the manager's overconfidence. Therefore, it's important to control for the tax motivation for not selling equity when examining the role overconfidence plays in a manager's decision to sell equity.

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

⁹ A tangentially related paper on the role of taxes on a manager's decision to sell firm equity is Goolsbee (2000), who uses Executive Compensation data to show that in anticipation of a tax rate increase, executives of large corporations substantially increase the exercise of stock options to take advantage of future lower rates. Thus, executives are highly responsive to tax incentives.

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 Execucomp. In 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. However, hedging does exist, although we are unaware of the extent of hedging by CEOs.

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, unobservable 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 accomplished the dual objective of achieving diversification and reducing the 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:

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

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 sections 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. Thus, we must estimate CEOs' stock and option positions at various points in time. For this purpose, we use 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 that are available to interested readers from the authors.

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.¹⁰

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 exercises. As documented by Ofek and Yermack (2000), CEOs frequently sell all the stock acquired through option exercise. Such selling, while 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, which excludes the sales linked to option exercise. Similar logic applies to selling of equity in response to restricted stock grants, which we exclude in calculating the equity sold variable in robustness tests.

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

¹⁰ 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.

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.¹¹

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.””

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.¹² As a robustness check, we also employ an alternative measure of overconfidence using the CEO's “net buying of stocks,” as in Jenter (2005). The tenor of the results using the Jenter (2005) measure is similar to that of the results using the Malmendier and Tate (2005) measure of overconfidence.

¹¹ 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 divided 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 $\$1/\$P * \text{delta} / \$V$, where $\$V$ is the total dollar value of executive wealth in firm (both stock and options value).

¹² 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).

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 contrast, a less risk-averse CEO, if rational, would behave differently compared to an overconfident CEO. Specifically, a less risk-averse rational CEO would still not hold firm equity, if given the choice between firm equity and the market portfolio, because the latter represents a better risk-return tradeoff: 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.¹³ 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. Sales of stocks attract capital gains tax, which is 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

¹³ 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 $W \tau * r(1-\tau)$.

calculation uses the appropriate tax rate for stock and options.¹⁴ 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 "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 $(\text{Current Price} - \text{Average Effective Tax Basis}) / \text{Current Price}$. 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 $(\text{Current Price} / \text{Average Effective Tax Basis})$. 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. Results using the other measure are available from the authors.

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. Some of the

¹⁴ 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 are included in the main analysis, whereas others are incorporated in the robustness tests primarily because of the attrition of the sample due to data availability reasons.

Cost of under-diversification. We use Hall and Murphy's (2002) utility-function based approach to estimating a CEO's cost of under-diversification. The under-diversification cost therefore is estimated assuming a specific utility function (constant relative risk aversion with a relative risk aversion parameter of three) and 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. 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.¹⁵

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.¹⁶

¹⁵ Alternatively, Meulbroek (2001) proposes a measure that does not depend on specific utility function. As a robustness test, we also conduct analysis using the Meulbroek approach and find that the results are similar to those reported in the tables.

¹⁶ 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.

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 hold onto 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 other words, it is not entirely clear whether institutional ownership should complement or substitute for CEO equity ownership. In our regression specifications, we control for tenure, dual CEO-chairman title, and the level of institutional ownership.

Mechanical relation between selling and grant. Ofek and Yermack (2000) document that CEOs, particularly those with relatively high level of equity holdings, often undo new grants by almost immediately selling off the equivalent amount of vested shares. By the same token, a restricted stock grant might also trigger selling. Thus, the selling of vested equity could be a predictable function of the company grants in the current year. 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 current year 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 mostly 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) 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. Ideally, it would have been desirable to also include three-to-five-year-ahead realized earnings, but since our panel only spans 7 years, losing 3-5 years of data would have rendered the results meaningless.

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 to control for the mechanical effect of accumulated stock and options in CEO's portfolio on the selling behavior. The difficulty we encounter in using the two variables is that they are missing for a large number of observations in the ExecuComp database. Therefore, we face the trade-off between larger sample size and more explanatory variables. We decided against sacrificing the sample size, so we present results using the two variables only in the robustness section.

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, as well as many other variables, contains outliers, as evidenced by a very large skewness in the data. To make sure that our inferences are not unduly affected by these 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.¹⁷ While the tabulated results are based on outlier-truncated data, we fail to find a qualitative change in the results due to truncation. Interested readers can obtain the regression results without truncation from the authors.

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 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 lost diversification is a ranked measure, its

¹⁷ 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.

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 is almost 17 years, but the high number is because not all of the tenure is as the CEO. The average age of the CEO is almost 60 years with one CEO going strong at age 90.

[Table 1]

Table 2 reports Pearson product-moment correlations among the main set of variables. A CEO's equity ownership has a significant 0.06 correlation with tax burden, which is consistent with CEOs holding on to appreciated equity that would attract a tax liability if sold. 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 with ownership. Similarly, the cost of lost 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 grants of stock and options and also are more likely to assume the dual title. Tax burden and past performance has a positive correlation of 0.45, which suggests CEOs do not sell equity that has appreciated and thus 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 grants of stock and option exercise during the year. Ofek and Yermack (2000) report that CEOs offload most of the stock they acquire from option exercise immediately after the exercise. Such sales do not result in a net decrease in the CEO's stock ownership. 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) CEO wealth per \$1,000 change in shareholder value.¹⁸ Taken together, the evidence suggests

¹⁸ 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.

that a significant number of CEOs sell their stock annually and that the amount sold represents a non-trivial fraction of their stock ownership.

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 nowadays typically 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.¹⁹ 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 roughly 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

¹⁹ 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.

current 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.²⁰

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,²¹ 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.

²⁰ 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.

²¹ 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.

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 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).

Table 4 reports the regression results. The first column reports the regression where we do not control for tenure and age. The results show that the tax burden significantly discourages CEOs from selling their stock. The coefficient on the tax burden variable, -0.17 (t-statistic = -3.46) 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 0.11% of shares outstanding, which is reported in 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 fails to significantly impact a CEO's stock selling behavior. Specifically, the coefficient on overconfidence is -0.10 (t-statistic = -1.03). 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. In addition, under-diversification cost is not a significant factor determining the selling of vested equity.

[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, decreases the selling of vested equities. The result is broadly consistent with their interpretation, and with the result of Noe (1999). 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 separately include 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 attempts to gauge the relative importance of overconfidence and taxes in explaining CEOs' selling of their stock. However, a fundamental potential criticism is whether our proxies for overconfidence and taxes truly measure the distinct motivations affecting the CEO in her decision to sell equity. Specifically, as discussed in the first two sections of the paper, 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 relative importance of taxes and overconfidence. 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 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 to tease out the relative importance of overconfidence and taxes. 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 ($\geq 50\%$) 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:

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

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 = -1.77) 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 twice as big an impact on the CEO's level of equity holding as overconfidence. This gulf widens when we restrict the sample to those observations with data on CEO tenure and age. Cost of under-diversification is not significant. 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 86.2%. 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, and the results also suggest that taxes play a more salient role compared to managerial overconfidence.

[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. 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 that the results using this approach are most conservative in controlling for various confounding effects and in gauging the statistical significance of the estimated coefficients. However, the tenor of the results is unchanged using OLS regressions with industry and year fixed effects and using clustering regressions at firm or industry level to calculate standard errors.

In other robustness tests, 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 tranche of options using the grant-date information, as developed in Jin and Meulbroek (2004). We obtain qualitatively similar results.

To measure the discount CEOs might assign to company stocks due to under-diversification, we use the Hall and Murphy (2002) formula. We replicate the analysis using the under-diversification metric in Meulbroek (2001). The results are not qualitatively different.

We measure past performance as three-year market-model-adjusted return up to the end of the previous fiscal year. We experimented with performance measured over five years and other methods to estimate abnormal returns (e.g., the Fama-French three-factor model). The results are unaffected.

5. Summary and conclusions

CEOs accumulate large amounts of firm equity because of equity-based compensation, i.e., stock and option grants, and their own decision to invest in the firm's equity. Their

investment in the firm declines as they sell (a portion of) the firm's stock. In this study 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 managerial overconfidence and taxes 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. Our in-depth analysis suggests that taxes swamp overconfidence as a factor influencing CEOs' decision to sell, or not sell, their vested equity. 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.

Ceteris paribus, tax burden from selling equity is expected to increase in the firm's past performance. However, managerial overconfidence is likely to be positively correlated with superior past performance, which managers typically attribute to themselves as a result of behavioral biases. Therefore, we cannot unambiguously infer that our tax burden variable captures only tax-related effect on a CEO's stock-selling decision. It might also proxy for overconfidence and thereby the overconfidence proxy might lose its explanatory power. To overcome this problem of inference, i) we include past performance in the regressions, and ii) we use institutional investors' equity-selling behavior as a control. Institutional investors are likely to be sensitive to taxes, but they are not likely to suffer from overconfidence as do the insiders

like the CEO. Our comparison of the effect of taxes on a CEO's stock selling behavior with that of institutional investors reveals that institutional investors are somewhat more sensitive to taxes than CEOs. More importantly, however, managerial overconfidence fails to exhibit incremental significance beyond the role of taxes in explaining a CEO's stock-selling. Other determinants affect CEOs' selling decisions largely as predicted in the existing literature.

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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, $(N_{\text{stock}} + \text{delta} * N_{\text{options}})$, 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	0.50	0.49	0.29	0.00	0.00	0.24	0.74	0.99
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 ⁽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 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 2 and that CEOs have 67% 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.
- (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.	Overconfiden ce Dummy 1	Overconfiden ce 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							
Institutional 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⁾	0.02 0.07	0.10 <.0001	-0.21 <.0001	0.12 <.0001	-0.04 <.0001				
Overconfidence measure 1 ⁽⁵⁾	-0.01 0.18	-0.02 0.01	0.05 <.0001	0.02 0.04	0.03 0.00	-0.11 <.0001			
Overconfidence measure 2 ⁽⁶⁾	0.05 <.0001	-0.02 0.00	0.04 <.0001	0.05 <.0001	0.03 0.00	-0.05 <.0001	0.02 0.06		
Past performance ⁽⁷⁾	0.05 <.0001	0.02 0.01	0.45 <.0001	0.10 <.0001	0.03 <.0001	-0.09 <.0001	0.03 0.00	0.03 <.0001	
Future EPS ⁽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 2 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.

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 offset 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 both stocks and options positions	41.92%							
Selling / total holding ⁽¹⁾		0.13	0.16	0.00	0.02	0.08	0.18	0.82
Selling / shares outstanding x 100 ⁽²⁾		0.60	2.01	0.00	0.03	0.12	0.44	8.01
Reduction of stock and option positions (not including reduction to offset current year option grants)	20.72%							
Selling / total holding ⁽¹⁾		0.13	0.18	0.00	0.02	0.06	0.16	0.87
Selling / shares outstanding x 100 ⁽²⁾		0.88	2.67	0.00	0.04	0.18	0.65	12.59
Reduction of stock and option positions (not including reduction to offset current year option and stock grants)	19.21%							
Selling / total holding ⁽¹⁾		0.13	0.18	0.00	0.02	0.06	0.16	0.87
Selling / 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	-	-0.17 (-3.46)	-0.11	-0.22 (-3.56)	-0.14
Cost of under-diversification	+	0.04 (0.96)	0.01	0.08 (1.32)	0.02
Overconfidence	-	-0.10 (-1.03)	-0.03	-0.14 (-1.54)	-0.05
Lagged holding of vested equity		0.00 (-0.73)		0.00 (-0.28)	
Current grant of stock and options		0.03 (1.94)		0.08 (2.45)	
Past return		0.04 (1.67)		0.06 (4.01)	
Size		0.01 (1.17)		0.02 (0.45)	
Book to market ratio		-0.01 (-1.03)		0.00 (-0.04)	
Future EPS		-0.36 (-0.70)		-0.24 (-0.81)	
Institutional ownership		0.24 (1.82)		0.49 (2.39)	
Flag for CEO being Chairman		-0.07 (-1.01)		0.09 (0.52)	
CEO Tenure				-0.01 (-1.32)	
CEO Age				0.01 (0.43)	
Number of Observations		4,307		1,117	
Average Adjusted R-squared		0.2457		0.2206	

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⁾

Independent Variables ⁽³⁾	Dependent Variable: Reduction of vested equity ⁽²⁾				
	Predicted Sign	Regression Coefficients	Economic Significance	Regression Coefficients	Economic Significance
Tax burden	-	-0.22 -(3.63)	-0.14	-0.32 -(4.85)	-0.21
Cost of under-diversification	+	0.09 (0.91)	0.03	0.06 (1.32)	0.02
Overconfidence	-	-0.13 -(0.93)	-0.04	-0.14 -(1.24)	-0.05
Lagged holding of vested equity		0.00 (4.04)		0.00 (2.17)	
Current grant of stock and options		0.03 (3.43)		0.10 (1.87)	
Past return		0.02 (0.87)		0.08 (3.16)	
Size		0.00 (0.07)		-0.01 -(0.06)	
Book-to-market ratio		0.00 (0.05)		0.01 (1.02)	
Future EPS		-0.44 -(0.76)		-0.28 -(0.48)	
Institutional ownership		0.63 (2.24)		0.97 (1.91)	
Flag for CEO being Chairman		-0.25 -(1.35)		-0.14 -(0.50)	
CEO Tenure				0.00 -(0.44)	
CEO Age				0.01 (1.13)	
Number of Observations		2,131		561	
Average Adjusted R-squared		0.2625		0.2227	

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 Holdings Combined Regressions from 1996-2002 ⁽¹⁾⁽²⁾

Independent Variables ⁽³⁾	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	
	Coefficient Estimates	Economic Significance	Coefficient Estimates	Economic Significance
Manager dummy	-0.06 -(0.60)		-0.28 -(8.15)	
Tax burden	-0.09 -(22.42)	-0.06	-0.09 -(28.19)	-0.06
Manager dummy x Tax burden	0.02 (1.81)	0.01	0.06 (2.97)	0.04
Manager dummy x cost of under-diversification	0.05 (1.70)		0.05 (1.58)	
Manager dummy x overconfidence	-0.02 -(1.77)		-0.02 -(1.32)	
Past return	0.02 (3.32)		0.01 (2.86)	
Size	0.00 (0.08)		0.00 -(0.61)	
Book to market ratio	0.00 (1.27)		0.00 (1.23)	
Future EPS	-0.07 -(3.08)		-0.07 -(2.64)	
Inst. Holding	0.05 (1.18)		0.00 -(0.24)	
Number of Observations	3,288		3,288	
Adjusted R-Squared	0.1257		0.2834	

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) 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⁾

Independent Variables ⁽³⁾	Dependent Variable: Holding of vested equity ⁽²⁾				
	Predicted Sign	Regression Coefficients	Economic Significance	Regression Coefficients	Economic Significance
Tax burden	+	2.35 (2.44)	1.54	2.84 (2.70)	1.86
Cost of under-diversification	-	-1.02 (-0.87)	-0.29	-0.89 (-1.35)	-0.26
Overconfidence	+	2.27 (4.01)	0.76	1.97 (3.69)	0.66
Lagged holding of vested equity		0.83 (6.59)		0.87 (5.57)	
Current grant of stock and options		-0.25 (-1.34)		-0.15 (-1.23)	
Past return		-0.55 (-2.30)		-0.76 (-1.87)	
Size		-1.06 (-9.06)		-1.42 (-4.44)	
Book to market ratio		0.30 (1.57)		0.66 (1.48)	
Future EPS		2.46 (1.51)		3.13 (1.89)	
Institutional ownership		-4.75 (-4.26)		-4.65 (-2.68)	
Flag for CEO being Chairman		0.86 (2.83)		0.04 (0.03)	
CEO Tenure				0.10 (1.64)	
CEO Age				-0.10 (-0.68)	
Number of Observations		7,435		1,883	
Average Adjusted R-squared		0.8624		0.8803	

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

Independent Variables ⁽³⁾	Dependent Variable: Holding of vested equity ⁽²⁾				
	Predicted Sign	Regression Coefficients	Economic Significance	Regression Coefficients	Economic Significance
Tax burden	+	1.32 (3.61)	0.86	1.46 (3.71)	0.95
Cost of under-diversification	-	-1.93 (-1.77)	-0.56	-3.20 (-1.19)	-0.92
Overconfidence	+	5.18 (8.75)	2.38	6.93 (7.92)	3.19
Lagged holding of vested equity		0.83 (65.79)		0.88 (36.28)	
Current grant of stock and options		-0.29 (-0.21)		-0.41 (-0.34)	
Past return		-0.48 (-2.37)		-0.35 (-0.87)	
Size		-0.89 (-7.84)		-0.90 (-3.12)	
Book to market ratio		0.26 (0.68)		0.29 (0.62)	
Future EPS		1.76 (1.24)		2.68 (1.05)	
Institutional ownership		-4.84 (-4.20)		-4.84 (-2.76)	
Flag for CEO being Chairman		1.12 (3.57)		0.45 (0.30)	
CEO Tenure				0.13 (2.56)	
CEO Age				-0.07 (-0.70)	
Number of Observations		7,435		1,883	
Average Adjusted R-squared		0.8685		0.8915	

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.