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The Deadweight Loss of Equity-Based Compensation

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ABSTRACT

In order to maximize shareholder value, firms attempt to align the incentives of the executives with those of the shareholders by giving them equity as a portion of their compensation package. The terms associated with this equity compensation forces the executives to hold undiversified portfolios, resulting in a sizeable deadweight loss. This paper uses the formula developed by Meulbroek (2001)[1] to calculate the dollar value of this deadweight loss, in order to quantify the costs associated with equity-based compensation. We find that the 56 executives in our data set have a combined deadweight loss of $70 billion, and that on average they are losing $1.25 billion each. These results raise the question of whether the incentive alignment is worth the large costs associated with it, and why firms continue to use equity as a form of compensation.

[1] Meulbroek, Lisa. "The Efficiency of Equity-Linked Compensation: Understanding the Full Cost of Awarding Executive Stock Options."*Financial Management* 30 (Summer 2001): 5-44.

INTRODUCTION

The overarching goal of every public company is to maximize shareholder value, which is done in many ways. Incentivizing employees to work their hardest and make the best decisions for the value of the company is a topic that has been studied from many angles and by many different groups both academically and privately. One method that many firms have used to align the incentives of the employees with those of the shareholders is the use of equity-linked compensation in addition to salary and other benefits.

There are multiple reasons why granting equity to employees would motivate them to act in the best interests of shareholders. The main reason cited by many large companies is that when the employees also are shareholders of the company, they will act in their own best interests, thereby maximizing value for all shareholders. Another reason is that the details of some forms of equity-based compensation require vesting periods, which incentivize employees to remain at the company so that their options will have time to vest, thereby retaining valuable human capital for the firm. For stock option compensation, the employee has to use cash to acquire their options, and if the employee does not have available cash when they need it, then the company is able to get away with compensating their employees less. Also, there are certain accounting rules in place that are favorable towards equity-based compensation over salary compensation. Finally, in firms that are tight on cash such as startups, equity can be an easy alternative form of compensation that allows the company to compensate their employees adequately, while also being able to reserve the cash for other aspects of the business.

Our analysis is focused on executives in large companies, and therefore assumes that the management-to-shareholder incentive-alignment is the primary justification for equity-based compensation. We made this assumption because large firms consistently cite management incentive alignment as the reason for their use of equity-based compensation. It should be noted that some of the interpretations of our results may be different if they were applied to employees in early-stage, entrepreneurial companies, rather than large firms, because their use of equity-based compensation would have different justifications.

Equity-linked compensation comes in three different forms, each with its own strings attached. Stock options give employees the right to purchase a share of the stock sometime in the future, for a predetermined price. If the stock price is higher than the price the employee must pay to acquire the stock (called the strike or exercise price) once the necessary amount of time has passed, then the employee can exercise the option and see an instant net gain on their investment (the difference between the current stock price and their exercise price). The second type of equity-linked compensation is restricted stock, which does not have an exercise price. When an employee is granted restricted stock, they are not allowed to sell the stock until a certain amount of time has passed, called the vesting period. Restricted stock vesting periods commonly range from 2-5 years, and once that period is over the employee owns the shares and is free to sell them at any time. The final type of equity-linked compensation is unrestricted stock, which is when the employee is given stock which they could, if they wanted to, turn around and sell immediately with no vesting period or exercise price.

When employees have equity in their own company, they are exposing themselves to both market risk and firm-specific risk. Market risk occurs because there is the possibility of large effects impacting the overall performance of the markets, such as a natural disaster or political unrest that would influence the entire financial system. In comparison, firm-specific risk is limited to effects impacting only the company itself, such as a bankruptcy filing or lawsuit. According to basic portfolio theory, it is possible to offset all firm-specific risk by holding stock from other companies in a diversified portfolio. Market risk cannot be eliminated, but exposure to firm-specific risk can be completely offset by holding stocks that are negatively correlated to each other. For example, if an employee works for an airline and has stock in their company and the main risk associated with airline companies is from fluctuations in the price of oil, the employee could offset that firm-specific risk by buying stock in an electric car manufacturer. Then if oil prices go up, the airline stock would depreciate in value, but this would be offset by more people wanting to buy electric cars and the car manufacturers stock appreciating. Finance theory says that a properly weighted portfolio made up of a minimum of 20-30 stocks can completely eliminate all firm-specific risk, leaving the investor exposed only to market risk.[2]

If an employee has the goal of maximizing wealth while simultaneously minimizing risk exposure, they will only want to hold on to a portion of the equity that they are issued as compensation, and balance it with other stocks. This will allow them to maintain a diversified portfolio. However, the terms of the options and restricted stock

[2] Fisher, Lawrence, and James H. Lorie. "Some Studies of Variability of Returns On Investments in Common Stocks." *Journal of Business* 43, no. 2 (1970): 99-134.

shares prevent them from selling portions of their equity-based compensation, which forces them to hold undiversified portfolios. This is called forced undiversification. Employees also can choose to be undiversified by holding on to their equity compensation even when they have the choice to sell it. This is called voluntary undiversification.

When employees are forcefully undiversified, they value the equity at less than its market value because they are not being compensated for the additional risk associated with the equity compensation. Therefore, if a firm wants to give employees equity compensation with a specified total value, they will need to grant the employees *more* stock than they would have needed to sell on the open market to make the same amount of money. According to Meulbroek (2001), "The *value* of equity-linked compensation to undiversified managers may be much less than the *cost* of providing this compensation to the firm".[3] This creates a deadweight loss because the firms could have given the employees the same amount of compensation by selling a smaller number of shares on the open market, and then giving the proceeds to the employee in increased salary or bonus. Therefore, equity-based compensation is hurting the employees by forcing them to take on more risk than necessary, and hurting the companies by requiring them to spend more to pay employees the same amount.

Academic research done on the topic of equity-based compensation has also shown that the amount of deadweight loss created by equity-based compensation varies based on the size of the employee's equity holdings, their holdings outside the company,

[3] Meulbroek, Lisa. "The Efficiency of Equity-Linked Compensation: Understanding the Full Cost of Awarding Executive Stock Options."*Financial Management* 30 (Summer 2001): 5-44.

and the volatility of the company's stock. The largest deadweight loss will occur when the employee has most of their wealth invested in the company's equity, and the company's stock is highly volatile.

If equity-based compensation is able to create the desired management-to-shareholder incentive-alignment, then it could be worth the additional risk and costs. But a large body of academic research has concluded that equity-based compensation is actually more likely to *lower* the profits of a company than it is to raise them.[4] There are a number of empirical and psychological reasons that could explain this result, many of which are explained in the book titled *Indispensable and Other Myths: Why the CEO Pay Experiment Failed and How to Fix It* by Michael Dorff. Without going into detail, we will explain two of the reasons explained in Dorff's book. First, in order for equity-based compensation to work, the equity-based pay must be effective in improving the performance of the employees. But psychological research has found that in creative and analytical tasks such as those done by executives, equity-based compensation actually reduces intrinsic motivation, thereby hurting employee performance.

Second, the risk preferences of the shareholders does not necessarily line up with those of the executives when the executives are forced to hold undiversified portfolios of their firm's stock. Because shareholders are able to diversify away all firm-specific risk, they will prefer that the firm take on more risk, in order to maximize their potential return. But the executives who have a large percentage of their net worth tied into the stock of the firm are unable to diversify away the firm-specific risk, and will therefore want to

[4] Dorff, Michael. *Indispensable and Other Myths: Why the CEO Pay Experiment Failed and How to Fix It*. Oakland, CA: University of California Press, 2014.

decrease that type of risk in order to reduce the overall risk of their own portfolio. This will cause the executives to take on less risk than the shareholders desire, thereby reducing profitability for the shareholders. Both of these examples explain why equity-based compensation will, at minimum, not improve company profitability, and will most likely reduce profitability because of the additional costs associated with granting equity-based compensation.[5]

A number of sources have created models to calculate the deadweight loss due to employee equity-based compensation. But our research shows that no one has attempted to empirically quantify the deadweight loss associated with equity-based compensation granted to executives. The goal of this paper is to find the dollar value of that deadweight loss. Our analysis will fill this gap in the literature by using multiple data sources and an option efficiency metric that was created by Meulbroek (2001).[6] The efficiency metric determines how much the employee will value the stock compared to the market, represented as a percentage between 0 and 100%. It is calculated based off of two well-respected financial equations: the Black-Scholes option pricing model and the Sharpe ratio, each of which will be described in the following section. The end result will be to calculate the dollar amount of deadweight loss that is being generated due to equity-based compensation awarded to 56 top-level executives of U.S. firms.

[5] Michæl Dorff, *Indispensable and Other Myths: Why the Ceo Pay Experiment Failed and How to Fix It* (Oakland, CA: University of California Press, 2014), 8.

[6] Lisa Meulbroek, "The Efficiency of Equity-Linked Compensation: Understanding the Full Cost of Awarding Executive Stock Options", *Financial Management* 30 (Summer 2001): 5-44.

PART I.

LITERATURE REVIEW

The formula that is most widely used to calculate the value of stock options is called the Black-Scholes model. It is used both by academics and in the financial markets, and is the standard method used to value options. Quantifying the efficiency of stock options is less common, and multiple academic models have been created in an attempt to calculate it. Each of these models will be described in the following paragraphs, along with the differences between the assumptions underpinning each model.

Fisher Black and Myron Scholes introduced what has come to be known as the Black-Scholes model in 1973. Its purpose is to value European-style options and, by extension, corporate liabilities including warrants, common stock, and corporate bonds. There are a number of assumptions made by their method:[7]

a) The short-term investment rate is known and is constant through time.
b) The stock price follows a random walk in continuous time with a variance rate proportional to the square of the stock price. Thus the distribution of possible stock prices at the end of any finite interval is log-normal. The variance rate on the return of the stock is constant.
c) The stock pays no dividends or distributions.
d) The option is "European," that is, it can only be exercised at maturity.
e) There are no transaction costs in buying or selling the stock or the option.
f) It is possible to buy any fraction of the price of a security to buy it or to hold it, at the short-term interest rate.
g) There are no penalties to short selling. A seller who does not own a security will simply accept the price of the security from a buyer, and will agree to settle with the buyer on some future date by paying him an amount equal to the price of the security on that date.

[7] Fischer Black and Merton Scholes, "The Pricing of Options and Corporate Liabilities", *Journal of Political Economy* 81, no. 3 (1973): 637-54.

Under these assumptions, the Black-Scholes formula can be derived either by using differential equations or the Capital Asset Pricing Model (CAPM). The Black-Scholes formula is defined as:

$C = SN(d_1) - N(d_2)Ke^{-rt}$

Where:

C = Call premium
S = Current stock price
t = Time until option exercise
K = Option striking price
r = Risk-free interest rate
N = Cumulative normal standard deviation
σ = Standard deviation

and

$$d_1 = \frac{\ln\left(\frac{S}{K}\right) + \left(r + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

This model and approach to option valuation has been widely embraced by the financial markets. The adoption of the technique has been well documented over the past decades in many sources including *An Engine, Not a Camera: How Financial Models Shape Markets* by Donald MacKenzie.[8]

William F. Sharpe introduced the Sharpe ratio in 1966 in his influential paper titled "Mutual Fund Performance".[9] Its most common financial application is used to calculate the risk-adjusted performance of a portfolio of stocks, in order to determine

[8] Mackenzie, Donald. *An Engine, Not a Camera: How Financial Models Shape Markets*. Cambridge, MA: The MIT Press, 2008.

[9] William Sharpe, "Mutual Fund Performance", *Journal of Business* (January 1966): 119-38.

what portion of the returns is made by intelligent investment decisions and what portion is made by taking on excessive amounts of risk. Higher Sharpe ratios indicate that the portfolio's returns are attributable to intelligent investing, while low Sharpe ratios indicate excessive risk taking by the portfolio manager. The Sharpe ratio formula is defined as:

$$\text{Sharpe Ratio} = \frac{R_p - R_{rf}}{\sigma_p}$$

Where

R_p = Expected portfolio/asset return

R_{rf} = Risk-free rate of return

σ_p = Portfolio/asset standard deviation

This ratio is useful when comparing two or more portfolios against each other. It helps to make the portfolios more comparable by adjusting the returns of each portfolio by its level of risk.

Meulbroek (2001) used both the Black-Scholes model and the Sharpe ratio to derive a formula that calculates the efficiency of option compensation based on the variables of the Black-Scholes formula. The output of this formula is a percentage between 0 and 100%, which represents how much the undiversified investor would value the stock option compared to the market. She finds that contingent upon their level of diversification, executives will value their firm's stock options at 50-80% of market value. Subtracting this from the market value of the options (100%), means that the deadweight loss is between 20-50% of the total option value. These values are likely underestimates of the actual loss that executives are experiencing through their equity

holdings, because it does not take into account the risk preferences of the managers. The calculations done by Meulbroek assume that the managers are compensated at the market's risk-return tradeoff level, represented by the Sharpe ratio. But individual managers may be more or less risk-averse than this, which would impact the deadweight loss experienced by each manager. Her analysis found that this deadweight loss is highest for managers in high-volatility firms and for the managers with most of their personal wealth tied up in the firm through both their assets and their human capital. This fact is especially disquieting, as "growth firms use equity-based compensation more frequently than other firms",[10] and growth firms are typically the most volatile due to their unpredictable growth trajectories. This paper implies a significant deadweight loss being taken on by the executives when their compensation packages dictate that they hold undiversified portfolios.

As we discussed in the introduction, Meulbroek cites management-to-shareholder incentive alignment as the primary motivator for awarding stock option compensation. In order to maintain incentive alignment, managers must be exposed to firm-specific risk, which will disappear as managers strive to hold a diversified market portfolio. Compelling management to hold undiversified portfolios through restricted stock and option awards provides the desired incentive alignment, but at the cost of the manager's ability to hold a diversified portfolio. Meulbroek notes that "the value of equity-linked

[10] Lisa Meulbroek, "The Efficiency of Equity-Linked Compensation: Understanding the Full Cost of Awarding Executive Stock Options", *Financial Management* 30 (Summer 2001): 5-44.

compensation to undiversified managers may be much less than the cost of providing the compensation to the firm".[11]

Another equation developed by Hall and Murphy (2000[12] and 2002[13]) used a certainty-equivalence approach to calculate this deadweight loss, while also taking into account assumptions about the risk preferences of the employees. They found that approximately half of the cost that firms pay to use options as compensation is taken up by deadweight loss. They also concluded that the deadweight loss would be substantially higher "if the options have an exercise price that is above the existing market price, or if the exercise prices increases over time, or if the option has a long vesting period".[14] These estimates are higher than those made by Meulbroek (2001), but it must be noted that her analysis did not make assumptions about the risk preferences of the employees, while Hall and Murphy (2000 and 2001) take the risk preferences of the employees into consideration. This may account for the difference in deadweight losses found by the two papers.

In 2004, Kwok and Lau used a utility maximization modeling approach to determine whether having the choice to "reload" employee stock options decreased the deadweight loss associated with undiversification due to stock option compensation.

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[11] Lisa Meulbroek, "The Efficiency of Equity-Linked Compensation: Understanding the Full Cost of Awarding Executive Stock Options", *Financial Management* 30 (Summer 2001): 5-44.

[12] Hall, Brian, and Kevin Murphy. "Optimal Exercise Prices for Risk Averse Executives." *American Economic Review* (May 2000): 209-14.

[13] Hall, Brian, and Kevin Murphy. "Stock Options for Undiversified Executives." *Journal of Accounting and Economics* 33 (2002): 3-42.

[14] Hall, Brian, and Kevin Murphy. "The Trouble with Stock Options." *Journal of Economic Perspectives* 17, no. 3 (Summer 2003): 49-70.

Option reloading occurs when an employee's stock options are exercised before their expiration date and, instead of being paid out in cash, the employee chooses to be compensated with stock options with the new exercise price set to the current stock price. The expiration date on the new shares is the same as that on the original shares. "The reload feature enables employees to lock in the gain on the part that represents the in-the-moneyness of the stock options, while continue to retain the potential upside growth of the stock price through the holding of the reload options".[15] Their analysis concluded that when employees are given a reload provision, the deadweight loss associated with stock option compensation decreases with the in-the-moneyness of the options. Whereas Meulbroek had found that the deadweight loss ranged from about 20-50%, Kwok and Lau's approach estimated that the deadweight loss was from about 25-40% when the employee was given a reload provision. Their model also suggests that, as was found in Meulbroek (2001), the deadweight loss decreases when the employee's initial wealth is higher, and also decreases when options make up a smaller portion of the employee's compensation package.

Oyer and Schaefer (2004) analyzed data from the 2000 Survey on Current Practices in Broad-Based Stock Option Plan Design conducted by the National Center for Employee Ownership (NCEO). This data included detailed compensation information for individual employees below the executive level in the U.S. They used this data to calculate the deadweight loss associated with stock option compensation for middle

[15] Kwok, Yue Kuen, and Ka Wo Lau. "Valuation of Employee Reload Options in Utility Maximization Framework." *International Journal of Theoretical and Applied Finance* 8 (August 2004): 659-74.

managers. Compared to a hypothetical employee paid with an all-cash compensation package, Oyer and Schaefer found that granting stock options to these employees "cost many firms at least several thousand dollars per middle manager per year".[16] They further found that the typical firm was able to "report pre-tax income of $10,000 or more higher per middle manager than it would have reported had it paid the manager in cash".[17] One of the major conclusions from their analysis was that if stock options are being granted to middle management employees primarily for their accounting treatment, then stockholders are losing significant value by allowing this practice to continue. They found that "if options are granted strictly to increase reported earnings, the median firm in our sample is willing to incur real costs of sixty-four cents to increase pre-tax income by one dollar".[18]

A number of sources have created models to approximate the percentage of deadweight loss due to employee stock option compensation. Meulbroek (2001) found that deadweight losses ranged from 20-50% of option value, but did not account for the risk preferences of the employees. Hall and Murphy (2000 and 2001) incorporated the risk preferences of the employees into their analysis, and found the deadweight loss of option compensation was approximately 50%. Kwok and Lau (2004) interpreted how stock option reloading impacted the efficiency of option compensation, and found that having reload options caused the deadweight loss to be between 25-40%. Oyer and

[16] Oyer, Paul, and Scott Schaefer. "Compensating Employees Below the Executive Ranks: A Comparison of Options, Restricted Stock, and Cash." NBER Working Paper No. 10221 (2004).

[17] Paul Oyer and Scott Schaefer, "Compensating Employees Below the Executive Ranks: A Comparison of Options, Restricted Stock, and Cash", NBER Working Paper No. 10221 (2004).

[18] Ibid.

Schaefer (2004) looked at a unique dataset and calculated the dollar amount of deadweight loss created by stock option compensation granted to middle managers. Oyer and Schaefer (2004) also brought up the idea that accounting practices may create an alternative justification for equity-based compensation, beyond the shareholder incentive alignment cited by other sources.

For the present analysis, we intend to use the Meulbroek (2000) model to empirically quantify the deadweight loss associated with stock option compensation granted to top-level executives. The following sections will detail how we calculated our results, and what the implications of those results are.

PART II.

MODEL FRAMEWORK

The equation created by Meulbroek (2000) maintains the assumptions used in the Black-Scholes model, which were presented in Part I. The equation allows us to calculate the efficiency of stock option compensation, represented as a percentage between 0 and 100%. These calculations are based on a number of variables, including: firm and market volatility, firm and market correlation, firm stock prices, firm beta, and the terms of the options granted to the executives. By combining this efficiency metric with other information regarding the equity holdings, the intent of this analysis is to value the financial deadweight loss associated with holding stock options. Similar calculations can also be applied to restricted and unrestricted stock holdings, in order to calculate the total executive deadweight loss due to undiversification that is both forced and voluntary.

Before the analysis can be done, data for the following variables must be obtained in order to use Meulbroek's equation:

V_j (t) = value of stock j at time t (the market price).

T = date at which the undiversified investor is free to sell the stock.

t = current date.

$\tau = T - t$.

r_f = the risk-free rate of return.

r_m = the expected market return.

($r_m - r_f$) = the market's risk premium.

σ_m = the market's annualized volatility.

σ_j = firm *j*'s annualized volatility.

r_j = the expected return of firm *j*.

r_j^u = the expected return of the undiversified position.

$s_j = r_j^u - r_j$, which is the return premium that an undiversified investor in the stock would require to make her indifferent to holding the stock versus holding the market portfolio levered to the volatility of the stock.

ρ_{jm} = the correlation coefficient between firm *j*'s returns and the market returns.

N = Cumulative normal standard deviation.

$$s_j = \left(\left[\frac{\sigma_j}{\sigma_m}\right] - \beta_j\right)(r_m - r_f) = \left[\frac{\sigma_j}{\sigma_m}\right](1-\rho_{jm})(r_m - r_f)$$

$V_j^u(t)$ = the private value placed on the stock of *j* by an investor forced to hold the stock *j* position undiversified until date *T*.

$$V_j^u(t) = e^{-s_j\tau} \cdot V_j(t)$$

Once all this information has been obtained, the efficiency of the executive's stock options can be calculated using the following formulas:

$$f(V_j) = V_j e^{s_j t} N(d_j) - X e^{-r_j t} N(d_j - \sigma_j\sqrt{\tau})$$

where

$$d_j = \frac{\ln(\frac{V_j}{X}) + (r_f - s_j + \frac{1}{2}\sigma_j^2)\tau}{\sigma_j\sqrt{\tau}}$$

and

$$f(V_j^u) = V_j^u N(d_j) - X e^{-r_f\tau} N(d_j - \sigma_j\sqrt{\tau})$$

where

$$d_j = \frac{\ln(\frac{V_j^u}{X}) + (r_f + \frac{1}{2}\sigma_j^2)\tau}{\sigma_j\sqrt{\tau}}$$

Then the efficiency of option compensation is equal to

$$\Phi = \frac{F(V_j^u, T-t, \sigma_j, r_f, X = V_j)}{F(V_j, T-t, \sigma_j, r_f, X = V_j)}$$

Phi (Φ) represents the efficiency of the stock, and is given as a percentage. Phi is the value that the executive places on the stock option, compared to the value given to it by the market. Φ = 100% would mean that the executive values the stock equally to the market, and Φ = 50% would mean that the stock is only worth half as much to the executive as it would be worth to the market. Executives with fully diversified portfolios will value their options at Φ = 100%, and as their level of diversification decreases so does the value they place on the options. Therefore, (1- Φ) is the difference between the market value of the option and how much value the executive places on the option. This can be identified as the deadweight loss associated with granting stock options as a portion of the executive's compensation. To find the market value of the options, represented as a dollar amount, we used the Black-Scholes model. Then, by multiplying (1- Φ) by the value of the option holdings of the executive, it is possible to calculate the dollar value of deadweight loss that is attributable to undiversification due to stock option compensation.

In order to calculate the efficiency of the restricted and unrestricted stock holdings of the executives, we made the assumption that executives place the same value on both

restricted and unrestricted stock. Reasons why this could be true are numerous, and include contractual obligations, the desire to show support for the company, a biased view of the company's expected returns relative to the market, and the possibility that the executives have so much wealth that they are indifferent to the deadweight loss due to undiversification. These possibilities as well as others will be explained more fully in Part V. Using the V_j and V_j^u values from Meulbroek (2001), we calculated the deadweight loss attributable to restricted and unrestricted stock as $(1 - V_j^u / V_j)$. The dollar value of unrestricted stock was found by multiplying the number of unrestricted shares owned (as reported in the firm's annual proxy statement) by the stock price at the date that the Forbes 400 net worth data was gathered. The dollar value of restricted stock was determining by multiplying the number of restricted stock holdings by V_j^u, which is found during the option efficiency calculations. The data sources used to make these calculations will be described in the following section.

PART III.

DATA AND DATA SOURCES

In order to calculate the dollar value of deadweight loss for a specific executive, it is necessary to know the efficiency of the stock (calculated using the Meulbroek (2001) formula), the value of all restricted and unrestricted stock that they hold in their company, the value of their total options holdings, and the value of their total holdings both inside and outside their firm (their net worth).

We gathered net worth data from the Forbes 400 list,[19] which reports the net worth of the 400 richest Americans every year. The Wharton Research Data Services (WRDS)[20] provides data on executive stock and options holdings for any executive who works in an S&P 1500 firm, as well as stock price data. The WRDS data is pulled directly from proxy statements (SEC form DEF 14A) which are submitted annually by public firms and are made publicly available through the SEC website. By cross-referencing the Forbes 400 list against the WRDS database, it is possible to create a list of all executives who are both in the Forbes 400 and have publicly available data for stock, options, and restricted stock holdings. Although the Forbes 400 list was published for 2013, the most recent year stock and options holding data available for most companies in the WRDS database is 2012. Therefore, most data points come from 2012 sources. Of the 400 men and women on the list in 2012, 34 also have stock, options, and

[19] *Forbes*. The Forbes 400: The Richest People in America. September 1993 - September 2012.

[20] *Wharton Research Database Services*. Accessed March 10, 2014, https://wrds-web.wharton.upenn.edu/wrds/.

restricted stock holdings information available. By using data from previous years of the Forbes 400 list going back as far as 1993, as well as one data point from 2013, I was able to expand this data set from 34 individuals to 56. Of these, 55 are men, and one (Meg Whitman of Hewlett-Packard) is a woman. Their net worths range from $600 million to $53 billion with an average net worth of $6.62 billion and a median of $2.2 billion. The average age of the group is 65, with a high of 91 for George Joseph of Mercury General Corp. and a low of 39 for Lawrence Page and Sergey Brin, both of Yahoo! Inc. The executives represent a range of industries, including tech, retail, banking, and hospitality. **Table 1** shows the data gathered from the Forbes 400 lists for the 56 individuals in our data set, as well as summary statistics where appropriate. Our dataset was limited by the availability of net worth data for executives in public companies. If more net worth data had been accessible, our results could have potentially been much more impactful.

According to the Forbes website, the net worth data for 2012 was calculated using the following methodology:

> "To compile these rankings, we started with a list of 540 individuals considered strong candidates and then got to work. When possible we met with list candidates in person; we spoke with at least 95 billionaires this year. We also interviewed their employees, handlers, rivals, peers and attorneys. We pored over hundreds of Securities & Exchange Commission documents, court records, probate records, federal financial disclosures and Web and print stories. We took into account all assets we could value and we factored in debt in many cases. Of course, we don't pretend to know what is listed on each billionaire's private balance sheet, although some candidates did provide paperwork to that effect."[21]

[21] Kroll, Luisa. "The Forbes 400: The Richest People in America." Forbes. September 19, 2012. Accessed April 26, 2014. http://www.forbes.com/sites/luisakroll/2012/09/19/the-forbes-400-the-richest-people-in-america/.

No additional methodology information was available, either through the Forbes website or upon request from the Forbes 400 data gathering group.

The Forbes 400 has been published annually since 1982, and we made the assumption that net worth data for previous years was calculated using the same methodology. It must be noted that these figures are only estimates, and may not perfectly reflect the net worth of the individuals in the data set. The data may also not properly align with the methodology for the data collected from the WRDS database, which could lead to some calculation errors. But because net worth data is not public information for U.S. executives, alternative sources must be used to gather this data. The Forbes 400 data is extensively used as a resource for net worth data in financial academic papers such as *It's the Market: The Broad-Based Rise in the Return to Top Talent* written by Steven N. Kaplan and Joshua Rauh, and published in the Journal of Economic Perspectives.[22] Therefore, in order to make our calculations possible, we made the assumption that the Forbes 400 is reasonably accurate and sufficiently credible for the analysis of this paper.

The Wharton Research Data Services (WRDS) website includes compiled information of executive compensation in their ExecuComp database.[23] This data is collected directly from the annual proxy forms of public U.S. companies that are part of the S&P 1500. Information from this database was used to assemble all the data relating

[22] Kaplan, Stephen N., and Joshua Rauh. "It's the Market: The Broad-Based Rise in the Return to Top Talent." *The Journal of Economic Perspectives* 27, no. 3 (2013): 35-55.

[23] *Wharton Research Data Services*. "ExecuComp," accessed February 15, 2014, http://wrds-web.wharton.upenn.edu/.

to executive equity-based compensation: the number of executive stock holdings, the number of stock option holdings, and the number of restricted stock holdings.

All but one of the executives had unrestricted stock holdings in their company, and many had vast holdings. The executive with the largest unrestricted stock holdings was Lawrence Ellison of Oracle, who had $35.5 billion in unrestricted Oracle stock as of 2012. The average unrestricted stock holdings had a value of $3.8 billion, and the median had a value of $1.1 billion. Of the executives in the data set, 19 had restricted stock holdings in the year analyzed. Within these 19 executives, the average value of their restricted stock holdings was $10.1 million. Stock options were a relatively common form of executive compensation, with 24 of the 56 executives having unvested options during the year we analyzed. Of those executives holding unvested options, the average value of the options was $19.0 million. **Table 2** includes the equity holdings of the executives, shown as a number of shares, as well as summary statistics where appropriate. **Table 5** provides the dollar value of these equity holdings, calculated using the methodology described in Part II.

Data on stock prices, firm and market volatility, firm and market correlation, and firm beta is calculated using historical stock and market data obtained from the WRDS's Center for Research in Security Prices (CRSP) dataset,[24] and calculated using traditional finance equations sourced from *Corporate Finance*.[25] A market risk premium ($r_m - r_f$) of 7.5% (7.23%, continuously compounded) is used based on the assumption made on page

[24] *Wharton Research Data Services*. "Center for Research in Security Prices," accessed February 15, 2014, http://wrds-web.wharton.upenn.edu/.

[25] Jaffe, Jeffrey, Stephen Ross, and Randolph Westerfield. *Corporate Finance*. 10th ed. Mcgraw Hill/Irwin, 2013.

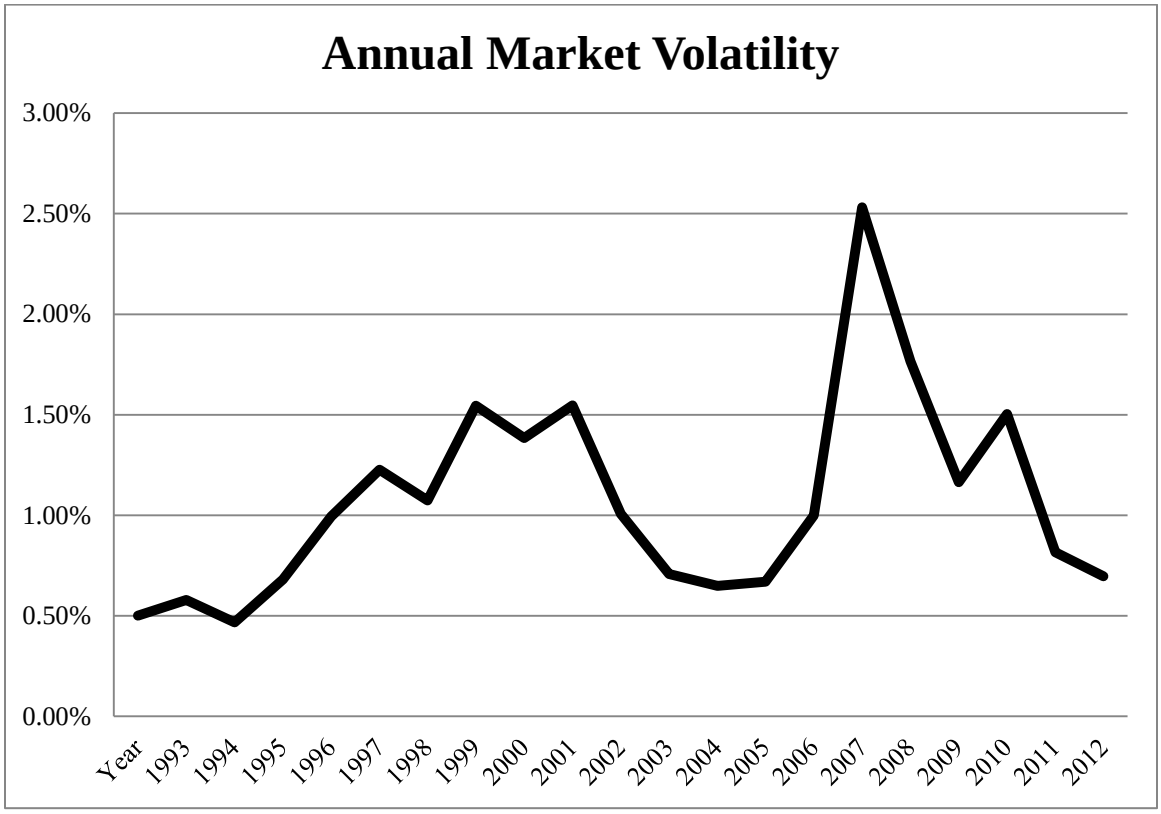
41 of Meulbroek (2001). Values used for the risk-free rate of return (r_f), are based on the rate of return on the 10-year Treasury bill[26] corresponding to the date that the Forbes 400 net worth was calculated. A complete list of data gathered from these sources can be found in **Table 3**.

As can be seen in Table 3, the volatility of both the firms and the market varied widely over the 21-year period that the data spans. **Figure 1** shows the monthly market volatility over the period from 1993 to 2013. Periods of higher market volatility corresponds to downturns in the financial markets. Specifically, the dot-com bubble which burst in March 2000 led to a downturn in the financial markets that caused market volatility to be higher between 2000 and 2002. Similarly, the 2008 subprime mortgage crisis caused what has come to be known as the Great Recession, which corresponds to the higher market volatilities between 2008 and 2010.

[26] U.S. Department of the Treasury. *Daily Treasury Yield Curve Rates*. Retrieved from website: http://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=yield.

Figure 1

Annual market volatility between 1993 and 2013



We made assumptions regarding a number of the values that were used to complete the Meulbroek (2000) option efficiency calculations. This was necessary because firms are not required to disclose the terms of the options granted to executives in their proxy statements. We assumed that the options were granted with a strike price (*K* in Black-Scholes, and *X* in Meulbroek (2000)) equal to the stock price on the date that the options were granted. We further assumed that the vesting period of the options (*T*) was four years. These assumptions are consistent with those made by David Yermack in his 1995 paper titled *Do corporations award CEO stock options effectively?*[27] To

[27] Yermack, David. "Do Corporations Award Ceo Stock Options Effectively?" *Journal of Financial Economics* 39, no. 2 (1995): 237-69.

determine the time until the options vested (τ), we assumed that the four-year vesting period was halfway complete, and that therefore τ was equal to two. This simplification was made in order to avoid going through at least four years of proxy statements for every executive's firm in order to determine the number of options granted in each year. Without knowing the length of the vesting period, this would not have added much clarity to the calculations and we therefore deemed it to be unnecessary. As an extension of this assumption, we assumed that the options were granted two years before the date for which net worth data was calculated. Finally, we assumed that the market risk premium was equal to 7.5% (7.23% continuously compounded) and that the risk-free rate was equal to the interest rate on the 10-year Treasury bill on the date that the net worth data was calculated. Both of these are consistent with assumptions made by Meulbroek (2000).

PART IV.

RESULTS AND ANALYSIS

This section will describe the results of the key calculations done in the Meulbroek (2001) efficiency equation, followed by the results of the valuations done on the stock options as well as the restricted and unrestricted stock holdings of the executives. Next it will identify some problems that were encountered when analyzing the data. Finally, it will combine the findings in order to reach conclusions regarding the efficiency of the equity-compensation packages of the executives and calculate their deadweight losses that are attributable to undiversification.

Chapter 1

Results of Efficiency Calculations

The equation described in Meulbroek (2001) derives a return premium (s_j) that is, "the expected return needed to make an undiversified manager indifferent between holding a single-stock portfolio of her firm's stock and holding a market portfolio levered to an equivalent volatility level".[28] Based on our analysis, we found that the values of (s_j) ranged from a low of 2% to a high of 17%, with an average of 7%. Lower values of (s_j) identify lower volatility firms. As defined in Part II, V_j^u is the value that the undiversified investor places on the stock. These values ranged from a low of 71% of the market price

[28] Lisa Meulbroek, "The Efficiency of Equity-Linked Compensation: Understanding the Full Cost of Awarding Executive Stock Options", *Financial Management* 30 (Summer 2001): 5-44.

to a high of 97%, with an average of 87%. Lower percentages are associated with high-volatility firms, and identify those companies in which executives will experience the greatest deadweight loss due to undiversification.

The equation used to calculate $f(V_j)$ in Meulbroek (2001) is identical to the Black-Scholes model described in Part I. Using the assumptions outlined in the previous section, we calculated option values that ranged from a low of 2% of the market price to a high of 65%, with an average of 33%. In this calculation, firms with higher volatilities have higher option values (represented as a percentage of market price) because an option allows the owner to capture all of the gains in stock price without risking any of the downside if the price drops. If the price of the stock drops, the option holder will choose not to exercise the option and will therefore only have lost the sunk cost of buying the option. High volatility firms experience greater stock price fluctuations in both positive and negative directions. Because options protect the holder from experiencing the downside, they are only exposed to the potential upside. Therefore, more volatile stocks will have a higher value. The calculation of $f(V_j^u)$ is nearly identical to that done for $f(V_j)$, with the one exception being that the value of the stock to the undiversified investor (V_j^u) is used as the current stock price (S from the Black-Scholes model). This shows how much an undiversified investor would be willing to pay for a single stock option of the firm.

By dividing $f(V_j^u)$ by $f(V_j)$ we are able to calculate Φ: the efficiency of the stock option. These values range from a low of 40% for Stryker Corporation (a medical technologies firm) to a high of 89% for CBS Corporation (a mass media firm). The average efficiency of the stocks is 69%. As discussed in Part II, the percent of the value

that is lost due to undiversification is calculated as $(1 - \Phi)$. The higher the percentage of $(1 - \Phi)$, the less value an undiversified executive will place on owning that stock option. Inversely related to the high and lows for Φ, the firm that experiences the highest deadweight loss due to undiversification is Stryker Corporation, where 60% of the value is lost to the undiversified investor. CBS Corporation has the smallest deadweight loss, losing only 11% of its value when granted to an undiversified executive.

The average deadweight loss within the sample of 56 firms was 31%, and the median was 29%. A deadweight loss of 31% means that an executive who holds a single-stock portfolio including only the stock of that company would lose 31% of the market value of any stock options that were granted to them as part of their compensation package. This deadweight loss affects both the firms and the executives. Firms who want to use stock options as a part of their executive compensation packages are forced to grant more options to their undiversified executives in order to give the executives the same value of compensation. At the same time, the executives are being forced to hold undiversified portfolios until their options vest, which means that they are taking on unnecessary firm-specific risk and being exposed to more volatile portfolio returns. **Table 4** shows some of the efficiency calculations highlighted in this chapter, as well as summary statistics where appropriate.

Chapter 2

Valuing the Equity-Based Compensation

We valued the stock option holdings of the 24 executives who had them by multiplying the number of unvested options, as reported by WRDS's ExecuComp, by the Black-Scholes option pricing value determined during the efficiency calculations ($f(V_j)$). Lawrence Ellison of Oracle had the highest option valuation with $192.4 million, and Robert Fisher of Gap had the lowest non-zero option valuation with $26,800. The average stock option value for the 24 executives who held options was $19.0 million, and the median was $4.3 million.

The unrestricted stock holdings were valued by multiplying the number of unrestricted stock shares as reported by the WRDS ExecuComp database, by the stock price of the firm on the date of the net worth data. All but one executive, George Lindermann of Southern Union Company (a natural gas firm), had unrestricted stock holdings in their company. Once again, Lawrence Ellison of Oracle had the largest holdings, with his unrestricted stock valued at $35.5 billion. Sumner Redstone of CBS Corporation had the smallest holdings, with his unrestricted stock valued at $1,500. The average value of the unrestricted stock was $3.9 billion, and the median was $1.1 billion.

For the 19 executives who held restricted stock during the year that data was collected, the holdings were valued by multiplying the number of restricted stock shares by the value that an undiversified investor would place on them (V_j^u). Howard Schulze, CEO of Starbucks, had the largest holdings, with his restricted stock valued at $38.2 million. James France, CEO of International Speedway Corporation, had the smallest

non-zero holdings of restricted stock, valued at $328,900. The average value of the non-zero restricted stock holdings was $10.1 million, and the median was $5.0 million.

For the 56 executives in the data set, their total equity holdings, including those from options, restricted, and unrestricted stock, had an average value of $3.8 billion and a median value of $1.1 billion. Lawrence Ellison had the largest total equity value, with his holdings worth $35.7 billion, and Meg Whitman, CEO of Hewlett-Packard, had the smallest total equity value, worth $3.2 million. **Table 5** shows the value of equity-based compensation granted to each executive, as well as summary statistics where appropriate.

Chapter 3

Issues Encountered While Analyzing the Results

Once these results had been established, we next tried to calculate how much of the executives' net worth was made up of their equity holdings by dividing the total equity holdings by the corresponding executive's net worth. Unfortunately, this calculation created some unexpected results that seem to indicate low validity within our analysis. Three of the percentages that resulted from this calculation had values larger than one, which would mean that the equity holdings of these executives are valued at more than their entire net worth, as estimated by Forbes. The equity holdings of Tom Golisano, CEO of Paychex Incorporated, were valued at 118% of his net worth. The equity holdings of Robert Fisher, CEO of Gap Incorporated, were valued at 189% of his

net worth. By far the largest outlier was the equity holdings of Richard Kinder, CEO of Kinder Morgan Energy Partners, which were valued at 210% of his net worth.

After recognizing this discrepancy in the data, we went through the corresponding proxy statements for each of the three executives in an attempt to identify where the disagreement in the data had originated. In each of the proxy statements where the equity holdings of the executives were presented, there were footnotes to the data that provided further qualifications of the equity holdings. For example, the footnote to the table where Robert Fisher's 140 million total equity holdings are presented states the following: "Includes 2,623,725 shares held jointly by Robert J. Fisher and his spouse, 19,393,356 shares held by Robert J. Fisher as trustee under certain trusts for which voting and investment power is shared, and 101,000,000 shares held by Fisher Core Holdings L.P., of which Robert J. Fisher is a general partner and over which he shares voting and investment power. Mr. Fisher disclaims individual beneficial ownership of shares owned by Fisher Core Holdings L.P. or its other general partners except to the extent of his actual ownership interest therein (5,000,000 shares)".[29] Similar qualifications were made to the stock holdings for both Tom Golisano[30] and Richard Kinder.[31]

By comparing these proxy statement footnotes to the methodology described by the Forbes 400, we concluded that some additional analysis must have been done in the

[29] Gap, Inc. *2008 Proxy Statement*. Page 21. Accessed April 15, 2014. http://www.sec.gov/Archives/edgar/data/39911/000119312508082623/ddef14a.htm

[30] Paychex, Inc. *2005 Proxy Statement*. Accessed April 15, 2014. http://www.sec.gov/Archives/edgar/data/723531/000095015205007394/l14023adef14a.htm

[31] Kinder Morgan Energy Partners. *2013 Proxy Statement*. Accessed April 15, 2014. http://www.sec.gov/Archives/edgar/data/1506307/000150630713000022/kmi2013annualproxystatement.htm

process of the Forbes net worth calculations that was not reflected in the WRDS ExecuComp data. One possible explanation is that the Forbes analysts subtracted the value of some of these groups of stocks that were discussed in the footnotes from their net worth calculations. Alternatively, it is possible that debt or other deductions may have caused the net worth valuation calculated by Forbes to be lower than the value of the executives' equity holdings.

It would be a major undertaking to attempt to unravel the complex web of holding companies, trusts, and foundations where these shares are held in an attempt to calculate a more accurate number of equity holdings. Even if that were completed, it is unlikely that the number would have been calculated using a method similar enough to that in the Forbes analysis. We attempted to acquire more accurate data and information on how the Forbes net worth numbers were developed, but no one with whom we have talked within Forbes has been able to provide the necessary information. Therefore, the rest of this paper will work off of the assumption that the values calculated are accurate, with the qualification that there are discrepancies in the different methods used to derive our results that may make the conclusions less valid. These percentages can be found in **Table 5**.

Chapter 4

Executive Deadweight Losses Attributable to Undiversification

The deadweight losses attributable to executive undiversification were calculated in two separate parts. First, the deadweight loss from options was determined by

multiplying the value of the unvested options by the option deadweight percentage (1-Φ) that was found previously in the efficiency calculations in Part IV, Chapter 1. The values for this portion of the deadweight loss ranged from a high of $29.3 million to a low of $10,600 within the 24 executives who held stock options during the period. The average deadweight loss due to option-attributable undiversification was $4.2 million and the median was $1.3 million. In Part II we made the assumption that executives place the same value on both restricted and unrestricted stock. Based on this, we then calculated the deadweight loss attributable to restricted and unrestricted stock by multiplying the value of their combined restricted and unrestricted stock holdings by a deadweight percentage equal to (1- V_j^u / V_j). This is the same method used to measure the efficiency of the option holdings, in which the deadweight percentage was equal to ($1 - f(V_j^u) / f(V_j)$). The values of the deadweight loss attributable to restricted and unrestricted stock ranged from a high of $4.5 billion for Microsoft CEO Bill Gates to a low of $394,600 for Hewlett-Packard CEO Meg Whitman. The average deadweight loss due to restricted and unrestricted stock holdings was $451.3 million and the median was $155.4 million.

By adding the deadweight loss values attributable to both option holdings and restricted and unrestricted stock holdings, we finally calculated the total value of deadweight loss that each executive experienced as a result of their equity-based compensation. Bill Gates had the highest total deadweight loss, with $4.5 billion lost due to undiversification, and Meg Whitman had the lowest total deadweight loss, with $424,000 lost. The average was $453.1 million and the median was $156.5 million.

The next piece of analysis that we did with the data results was to calculate what percentage of their net worth (as calculated by Forbes) each executive was losing to

equity-based undiversification. Robert Fisher of Gap Incorporated was losing the largest percentage of his net worth to undiversification. His $375.6 million in undiversification losses accounted for 23.9% of his net worth of $1.4 billion. Meg Whitman of Hewlett-Packard was losing effectively none of her net worth to undiversification, because her total deadweight loss was only $430,600 out of her net worth of $1.7 billion. Across all the executives, the average loss due to undiversification was 7.5% of their net worth and the median was 6.1%.

Finally, we used the CPI[32] to convert each executive's total deadweight loss into 2013 dollars. By adding up all of these values, we found that the total deadweight loss experienced by the individuals in the dataset was equal to $27.0 billion 2013 dollars. To put this value in perspective, if someone was able to capture this $27.0 billion of deadweight loss, they would have ranked as the 13th richest person in the United States, based on the 2013 Forbes 400,[33] and they also would have been 21st richest person in the world, based on the Forbes 2013 list of the world's billionaires.[34] **Table 6** shows the value of the deadweight loss attributable to each executive, as well as summary statistics where appropriate.

[32] "Converter of Current to Real Us Dollars." Accessed April 16, 2014 http://stats.areppim.com/calc/calc_usdlrxdeflxcpi.php.

[33] *Forbes*. The Forbes 400: The Richest People in America. September 2013.

[34] *Forbes* "The World's Billionaires." Accessed April 15, 2014. http://www.forbes.com/billionaires/.

PART V.

SHORTCOMINGS

The shortcomings of our research process and analysis stemmed from three areas. First are the shortcomings involved with the data and data collection methods, which were partially discussed in Part IV. The second shortcoming is due to the assumptions that needed to be made in order to complete the option efficiency calculations, and these were primarily due to gaps in the available data. The final shortcoming was the assumption made in Part II that executives value restricted and unrestricted stock equally, which was done in order to calculate the efficiency of these holdings. Details and justification for each of these shortcomings will be discussed in the following chapters.

Chapter 1

Data Shortcomings

The data used for our analysis was gathered from two main sources. Net worth data was gathered from historical years of the Forbes 400 list, and almost all the other data was gathered from the WRDS databases. As discusses in Part IV, we do not have detailed knowledge of how the Forbes 400 net worth data was calculated, and therefore cannot ensure that they used the same stock and equity values in their analysis. The methodology behind the Forbes 400 also explicitly states that these numbers are not perfect, due to the lack of public information. From the results we found, it seems likely that the Forbes 400 calculations that were used to determine the stock and equity holdings

of the executives included different analysis than our own calculations. This leads to an obvious shortcoming in our analysis, because the assumptions built into the net worth data are not consistent with the assumptions made in our own calculations. This became apparent when we calculated the executives' deadweight loss as a percent of their total net worth. Some of the percentages were greater than one hundred percent, which indicates that the underlying data is not based on consistent assumptions.

Further shortcomings were due to lack of available data. We did not have detailed information on the terms of the options granted by the firms to the executives. Specifically, data on holding periods, vesting periods, strike prices, and grant dates were either not available, or not reported consistently enough to be used in our analysis. This lack of data let to a number of assumptions that needed to be made, in order to complete the calculations. These assumptions will be described in the next chapter.

Chapter 2

Assumption Made in Calculating Option Efficiency

In order to complete the calculations of option efficiency, data assumptions were made regarding the holding periods, vesting periods, strike prices, and grant dates. This was necessary because firms are not required to disclose the terms of the options granted to executives in their proxy statements. Consistent with assumptions made in previous literature by the well-respected financial academic David Yermack, we assumed that the options were granted with a strike price (K in Black-Scholes, and X in Meulbroek (2000)) equal to the stock price on the date that the options were granted.

Data on vesting periods is usually available in firm proxy statements, but collecting the correct information would have involved going through four or more years of proxy statements for each executive in order to determine the number of options granted in each year. If we had attempted to do this, we would also have needed to gather corresponding equity, volatility, and stock data for each year that options were granted, in order to properly value the options. This would have drastically increased the amount of data collection and calculations needed for our analysis, without adding much to the validity of the results. Therefore, we made the simplifying assumption that the vesting period of the options (T) was four years. To determine the time until the options vested (τ), we assumed that the four-year vesting period was halfway complete, and that therefore τ was equal to two. As an extension of this, we assumed that the options were granted two years before the date for which net worth data was calculated.

Finally, we assumed that the market risk premium was equal to 7.5% (7.23% continuously compounded) and that the risk-free rate was equal to the interest rate on the 10-year Treasury bill on the date that the net worth data was calculated. Both of these assumptions are consistent with those made in Meulbroek (2001).

Chapter 3

Assumption Made in Calculating Unrestricted Stock Efficiency

When calculating the efficiency of the restricted and unrestricted stock holdings of the executives, we assumed that executives place the same value on unrestricted stock as they do on restricted stock. In order for this to be true, executives must be planning to

keep their restricted shares, even after they vest, and therefore do not make a distinction between the values they place on each. There are a number of reasons why this could be true.

Academic financial literature going back for decades has analyzed the impact that executive or insider trading has on the stock price of the firm, and concluded that insiders have information that allows them to predict stock price changes more successfully than outsiders.[35] Because of this body of evidence, markets follow very closely the selling of stock by executives and other insiders, in the belief that it is predictive of future stock price changes. Therefore, executives may hold on to their stock in order to protect the firm from negative market reactions that would occur if they sold their holdings. Because of the same logic, companies sometimes contractually require executives to maintain a certain level of equity holdings, in order to inspire investor confidence. This would force them to hold their restricted stock, even after the vesting period has passed.

They may also choose to keep their holdings because they believe the company's stock is going to be so successful that the stock returns will adequately compensate them for the additional risk associated with their undiversified portfolio. Finally, because the executives in our data sample are made up of extremely wealthy individuals, it might be the case that they are indifferent to the deadweight loss due to undiversification. They may simply have so much money that they don't care whether they are losing the opportunity to have a little more.

[35] Jaffe, Jeffrey. "Special Information and Insider Trading." *The Journal of Business* 47, no. 3 (July 1974): 410-28.

PART VI

CONCLUSION

Our analysis used the method developed by Lisa Meulbroek in her 2001 paper titled, "The Efficiency of Equity-Linked Compensation: Understanding the Full Cost of Awarding Executive Stock Options" in order to analyze the equity-based deadweight losses experienced by 56 executives. Using data gathered from the WRDS and historical Forbes 400 lists, we used the Meulbroek (2001) formula to calculate the efficiency ratio of each executive's options based on the volatility and historical stock prices of their firm. We then valued the options, restricted stock, and unrestricted stock holdings of each executive based on data from the WRDS ExecuComp database. The deadweight loss of the options was calculated using the option efficiency ratio, and the restricted and unrestricted stock deadweight loss was calculated using an efficiency ratio explained in Part IV. The average deadweight loss experienced by the executives in the year analyzed was $481 million (in 2013 dollars). The total deadweight loss experienced by all of the executives and expressed in 2013 dollars was $27 billion - enough income alone to qualify an individual as the 13th most wealthy citizen in the U.S.

If reliable net worth data were available for more than just the richest 400 Americans, future research could expand the results of this analysis to calculate the deadweight losses experienced by all equity-holding executives of all S&P 1500 companies. This would result in a data sample of over 7,500 executives, rather than only the 56 that were used in this analysis. But due to the limited availability of net worth data, this is unlikely to be achieved. It would also be insightful to analyze the deadweight loss

in smaller, early stage firms, because they have different reasons for using equity-based compensation, and therefore would likely have significantly different results.

Another extension of this analysis could calculate the option efficiency ratios of the S&P 1500 companies and analyze them based on industry, size, firm age, and other distinguishing features, to investigate the identifying markers that are shared among companies with high and low option efficiency ratios. While this extension would not be able to directly calculate the dollar value of deadweight loss, it could inform compensation package decisions made by firms. This would allow firms to make more informed decisions about the deadweight loss they are sharing with their employees due to undiversification.

The deadweight losses firms expose their employees to by granting equity-based compensation could actually be a rational choice for the companies. If the equity holdings of their employees effectively motivated them to work harder or remain at the company longer, and resulted in higher stock prices, this would have the result of maximizing shareholder value. This is an argument that has been made often as justification for granting equity as part of employee compensation packages. Unfortunately, according to a large body of academic research, "there is no convincing evidence that it works".[36] Michael Dorff's new book *Indispensable and Other Myths* discusses this body of literature and gives a broad perspective of the historical factors at play. According to his book, "performance pay is more likely to lower a business's profits than to raise them".[37]

[36] Michæl Dorff, *Indispensable and Other Myths: Why the Ceo Pay Experiment Failed and How to Fix It* (Oakland, CA: University of California Press, 2014), 8.

[37] *Ibid*., 9.

Therefore, the question must be asked: why are so many firms still using equity as a primary form of compensation? Perhaps in the future, firms will recognize this growing body of evidence and reduce their use of equity as a form of compensation, in order to truly maximize shareholder value.

Table 1

Data gathered from the Forbes 400 lists 1993-2013. Net worth is in nominal terms, as of the corresponding year in column 3. The year of net worth data is the most recent year in which both WRDS and Forbes data was available for each executive. Source of wealth refers to the company that the executive worked in, and the ticker is the stock ticker symbol for that company.

Full Name	Net Worth (in billions)	Year of Net Worth Data	Source of Wealth	Ticker	Age	Gender
H. Wayne Huizenga	$ 0.60	1993	Blockbuster Entertainment Corp.	BV	56	M
Rupert Johnson, Jr.	$ 1.50	1997	Franklin Resources, Inc.	BEN	58	M
Bernard Marcus	$ 3.00	2001	Home Depot Inc.	HD	72	M
Gerald J. Ford	$ 0.80	2001	Golden State Bancorp Inc.	GSB	57	M
John Brown	$ 0.96	2004	Stryker Corp.	SYK	70	M
Phil Knight	$ 7.40	2004	Nike	NKE	67	M
Charles Johnson	$ 2.50	2004	Franklin Resources, Inc.	BEN	72	M
Phillip Frost	$ 0.85	2004	Ivax Corp.	IVX	68	M
Richard Schulze	$ 2.50	2004	Best Buy Inc.	BBY	64	M
Tom Golisano	$ 1.00	2004	Paychex Inc.	PAYX	63	M
Thomas Siebel	$ 1.20	2004	Siebel Systems Inc.	SEBL	52	M
Bill Gates	$ 53.00	2006	Microsoft	MSFT	51	M
Leonard Lauder	$ 2.90	2006	Estee Lauder	EL	73	M
Robert Fisher	$ 1.40	2007	Gap Inc.	GPS	54	M
Patrick Ryan	$ 1.60	2008	Aon	AON	71	M
Irwin Jacobs	$ 1.90	2008	Qualcomm Inc.	QCOM	75	M
Sidney Kimmel	$ 1.10	2010	Jones Apparel Group	JNY	83	M
Jerry Yang	$ 1.15	2010	Yahoo Inc.	YHOO	42	M
Steve Jobs	$ 6.10	2010	Apple	AAPL	55	M
George Lindemann	$ 2.10	2011	Southern Union Co.	SUG	75	M
Marc Benioff	$ 2.20	2011	Salesforce.com	CRM	49	M
Leslie Wexner	$ 4.40	2012	L Brands Inc.	LTD	75	M
Min Kao	$ 2.20	2012	Garmin Ltd.	GRMN	64	M
Bernard Saul, II.	$ 1.20	2012	Saul Centers Inc.	BFS	80	M
Bill Marriott, Jr.	$ 1.60	2012	Marriott International Inc.	MAR	80	M
Henry Samueli	$ 1.80	2012	Broadcom Corp.	BRCM	58	M
Warren Buffett	$ 46.00	2012	Berkshire Hathaway	BRK.B	83	M
Lawrence Ellison	$ 41.00	2012	Oracle	ORCL	69	M
Jeffrey Bezos	$ 23.20	2012	Amazon.com	AMZN	50	M
Lawrence Page	$ 20.30	2012	Google	GOOG	40	M
Sergey Brin	$ 20.30	2012	Google	GOOG	40	M
Michael Dell	$ 14.60	2012	Dell	DELL	49	M
Charles Ergen	$ 9.00	2012	Dish Network	DISH	61	M
Richard Kinder	$ 9.40	2012	Kinder Morgan Energy	KMP	69	M
Eric Schmidt	$ 7.50	2012	Google	GOOG	58	M
Ralph Lauren	$ 6.50	2012	Ralph Lauren	RL	74	M
Micky Arison	$ 5.00	2012	Carnival Cruises	CCL	64	M
Sumner Redstone	$ 4.10	2012	CBS Corp.	CBS	90	M
Charles Schwab	$ 3.70	2012	Schwab (Charles) Corp.	SCHW	76	M
Charles Dolan	$ 3.00	2012	CableVision	CVC	87	M
Steve Wynn	$ 2.50	2012	Wynn Resorts	WYNN	72	M
David Murdock	$ 2.40	2012	Dole Food Co.	DOLE	90	M
Frederick Smith	$ 1.80	2012	FedEx	FDX	69	M
Mortimer Zuckerman	$ 2.40	2012	Boston Properties Inc.	BXP	76	M
Barry Diller	$ 1.80	2012	Expedia.com	EXPE	72	M
James France	$ 2.00	2012	Intl. Speedway Corp.	ISCA	69	M
Richard Marriott	$ 1.90	2012	Host Hotels and Resorts	HST	75	M
Howard Schultz	$ 1.50	2012	Starbucks	SBUX	60	M

Meg Whitman	$	1.70	2012	Hewlett-Packard	HPQ	57	F
Richard Hayne	$	1.40	2012	Urban Outfitters	URBN	66	M
Kevin Plank	$	1.35	2012	Under Armour	UA	41	M
Scott Cook	$	1.40	2012	Intuit	INTU	61	M
Neal Patterson	$	1.12	2012	Cerner Corp.	CERN	64	M
Jeffrey Lorberbaum	$	1.15	2012	Mohawk Industries Inc.	MHK	59	M
George Joseph	$	1.10	2012	Mercury General Corp.	MCY	92	M
Steven Ballmer	$	18.00	2013	Microsoft	MSFT	57	M

Average:	6.501428571	66
Median:	2.15	67
High:	53	92
Low:	0.6	40

Table 2

Data and summary statistics for executive equity holdings. Equity holdings data was gathered from the WRDS ExecuComp database. Net worth is in nominal terms, corresponding to the year in **Table 1**. Total equity holdings is equal to the sum of unvested options, restricted shares, and unrestricted shares.

Full Name	Net Worth (in billions)	Number of Unvested Options	Number of Unvested Restricted Shares	Number of Unrestricted Shares	Total Number of Equity Holdings
H. Wayne Huizenga	$ 0.60	-	-	10,905,890	10,905,890
Rupert Johnson, Jr.	$ 1.50	-	12,034,000	19,136,580	31,170,580
Bernard Marcus	$ 3.00	-	-	60,062,770	60,062,770
Gerald J. Ford	$ 0.80	365,333,000	48,120,000	19,161,804	432,614,804
John Brown	$ 0.96	274,000,000	-	18,505,510	292,505,510
Phil Knight	$ 7.40	-	-	65,173,880	65,173,880
Charles Johnson	$ 2.50	-	-	44,814,360	44,814,360
Phillip Frost	$ 0.85	309,375,000	-	39,044,830	348,419,830
Richard Schulze	$ 2.50	157,500,000	-	50,000,940	207,500,940
Tom Golisano	$ 1.00	-	-	39,282,990	39,282,990
Thomas Siebel	$ 1.20	-	-	38,662,340	38,662,340
Bill Gates	$ 53.00	-	-	957,499,340	957,499,340
Leonard Lauder	$ 2.90	-	-	8,588,470	8,588,470
Robert Fisher	$ 1.40	7,500,000	-	140,909,330	148,409,330
Patrick Ryan	$ 1.60	-	43,177,000	18,467,870	61,644,870
Irwin Jacobs	$ 1.90	451,670,000	-	25,502,120	477,172,120
Sidney Kimmel	$ 1.10	-	-	1,033,920	1,033,920
Jerry Yang	$ 1.15	-	-	45,810,560	45,810,560
Steve Jobs	$ 6.10	-	-	5,546,450	5,546,450
George Lindemann	$ 2.10	917,873,000	141,260,000	-	1,059,133,000
Marc Benioff	$ 2.20	860,420,000	-	10,000,000	870,420,000
Leslie Wexner	$ 4.40	716,566,000	430,582,000	26,217,750	1,173,365,750
Min Kao	$ 2.20	-	-	49,320,540	49,320,540
Bernard Saul, II.	$ 1.20	-	-	241,070	241,070
Bill Marriott, Jr.	$ 1.60	-	119,193,000	17,269,860	136,462,860
Henry Samueli	$ 1.80	-	189,212,000	16,957,800	206,169,800
Warren Buffett	$ 46.00	-	-	352,350	352,350
Lawrence Ellison	$ 41.00	17,500,000,000	-	1,110,434,580	18,610,434,580

Jeffrey Bezos	$	23.20	-	-	86,970,020	86,970,020
Lawrence Page	$	20.30	-	-	25,006,920	25,006,920
Sergey Brin	$	20.30	-	-	24,454,590	24,454,590
Michael Dell	$	14.60	301,900,000	-	273,332,370	575,232,370
Charles Ergen	$	9.00	150,000,000	-	240,667,400	390,667,400
Richard Kinder	$	9.40	-	-	240,872,510	240,872,510
Eric Schmidt	$	7.50	98,500,000	51,140,000	6,418,060	156,058,060
Ralph Lauren	$	6.50	186,720,000	191,370,000	22,196,440	400,286,440
Micky Arison	$	5.00	-	265,010,000	100,638,840	365,648,840
Sumner Redstone	$	4.10	1,032,390,000	629,410,000	40	1,661,800,040
Charles Schwab	$	3.70	1,027,730,000	-	178,626,540	1,206,356,540
Charles Dolan	$	3.00	1,747,600,000	454,300,000	20,487,000	2,222,387,000
Steve Wynn	$	2.50	-	-	10,031,710	10,031,710
David Murdock	$	2.40	170,000,000	45,000,000	35,318,590	250,318,590
Frederick Smith	$	1.80	496,440,000	-	19,627,900	516,067,900
Mortimer Zuckerman	$	2.40	101,540,000	143,510,000	1,495,400	246,545,400
Barry Diller	$	1.80	112,210,000	10,320,000	4,847,950	127,377,950
James France	$	2.00	-	14,050,000	1,674,440	15,724,440
Richard Marriott	$	1.90	-	-	8,562,620	8,562,620
Howard Schultz	$	1.50	1,807,600,000	942,940,000	19,637,470	2,770,177,470
Meg Whitman	$	1.70	200,000,000	163,200,000	37,840	363,237,840
Richard Hayne	$	1.40	-	-	29,655,120	29,655,120
Kevin Plank	$	1.35	-	-	20,975,200	20,975,200
Scott Cook	$	1.40	-	-	14,381,870	14,381,870
Neal Patterson	$	1.12	346,800,000	-	14,298,150	361,098,150
Jeffrey Lorberbaum	$	1.15	-	45,650,000	9,401,500	55,051,500
George Joseph	$	1.10	-	-	18,804,200	18,804,200
Steven Ballmer	$	18.00	-	-	333,252,990	333,252,990
Average:	$	6.50	1,222,486,125	207,340,947	83,646,865	669,465,265
Median:	$	2.15	328,087,500	141,260,000	20,487,000	136,462,860
High:	$	53.00	17,500,000,000	942,940,000	1,110,434,580	18,610,434,580
Low:	$	0.60	7,500,000	10,320,000	40	41

Table 3

Data and summary statistics for variables used as inputs in efficiency calculations. Risk-free rate data was gathered from the U.S. Treasury Department, and all other data was gathered from the WRDS CRSP database. Stock price at net worth data refers to the stock price of the executive's company on the date that net worth data was calculated by Forbes. Annualized firm and market volatility are based off of data from the 150 trading days prior to the date that net worth data was calculated. Beta is defined as the covariance of the firm and the market, divided by the variance of the market. The correlation coefficient is a number between -1 and 1 that represents the linear dependence between the firm's stock and the market. The risk-free rate is the theoretical rate of return on an investment with no risk, and is approximated by the rate of return on

Full Name	Ticker	Stock Price at Net Worth Date	Annualized Firm Volatility	Annualized Mkt Volatility	Beta [cov(j,m)/var(m)]	Correlation Coefficient	Risk-Free Rate at Net Worth Date
H. Wayne Huizenga	BV	$ 26.75	27.24%	8.73%	1.22	0.39	5.48%
Rupert Johnson, Jr.	BEN	$ 77.63	31.75%	13.68%	1.35	0.59	6.38%
Bernard Marcus	HD	$ 48.99	39.08%	21.34%	1.08	0.60	5.53%
Gerald J. Ford	GSB	$ 29.00	27.70%	21.34%	0.40	0.31	5.53%
John Brown	SYK	$ 46.06	29.94%	12.11%	0.97	0.39	4.86%
Phil Knight	NKE	$ 75.95	18.57%	12.11%	0.81	0.53	4.86%
Charles Johnson	BEN	$ 53.27	20.69%	12.11%	1.13	0.67	4.86%
Phillip Frost	IVX	$ 19.69	37.47%	12.11%	1.17	0.38	4.86%
Richard Schulze	BBY	$ 48.43	29.14%	12.11%	1.60	0.67	4.86%
Tom Golisano	PAYX	$ 30.00	25.76%	12.11%	0.93	0.44	4.86%
Thomas Siebel	SEBL	$ 7.82	44.51%	12.11%	2.27	0.62	4.86%
Bill Gates	MSFT	$ 25.70	24.08%	11.88%	0.65	0.33	4.92%
Leonard Lauder	EL	$ 36.86	21.29%	11.88%	0.72	0.39	4.92%
Robert Fisher	GPS	$ 18.76	27.41%	14.97%	0.90	0.49	4.83%
Patrick Ryan	AON	$ 47.49	25.43%	20.05%	0.91	0.72	4.35%
Irwin Jacobs	QCOM	$ 52.65	41.08%	20.05%	0.90	0.45	4.35%
Sidney Kimmel	JNY	$ 16.01	47.73%	21.04%	1.78	0.79	3.20%
Jerry Yang	YHOO	$ 13.26	31.40%	21.04%	1.02	0.69	3.20%
Steve Jobs	AAPL	$ 242.89	29.54%	21.04%	1.00	0.72	3.20%
George Lindemann	SUG	$ 41.88	39.93%	22.30%	0.63	0.36	3.07%
Marc Benioff	CRM	$ 117.50	42.40%	13.96%	1.27	0.66	3.07%
Leslie Wexner	LTD	$ 48.83	24.73%	13.96%	1.14	0.65	2.39%
Min Kao	GRMN	$ 40.50	28.04%	13.96%	0.97	0.49	2.39%
Bernard Saul, II.	BFS	$ 42.88	16.85%	13.96%	0.60	0.50	2.39%

Bill Marriott, Jr.	MAR	$	36.97	25.65%	13.96%	1.36	0.75	2.39%
Henry Samueli	BRCM	$	35.35	34.72%	13.96%	1.66	0.67	2.39%
Warren Buffett	BRK.B	$	85.39	12.78%	13.96%	0.68	0.75	2.39%
Lawrence Ellison	ORCL	$	31.95	22.54%	13.96%	1.20	0.75	2.39%
Jeffrey Bezos	AMZN	$	245.74	34.76%	13.96%	1.01	0.41	2.39%
Lawrence Page	GOOG	$	678.63	20.34%	13.96%	0.80	0.55	2.39%
Sergey Brin	GOOG	$	678.63	20.34%	13.96%	0.80	0.55	2.39%
Michael Dell	DELL	$	11.26	32.73%	13.96%	0.93	0.40	2.39%
Charles Ergen	DISH	$	32.27	27.98%	13.96%	1.23	0.61	2.39%
Richard Kinder	KMP	$	81.84	15.42%	13.96%	0.48	0.44	2.39%
Eric Schmidt	GOOG	$	678.63	20.34%	13.96%	0.80	0.55	2.39%
Ralph Lauren	RL	$	159.58	30.41%	13.96%	1.35	0.63	2.39%
Micky Arison	CCL	$	33.27	22.10%	13.96%	1.07	0.68	2.39%
Sumner Redstone	CBS	$	36.55	25.82%	13.96%	1.32	0.72	2.39%
Charles Schwab	SCHW	$	13.27	27.36%	13.96%	1.53	0.79	2.39%
Charles Dolan	CVC	$	15.17	34.08%	13.96%	1.37	0.56	2.39%
Steve Wynn	WYNN	$	105.33	32.65%	13.96%	1.29	0.56	2.39%
David Murdock	DOLE	$	12.96	45.05%	13.96%	0.86	0.27	2.39%
Frederick Smith	FDX	$	89.07	21.42%	13.96%	1.13	0.75	2.39%
Mortimer Zuckerman	BXP	$	111.84	17.00%	13.96%	0.84	0.69	2.39%
Barry Diller	EXPE	$	53.06	51.41%	13.96%	1.45	0.40	2.39%
James France	ISCA	$	25.40	21.21%	13.96%	0.95	0.63	2.39%
Richard Marriott	HST	$	15.35	29.51%	13.96%	1.68	0.80	2.39%
Howard Schultz	SBUX	$	48.70	30.82%	13.96%	0.93	0.42	2.39%
Meg Whitman	HPQ	$	17.58	32.69%	13.96%	1.43	0.61	2.39%
Richard Hayne	URBN	$	36.94	38.11%	13.96%	1.10	0.41	2.39%
Kevin Plank	UA	$	55.87	35.96%	13.96%	1.29	0.50	2.39%
Scott Cook	INTU	$	58.43	24.23%	13.96%	1.13	0.66	2.39%
Neal Patterson	CERN	$	71.27	31.34%	13.96%	1.04	0.47	2.39%
Jeffrey Lorberbaum	MHK	$	72.83	33.64%	13.96%	1.49	0.63	2.39%
George Joseph	MCY	$	38.02	18.24%	13.96%	0.58	0.44	2.39%
Steven Ballmer	MSFT	$	34.15	26.83%	11.68%	0.85	0.37	3.50%

Table 4

Data and summary statistics for selected sections of efficiency calculations. Variables are defined in Part II. s_j is the return premium that an undiversified investor would require to make her indifferent to holding the stock versus holding the market portfolio levered to the volatility of the stock. V_j^u/V_j is how much the undiversified investor would value the stock, as a percent of the stock's value to a diversified investor. $f(V_j)$ is the Black-Scholes option price of the stock to a diversified investor, and $f(V_j^u)$ is the Black-Scholes option price to an undiversified investor. Φ is the efficiency of the option compensation, and is calculated as $f(V_j^u) / f(V_j)$. $(1-\Phi)$ is the deadweight loss of the option to the undiversified investor, calculated as a percentage of the option value.

Full Name	s_j	V_j^u/V_j	$f(V_j)$	$f(V_j^u)$	Φ	$(1-\Phi)$
H. Wayne Huizenga	14%	76%	16.6	10.2	62%	38%
Rupert Johnson, Jr.	7%	87%	33.5	24.4	73%	27%
Bernard Marcus	5%	90%	7.9	5.6	71%	29%
Gerald J. Ford	7%	88%	11.2	8.0	72%	28%
John Brown	11%	80%	6.1	2.5	40%	60%
Phil Knight	5%	90%	34.9	27.4	79%	21%
Charles Johnson	4%	92%	21.0	16.9	81%	19%
Phillip Frost	14%	76%	7.9	4.1	52%	48%
Richard Schulze	6%	89%	28.6	23.4	82%	18%
Tom Golisano	9%	84%	8.8	5.1	58%	42%
Thomas Siebel	10%	82%	1.7	1.0	57%	43%
Bill Gates	10%	82%	3.9	1.6	41%	59%
Leonard Lauder	8%	86%	3.3	1.3	41%	59%
Robert Fisher	7%	87%	3.6	2.2	61%	39%
Patrick Ryan	3%	95%	17.1	14.9	87%	13%
Irwin Jacobs	8%	85%	21.5	15.0	70%	30%
Sidney Kimmel	4%	93%	3.6	3.0	83%	17%
Jerry Yang	3%	93%	1.0	0.7	74%	26%
Steve Jobs	3%	94%	88.2	76.2	86%	14%
George Lindemann	8%	85%	23.1	17.1	74%	26%
Marc Benioff	13%	77%	69.3	44.5	64%	36%
Leslie Wexner	5%	91%	25.6	21.4	84%	16%
Min Kao	7%	86%	15.9	10.9	69%	31%
Bernard Saul, II.	4%	92%	6.1	3.8	63%	37%
Bill Marriott, Jr.	3%	93%	8.7	6.9	79%	21%
Henry Samueli	6%	89%	9.2	6.5	71%	29%
Warren Buffett	2%	97%	13.9	11.6	83%	17%

Lawrence Ellison	3%	94%	11.0	9.3	85%	15%
Jeffrey Bezos	11%	81%	129.5	85.5	66%	34%
Lawrence Page	5%	91%	252.0	194.4	77%	23%
Sergey Brin	5%	91%	252.0	194.4	77%	23%
Michael Dell	10%	82%	2.2	1.1	49%	51%
Charles Ergen	6%	89%	15.8	12.5	79%	21%
Richard Kinder	5%	91%	18.5	12.5	68%	32%
Eric Schmidt	5%	91%	252.0	194.4	77%	23%
Ralph Lauren	6%	89%	83.6	66.3	79%	21%
Micky Arison	4%	93%	6.4	4.7	74%	26%
Sumner Redstone	4%	93%	23.9	21.2	89%	11%
Charles Schwab	3%	94%	2.1	1.7	79%	21%
Charles Dolan	8%	86%	0.9	0.5	50%	50%
Steve Wynn	8%	86%	33.4	22.2	66%	34%
David Murdock	17%	71%	5.1	2.3	46%	54%
Frederick Smith	3%	94%	18.2	14.5	80%	20%
Mortimer Zuckerman	3%	95%	36.2	30.5	84%	16%
Barry Diller	16%	72%	32.7	19.3	59%	41%
James France	4%	92%	5.0	3.6	72%	28%
Richard Marriott	3%	94%	4.0	3.3	83%	17%
Howard Schultz	9%	83%	27.1	19.2	71%	29%
Meg Whitman	7%	88%	0.3	0.1	46%	54%
Richard Hayne	12%	79%	10.9	5.8	53%	47%
Kevin Plank	9%	83%	23.8	15.7	66%	34%
Scott Cook	4%	92%	19.0	14.8	78%	22%
Neal Patterson	9%	84%	13.1	7.0	54%	46%
Jeffrey Lorberbaum	7%	88%	32.8	24.7	75%	25%
George Joseph	5%	90%	4.4	2.4	55%	45%
Steven Ballmer	10%	81%	11.5	6.3	54%	46%
Average:	7%	87%	32.5	24.2	69%	31%
Median:	6%	89%	14.9	10.6	71%	29%
High:	17%	97%	252.0	194.4	89%	60%
Low:	2%	71%	0.3	0.1	40%	11%

Table 5

Data and summary statistics for valuation of executive equity holdings. Calculations are described in Part II. The value of unvested options was found by multiplying the Black-Scholes option value found in the efficiency calculations (*f(Vj)*) by the number of shares held by each executive. The value of restricted stock was calculated by multiplying the number of shares owned by the executive, as found in the WRDS ExecuComp database, by the value of the stock to the undiversified investor (*Vju*). The value of unrestricted stock was found by multiplying the number of shares owned by the stock price at the date that the net worth data was calculated. Percent of net worth is equal to total stock holdings divided by net worth. All values are in nominal terms corresponding to the year that both WRDS and Forbes data was available for each executive.

Full Name	Value of Shares Owned	Value of Restricted Stock	Value of Unvested Options	Value of Total Stock Holdings	Percent of Net Worth
H. Wayne Huizenga	$ 291,732,558	$ -	$ -	$ 291,732,558	48.6%
Rupert Johnson, Jr.	$ 1,485,477,023	$ 811,821	$ -	$ 1,486,288,844	99.1%
Bernard Marcus	$ 2,942,475,102	$ -	$ -	$ 2,942,475,102	98.1%
Gerald J. Ford	$ 555,692,316	$ 1,224,916	$ 4,084,735	$ 561,001,966	70.1%
John Brown	$ 852,363,791	$ -	$ 1,675,681	$ 854,039,472	89.0%
Phil Knight	$ 4,949,956,186	$ -	$ -	$ 4,949,956,186	66.9%
Charles Johnson	$ 2,387,260,957	$ -	$ -	$ 2,387,260,957	95.5%
Phillip Frost	$ 768,792,703	$ -	$ 2,452,562	$ 771,245,264	90.7%
Richard Schulze	$ 2,421,545,524	$ -	$ 4,508,737	$ 2,426,054,261	97.0%
Tom Golisano	$ 1,178,489,700	$ -	$ -	$ 1,178,489,700	117.8%
Thomas Siebel	$ 302,339,499	$ -	$ -	$ 302,339,499	25.2%
Bill Gates	$ 24,607,733,038	$ -	$ -	$ 24,607,733,038	46.4%
Leonard Lauder	$ 316,571,004	$ -	$ -	$ 316,571,004	10.9%
Robert Fisher	$ 2,643,459,031	$ -	$ 26,856	$ 2,643,485,887	188.8%
Patrick Ryan	$ 877,039,146	$ 1,946,290	$ -	$ 878,985,436	54.9%
Irwin Jacobs	$ 1,342,686,618	$ -	$ 9,698,790	$ 1,352,385,408	71.2%
Sidney Kimmel	$ 16,553,059	$ -	$ -	$ 16,553,059	1.5%
Jerry Yang	$ 607,448,026	$ -	$ -	$ 607,448,026	52.8%
Steve Jobs	$ 1,347,177,241	$ -	$ -	$ 1,347,177,241	22.1%
George Lindemann	$ -	$ 5,003,041	$ 21,211,773	$ 26,214,815	1.2%
Marc Benioff	$ 1,175,000,000	$ -	$ 59,615,718	$ 1,234,615,718	56.1%
Leslie Wexner	$ 1,280,212,733	$ 19,200,319	$ 18,332,954	$ 1,317,746,006	29.9%
Min Kao	$ 1,997,481,870	$ -	$ -	$ 1,997,481,870	90.8%
Bernard Saul, II.	$ 10,337,082	$ -	$ -	$ 10,337,082	0.9%
Bill Marriott, Jr.	$ 638,466,724	$ 4,110,341	$ -	$ 642,577,065	40.2%
Henry Samueli	$ 599,458,230	$ 5,931,208	$ -	$ 605,389,438	33.6%
Warren Buffett	$ 30,087,167	$ -	$ -	$ 30,087,167	0.1%
Lawrence Ellison	$ 35,478,384,831	$ -	$ 192,372,249	$ 35,670,757,080	87.0%
Jeffrey Bezos	$ 21,372,012,715	$ -	$ -	$ 21,372,012,715	92.1%
Lawrence Page	$ 16,970,446,120	$ -	$ -	$ 16,970,446,120	83.6%
Sergey Brin	$ 16,595,618,412	$ -	$ -	$ 16,595,618,412	81.8%
Michael Dell	$ 3,077,722,486	$ -	$ 649,255	$ 3,078,371,741	21.1%
Charles Ergen	$ 7,766,336,998	$ -	$ 2,372,849	$ 7,768,709,847	86.3%
Richard Kinder	$ 19,713,006,218	$ -	$ -	$ 19,713,006,218	209.7%
Eric Schmidt	$ 4,355,488,058	$ 31,568,960	$ 24,825,752	$ 4,411,882,770	58.8%
Ralph Lauren	$ 3,542,107,895	$ 27,089,830	$ 15,617,941	$ 3,584,815,666	55.2%
Micky Arison	$ 3,348,254,207	$ 8,182,401	$ -	$ 3,356,436,608	67.1%
Sumner Redstone	$ 1,462	$ 21,294,623	$ 24,658,108	$ 45,954,193	1.1%
Charles Schwab	$ 2,370,374,186	$ -	$ 2,159,146	$ 2,372,533,332	64.1%
Charles Dolan	$ 310,787,790	$ 5,900,761	$ 1,616,344	$ 318,304,894	10.6%
Steve Wynn	$ 1,056,640,014	$ -	$ -	$ 1,056,640,014	42.3%
David Murdock	$ 457,728,926	$ 414,371	$ 864,404	$ 459,007,702	19.1%
Frederick Smith	$ 1,748,257,053	$ -	$ 9,026,831	$ 1,757,283,884	97.6%
Mortimer Zuckerman	$ 167,245,536	$ 15,186,631	$ 3,670,692	$ 186,102,859	7.8%
Barry Diller	$ 257,232,227	$ 396,679	$ 3,671,697	$ 261,300,602	14.5%
James France	$ 42,530,776	$ 328,874	$ -	$ 42,859,650	2.1%
Richard Marriott	$ 131,436,217	$ -	$ -	$ 131,436,217	6.9%
Howard Schultz	$ 956,344,789	$ 38,157,854	$ 49,023,856	$ 1,043,526,499	69.6%
Meg Whitman	$ 665,227	$ 2,512,823	$ 55,271	$ 3,233,321	0.2%
Richard Hayne	$ 1,095,460,133	$ -	$ -	$ 1,095,460,133	78.2%
Kevin Plank	$ 1,171,884,424	$ -	$ -	$ 1,171,884,424	86.8%
Scott Cook	$ 840,332,664	$ -	$ -	$ 840,332,664	60.0%
Neal Patterson	$ 1,019,029,151	$ -	$ 4,532,238	$ 1,023,561,389	91.4%
Jeffrey Lorberbaum	$ 684,711,245	$ 2,912,575	$ -	$ 687,623,820	59.8%

George Joseph	$	714,935,684	$	-	$	-	$	714,935,684	65.0%
Steven Ballmer	$	11,380,589,609	$	-	$	-	$	11,380,589,609	63.2%
Average:	$	3,859,116,389	$	10,114,438	$	19,030,185	$	3,801,791,074	58.6%
Median:	$	1,095,460,133	$	5,003,041	$	4,296,736	$	1,076,050,074	59.9%
High:	$	35,478,384,831	$	38,157,854	$	192,372,249	$	35,670,757,080	209.7%
Low:	$	1,462	$	328,874	$	26,856	$	3,233,321	0.1%

Table 6

Data and summary statistics for executive deadweight loss due to undiversification. *(1-Φ)* is the deadweight loss of the option to the undiversified investor, calculated as a percentage of the option value. Deadweight loss of shares (%) is the deadweight loss of both restricted and unrestricted stock holdings, calculated as a percentage of the value of the holdings. Deadweight loss from options is equal to *(1-Φ)* multiplied by the dollar value of each executive's option holdings. Deadweight loss from shares ($) is equal to the deadweight loss of shares (%) multiplied by the dollar value of each executive's total restricted and unrestricted stock holdings. Total deadweight loss in 2013 dollars is the total deadweight loss, CPI converted into 2013-equivalent dollars. Deadweight as a percent of net worth is equal to the executive's total deadweight

Full Name	*(1-Φ)*	Deadweight Loss of Shares (%)	Deadweight Loss from Options	Deadweight Loss of Shares ($)	Total Deadweight Loss	Total Deadweight Loss in 2013 Dollars	Deadweight as a Percent of Net Worth
H. Wayne Huizenga	38%	24%	$ -	$ 70,066,692	$ 70,066,692	$ 112,958,660	11.68%
Rupert Johnson, Jr.	27%	13%	$ -	$ 194,617,869	$ 194,617,869	$ 282,477,227	12.97%
Bernard Marcus	29%	10%	$ -	$ 301,261,288	$ 301,261,288	$ 396,278,507	10.04%
Gerald J. Ford	28%	12%	$ 1,144,783	$ 68,069,821	$ 69,214,604	$ 91,044,754	8.65%
John Brown	60%	20%	$ 997,447	$ 166,795,373	$ 167,792,820	$ 206,927,016	17.48%
Phil Knight	21%	10%	$ -	$ 491,914,486	$ 491,914,486	$ 606,643,340	6.65%
Charles Johnson	19%	8%	$ -	$ 191,863,521	$ 191,863,521	$ 236,611,709	7.67%
Phillip Frost	48%	24%	$ 1,177,490	$ 186,342,095	$ 187,519,585	$ 231,254,640	22.06%
Richard Schulze	18%	11%	$ 829,696	$ 266,912,184	$ 267,741,881	$ 330,187,123	10.71%
Tom Golisano	42%	16%	$ -	$ 187,363,630	$ 187,363,630	$ 231,062,312	18.74%
Thomas Siebel	43%	18%	$ -	$ 55,539,297	$ 55,539,297	$ 68,492,687	4.63%
Bill Gates	59%	18%	$ -	$ 4,453,823,113	$ 4,453,823,113	$ 5,146,573,625	8.40%
Leonard Lauder	59%	14%	$ -	$ 45,642,537	$ 45,642,537	$ 52,741,806	1.57%
Robert Fisher	39%	13%	$ 10,564	$ 334,287,171	$ 334,297,735	$ 375,596,838	23.88%
Patrick Ryan	13%	5%	$ -	$ 44,661,897	$ 44,661,897	$ 48,323,999	2.79%
Irwin Jacobs	30%	15%	$ 2,940,364	$ 204,910,971	$ 207,851,335	$ 224,894,335	10.94%
Sidney Kimmel	17%	7%	$ -	$ 1,123,573	$ 1,123,573	$ 1,200,353	0.10%
Jerry Yang	26%	7%	$ -	$ 40,092,519	$ 40,092,519	$ 42,832,267	3.49%
Steve Jobs	14%	6%	$ -	$ 76,741,155	$ 76,741,155	$ 81,985,313	1.26%
George Lindemann	26%	15%	$ 5,532,614	$ 772,048	$ 6,304,663	$ 6,529,394	0.30%
Marc Benioff	36%	23%	$ 21,289,097	$ 264,447,986	$ 285,737,083	$ 295,922,251	12.99%
Leslie Wexner	16%	9%	$ 2,989,683	$ 112,789,174	$ 115,778,857	$ 117,474,739	2.63%
Min Kao	31%	14%	$ -	$ 277,476,302	$ 277,476,302	$ 281,540,662	12.61%
Bernard Saul, II.	37%	8%	$ -	$ 863,110	$ 863,110	$ 875,752	0.07%
Bill Marriott, Jr.	21%	7%	$ -	$ 43,196,199	$ 43,196,199	$ 43,828,920	2.70%
Henry Samueli	29%	11%	$ -	$ 68,555,541	$ 68,555,541	$ 69,559,715	3.81%
Warren Buffett	17%	3%	$ -	$ 1,003,242	$ 1,003,242	$ 1,017,937	0.00%
Lawrence Ellison	15%	6%	$ 29,266,958	$ 2,045,496,837	$ 2,074,763,795	$ 2,105,154,095	5.06%

Jeffrey Bezos	34%	19%	$ -	$ 4,105,904,732	$ 4,105,904,732	$ 4,166,046,363	17.70%
Lawrence Page	23%	9%	$ -	$ 1,533,557,804	$ 1,533,557,804	$ 1,556,020,738	7.55%
Sergey Brin	23%	9%	$ -	$ 1,499,685,981	$ 1,499,685,981	$ 1,521,652,774	7.39%
Michael Dell	51%	18%	$ 328,643	$ 567,981,736	$ 568,310,378	$ 576,634,759	3.89%
Charles Ergen	21%	11%	$ 492,414	$ 824,604,543	$ 825,096,957	$ 837,182,643	9.17%
Richard Kinder	32%	9%	$ -	$ 1,704,178,011	$ 1,704,178,011	$ 1,729,140,121	18.13%
Eric Schmidt	23%	9%	$ 5,680,565	$ 396,442,467	$ 402,123,032	$ 408,013,167	5.36%
Ralph Lauren	21%	11%	$ 3,237,090	$ 403,098,157	$ 406,335,247	$ 412,287,082	6.25%
Micky Arison	26%	7%	$ -	$ 241,536,335	$ 241,536,335	$ 245,074,261	4.83%
Sumner Redstone	11%	7%	$ 2,801,222	$ 1,583,267	$ 4,384,489	$ 4,448,711	0.11%
Charles Schwab	21%	6%	$ 456,423	$ 142,368,450	$ 142,824,873	$ 144,916,914	3.86%
Charles Dolan	50%	14%	$ 815,826	$ 45,537,023	$ 46,352,849	$ 47,031,807	1.55%
Steve Wynn	34%	14%	$ -	$ 148,158,832	$ 148,158,832	$ 150,329,003	5.93%
David Murdock	54%	29%	$ 465,888	$ 132,626,724	$ 133,092,612	$ 135,042,099	5.55%
Frederick Smith	20%	6%	$ 1,819,544	$ 98,880,213	$ 100,699,757	$ 102,174,767	5.59%
Mortimer Zuckerman	16%	5%	$ 577,371	$ 9,815,181	$ 10,392,552	$ 10,544,778	0.43%
Barry Diller	41%	28%	$ 1,503,652	$ 70,996,711	$ 72,500,363	$ 73,562,319	4.03%
James France	28%	8%	$ -	$ 3,362,273	$ 3,362,273	$ 3,411,522	0.17%
Richard Marriott	17%	6%	$ -	$ 8,051,959	$ 8,051,959	$ 8,169,901	0.42%
Howard Schultz	29%	17%	$ 14,400,194	$ 168,128,232	$ 182,528,425	$ 185,202,028	12.17%
Meg Whitman	54%	12%	$ 29,750	$ 394,599	$ 424,350	$ 430,565	0.02%
Richard Hayne	47%	21%	$ -	$ 230,460,911	$ 230,460,911	$ 233,836,610	16.46%
Kevin Plank	34%	17%	$ -	$ 199,180,791	$ 199,180,791	$ 202,098,310	14.75%
Scott Cook	22%	8%	$ -	$ 70,097,624	$ 70,097,624	$ 71,124,386	5.01%
Neal Patterson	46%	16%	$ 2,089,285	$ 162,699,267	$ 164,788,552	$ 167,202,308	14.71%
Jeffrey Lorberbaum	25%	12%	$ -	$ 85,234,870	$ 85,234,870	$ 86,483,355	7.41%
George Joseph	45%	10%	$ -	$ 71,570,842	$ 71,570,842	$ 72,619,183	6.51%
Steven Ballmer	46%	19%	$ -	$ 2,150,101,553	$ 2,150,101,553	$ 2,150,101,553	11.95%
Average:	31%	13%	$ 4,203,190	$ 451,301,227	$ 453,102,594	$ 481,978,072	7.51%
Median:	29%	11%	$ 1,340,571	$ 155,429,050	$ 156,473,692	$ 158,765,656	6.09%
High:	60%	29%	$ 29,266,958	$ 4,453,823,113	$ 4,453,823,113	$ 5,146,573,625	23.88%
Low:	11%	3%	$ 10,564	$ 394,599	$ 424,350	$ 430,565	0.00%
Total:						$ 26,990,772,007	

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