

Evaluating Executive Compensation Packages

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Executive compensation is a topic that has received attention both in the media and the academic literature. This article discusses issues relevant to the construction and interpretation of compensation figures typically reported in both sources. First, it is not clear what precisely should be included within a measure of the chief executive officer's (CEO's) income tied to his firm. Second, the study of executive compensation remains constrained by the availability of data. We discuss the main source of data used in most studies on the topic: Execucomp. We highlight where the lack of data requires a deviation between a theoretical "ideal" measure of compensation and that which the researcher must use as an approximation. In this way, we hope our article will be a useful first introduction for those looking to do further research on the topic.

We propose a measure of realized annual pay, compare it to other measures used in the literature, and illustrate the difficulties in calculating it. Using data in Execucomp, we provide our pay measure for CEOs of large U.S. firms in the period 1993–2012 and use it to estimate sensitivity of pay to firm performance. The main difficulties in this exercise lie in the fact that compensation packages of most executives include stock and option grants on their own firm's shares, which typically come with requirements that they be held by the executive for at least three or four years.¹ This implies two important

■ We thank the editor, Ned Prescott, and the referees, Kartik Athreya, Zhu Wang, and Peter Debbaut, as well as Huberto Ennis and Todd Keister, for helpful comments. The views expressed in this article are those of the authors and do not necessarily represent the views of the Federal Reserve Bank of Richmond or those of the Federal Reserve System. E-mail: arantxa.jarque@rich.frb.org.

¹ Moreover, it is a fact that most CEOs hold on to stock for which selling restrictions have expired, or to options that are exercisable and in the money. The reasons for these "voluntary" holdings are not entirely clear, since CEOs are risk averse and

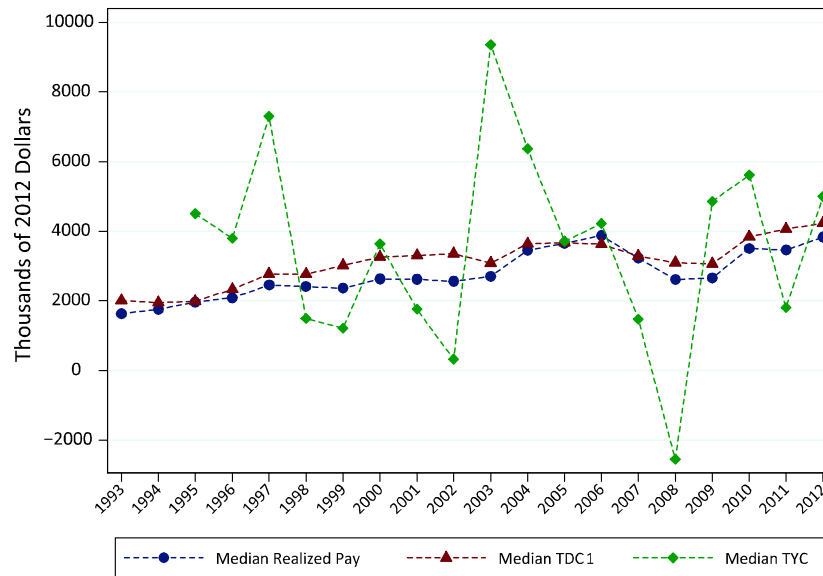
things. First, the compensation figures that are reported by firms (and are readily available to the press and researchers) are a combination of both *expected* value of compensation (for deferred compensation in the form of restricted stock and option grants that are not convertible into cash right away) and *realized* value (salaries, bonus payments, and perks). Second, a given year's compensation package provides income for several years to follow, since the CEO will be able to realize gains from selling and exercising stock and option grants once their vesting restrictions expire. That is, an important part of the annual realized pay of a CEO in any given year comes from his net gains from trading stock that he received in a past grant. Due to the fact that stock price realizations may differ from ex-ante expectations of those prices, the ex-post realized gains from those trades will typically differ from the valuation made at the time of the grant.

A measure of what is sometimes called *direct compensation* (the sum of salary, bonus, other compensation such as pension plans or perks, and the value of new stock and option grants during the year) is readily available in Execucomp (variable TDC1).² As we just discussed, grants included in this measure are valued in expectation. Our objective in this article is to provide a measure of *realized pay* instead. We define realized pay as the sum of salaries, bonuses, and other compensation, plus the gains from trades that the CEO realizes in a given year. We will argue that this measure is close to the one first proposed by Antle and Smith (1985) and used later by important contributions such as Hall and Liebman (1998) and Gayle and Miller (2009). *Total yearly compensation* is defined in these studies as the change in the wealth of the CEO that is tied to his employment in the firm, and it is calculated in practice as direct compensation plus the year-on-year change in the market value of stock and option holdings of the CEO from past grants. This measure is, hence, still a measure of expected pay, although more sophisticated than TDC1. The main departure of our measure of realized pay with respect to this total yearly compensation is that it does not attribute changes in the value of grants that are not yet exercised to the realized pay in the year when they occur; rather, the final realized value is captured in gains from trades and attributed to the period of exercise of the grants. This simplification is useful in terms of the calculation of the measure—we need to rely less heavily on assumptions about the unavailable details of grants.

standard economic theory would suggest that they would value a diversified portfolio of assets more. Overconfidence, privileged information, or personal tax considerations have been proposed in the literature as potential explanations (Jin and Kothari 2008).

²This measure has been studied, for example, in Gabaix and Landier (2008) and Frydman and Saks (2010).

Figure 1 Median Realized Pay, and Mean Expected Pay as Measured by Execucomp in the Variable TDC1, as well as Measured in Total Yearly Compensation (TYC)



Still, only part of the information that we need for our measure (about trades or vesting restrictions and exercise prices of past grants) is available in Execucomp. When approximating the gains from trades, in particular, we follow closely the algorithm used in Clementi and Cooley (2009) to recover the executive's holdings of stocks and options of his firm.³ In the Appendix, we walk the reader through the step-by-step construction of the portfolio, discussing the shortcomings of the available data in Execucomp and how different assumptions about the unknowns may affect the compensation numbers.

We use our measure of realized pay to provide an updated account of CEO compensation through the year 2012. Figure 1 presents a comparison of our measure of realized pay versus two measures of expected pay used in the literature: “direct compensation,” the variable TDC1 in Execucomp, and “total yearly compensation,” as calculated by us following the implementation in Clementi and Cooley (2009) of the

³ For another recent application of the algorithm first developed in Antle and Smith (1985), see Gayle and Miller (2009).

concept introduced by Antle and Smith (1985). Median realized pay is mostly below median direct compensation. The main difference observable with total yearly compensation is that it is a lot more variable than either of the other two measures. This figure suggests that different measures of pay present different pictures of CEO compensation, and it is important to understand what is behind the measurements before using them to evaluate pay practices.

We use our realized pay measure to perform a sensitivity analysis of annual realized pay to performance, with a special focus on the finance sector throughout the recent crisis in 2008. We simplify some of the difficulties of the analysis by assuming that the choice of selling and buying stock is invariant to the stock price movements in our counterfactual exercises; i.e., only the profits from the trades change, not the quantities. We find that in the aftermath of the crisis the realized pay of CEOs of finance firms has decreased in level relative to other industries. Moreover, the sensitivity exercise suggests that, during the whole sample period, mean realized pay for CEOs in finance firms changes with the performance of the firm in similar magnitudes than that of the average CEO.

We proceed as follows. In Section 1, we introduce compensation instruments included in most CEO pay packages and discuss data availability and measurement challenges. In Section 2, we present a simplified model of compensation accounting to illustrate the differences between three different measurement alternatives: the measure of realized pay that we construct in this article, and two measures of expected pay—the simple measure of expected pay readily available in Execu-comp, direct compensation, and the one based on the concept of total yearly compensation introduced by Antle and Smith (1985). Section 3 presents the results on the implied measure of realized pay over time, with a special focus on pay sensitivity, as well as a detailed look at the financial sector before and after the recent financial crises. Section 4 concludes. The Appendix provides the technical details on how we construct our realized pay measure from the data available.

1. UNDERSTANDING COMPENSATION PACKAGES

Nowadays, companies pay their top executives mainly through different combinations of the following instruments: a salary, a bonus program, a signing bonus, stock grants (also referred to as “restricted stock,” since they are usually granted with restrictions on the ability to sell them), grants of options on the stock of the firm, and perks and long-term incentive plans that specify severance payments, as well as pension plans.

Table 1 Summary of Annual Compensation Information Available in Execucomp

Instrument (Average % of TDC1)	Information in Execucomp
Salary (32%)	Value
Bonus and Incentive Compensation (23%)	Value, some details on targets (after 2006)
Perks and Other Compensation (6%)	Value
Restricted Stock Grants (11%)	Value (stock price times number of shares)
Stock Option Grants (28%)	Value (Black and Scholes), number of shares underlying options

Notes: Information available in Execucomp about the components of CEO compensation packages. For the percent calculations, the sample includes the CEOs of the largest 1,500 public firms in the United States in the period 1993–2010.

The publicly available information on CEO compensation comes from the compensation tables included by firms in their annual reports, as mandated by the Securities and Exchange Commission (SEC). This is the same data that Execucomp has compiled since 1992 and has been used in numerous empirical studies of CEO compensation, including this article. When the press publicizes information on CEO pay, it usually reports a summary measure of total or “direct compensation,” which is also readily available in Execucomp as the variable TDC1. Direct compensation is the sum of cash compensation (wage, bonus, and incentive compensation), pension contribution and other perks, plus the expected value of new stock and option grants given to the CEO within a given year. Execucomp also reports separately the different components of total compensation, and it includes some limited information on stock ownership and the portfolio of unvested restricted stock and option grants of the executives. A brief description of each of the instruments and further details on the information available about them in Execucomp follows. Table 1 presents statistics for their relative importance as a share of total pay using data from 1993 to 2010 and summarizes the information on availability.

Salaries are the simplest compensation instrument: They are not contingent on performance and information on their level is readily available on the proxy statements of firms.⁴ Bonus plans and incentive pay typically depend on yearly accounting results. Information is available mainly on payouts and more recently on some limited details of

⁴ The source for the shares of compensation that are reported come from Jarque and Gaines (2012). See the article for details on sample selection.

Table 2 Classification of Compensation Instruments

	Current (within year)	Deferred
Non-Contingent	Salary, perks, signing bonus	Pension plan
Contingent	Bonus plan	Options, stock, severance, future pay

the bonus plans. Information on perks and other compensation is also available, although not to a great level of detail. Grants of restricted stock of the firm make pay depend on the results of the firm over a longer time horizon, since the CEO is restricted from selling them until their vesting period expires. Execucomp compiles information on their expected value at the time of the grant (number of shares times market price of stock), but it does not have separate information on the number of shares granted. Grants of stock options allow the executive to purchase stock of the firm at a pre-established price (the “exercise price”) and are also typically granted with restrictions as to how soon they can be exercised. These also provide incentives for longer-term performance, but they only pay off if the stock price of the firm is above the exercise price. For option grants, Execucomp has information on both the number and the Black and Scholes value of the total grants during the year. Typically, both stock and option grants come with a clause that forces the executive to forfeit them in the event of employment termination. Information on the vesting periods is not generally available in Execucomp for either stock or option grants.⁵

It should be apparent that compensation instruments can be classified according to two criteria: whether or not they are contingent on the performance of the firm, and whether or not they are deferred.⁶ Table 2 summarizes this classification of the main compensation instruments.

Given that executives are risk averse, paying them with contingent instruments, such as bonuses, stocks, and options, comes at a cost, since they will demand higher expected payments to compensate them for the risk. The most accepted explanation for the inclusion of compensation instruments that are contingent on the performance of the firm is the existence of a moral hazard problem: The separation of ownership and control of the firm implies the need to provide incentives to the

⁵ A commonly cited length of this restriction period is four years, with vesting taking place proportionally over this period—see Hall and Liebman (1998).

⁶ Firm performance is typically proxied by accounting measures such as return on equity, sales, and profit, or on market-based measures such as the stock price.

CEO that align his interests with those of the firm owners.^{7,8} Within this context of incentive provision, it is also commonly accepted that expectations over future wages or jobs (career concerns), as well as the threat of dismissal, are also important compensation instruments—although less easy to study due to the lack of hard information on them.⁹

Deferral of pay also comes at a cost if CEOs are more impatient (i.e., they discount the future more) than the shareholders of the firms they manage. Several reasons may explain the use of deferred instruments. Perhaps the most accepted one is that, despite the cost of waiting, deferral is valuable—in combination with commitment to long-term contracts—because it allows to smooth incentives over time, making (costly) exposure to risk less necessary.¹⁰ Other reasons include retention purposes in the face of lack of commitment to long-term contracts or provision of incentives for hidden actions with long-term effects.¹¹

In most cases, instruments that are “cashed” within the year (labeled “current” in the table) are straightforward to value. In contrast, for contingent deferred instruments an expected value needs to be calculated, which presents some challenges. For example, the actual amount of compensation that the CEO will receive from stock and options granted to him in a given fiscal year will depend on the stock price of the firm at the moment he sells or exercises them. Similarly, the value of future compensation will depend on the performance of the firm during the tenure of the CEO. The value of pension payments will be contingent on the firm being solvent once the CEO retires. The value of severance payments is typically pre-set at the time of contracting, but a full list of the contingencies that may lead to termination is not written in the employment contract of the CEO. Hence, in order to calculate the expected value of compensation, one needs to know both the set of contingencies that trigger each payment (for example, the circumstances that trigger firing of the CEO or the performance targets for granting salary increases), as well as the probability attached to each of these performance contingencies (for example, the probability

⁷ See Prescott (1999) and Jarque (2010) for an introduction to static and dynamic moral hazard problems, respectively. Classical references in the literature include Grossman and Hart (1983), as well as Spear and Srivastava (1987).

⁸ Bebchuck and Fried (2004) argue that captive boards may use stock and option grants as a less obvious instrument to transfer excessive amounts of pay to their CEOs.

⁹ See Jensen and Murphy (1990); Gibbons and Murphy (1992); and Jenter and Kanaan (forthcoming).

¹⁰ Wang (1997) fleshes out this explanation using a repeated moral hazard model.

¹¹ See Bolton, Sheinkman, and Xiong (2006); Clementi, Cooley, and Wang (2006); and Edmans and Liu (2011).

distribution over future stock prices of the firm). These difficulties are important when choosing a measure of CEO pay.

Measurement of Pay: Expected versus Realized Value

There are two main approaches to measuring CEO pay:

1. *Expected* value of pay: The expected value of compensation granted in a given year, which includes the cash (realized value) he receives in salary and bonus, plus the expected value of the deferred contingent instruments such as stock and options;
2. *Realized* pay: The actual amount of money received in a given year, which includes the cash he receives in salary and bonus, plus the proceeds from selling past stock and option grants for which selling restrictions have expired (all realized).

Any attempt at valuing contingent deferred compensation, either in expectation or its realized value, will be constrained by the availability of data. Table 3 summarizes the data available in proxy statements and compiled by Execucomp about CEO holdings of stock and options of his own firm, the evolution of which is key to measurements in both categories. For stock holdings, we have the number of shares held by the CEO at the end of the fiscal year, as well as the number and value of both stock that remains restricted and of stock that vested during the year. For option holdings, we know the number of options exercised during the year, as well as their value. We also know the number and value of options exercisable (but still unexercised) and those whose vesting restrictions did not yet expire. These values, however, are calculated using the “intrinsic” valuation (stock price at the end of the year minus exercise price, times number of options, if positive), hence ignoring the options that are currently out of the money, and provide a simplistic evaluation (Black and Scholes would be a more accurate choice).

We choose our measure of realized pay (presented in the next section) in light of these data availability issues. Our choice tries to minimize the sensitivity of our measurements to assumptions about the unknown details of compensation packages, while still exploiting the information we have available on the portfolio of stock and options of the CEO.

Before we present our measure, it is important to note that we view expected and realized measures of pay as complements rather than substitutes when trying to understand incentives for CEOs. Expected

Table 3 Summary of Information Available in Execucomp about Stock and Option Holdings

	Information in Execucomp
Stock Holdings	Number of unrestricted Number of restricted Value of restricted Number vested during the year Value of vested during the year
Option Holdings	Number exercised during the year Value of exercised during the year Number of all unexercised vested Value of in-the-money unexercised vested (intrinsic) Number of all restricted Value of restricted in-the-money (intrinsic)

pay is a forward-looking measure, which gives important information about the value of the current compensation package given to the CEO. However, it is a difficult task to get a realistic valuation of stock or options for the CEO, especially because of selling restrictions and risk aversion considerations. In practice, the data in Execucomp reflects the firm's estimate of that value for CEOs. For options, usually a pricing model based on arbitrage conditions, such as Black and Scholes' option valuation model, is used to provide a value in the company's report with the SEC. Ad hoc modifications are often used to accommodate the fact that CEOs are risk averse and there are selling restrictions on the option grants.¹²

Realized pay, instead, is a backward-looking measure: Given past performance, we can calculate how much payoff the CEO actually got in the given period. In contract theory terms, we can view this measure as a description of the contract payoffs on the equilibrium path. That is, we observe what the CEO gets for the actual performance that materialized, but we do not have information on what the payoffs would have been for better or worse performances. For an estimate of these off-the-equilibrium-path payoffs, in Section 3 we perform sensitivity analyses that exploit the fact that we have some information on the number of stocks and options the executive sold or exercised.

¹² See Hall and Murphy (2002) for a quantitative evaluation of the difference between the executive's value of options and the cost to the firm in providing them.

One advantage of our realized pay measure is that we do not need to take expectations over the value of deferred contingent pay. Hence, we will be able to use the publicly available information on compensation packages without resorting to assumptions about the future value of contingent compensation. Still, even for the purposes of measuring realized pay, we are missing some important information on these deferred contingent instruments. As reflected in Table 3, Execucomp records the *value* of stock and the *value* and *number* of stock underlying options at the time when they are granted to the CEO. The values are approximations to the expected income that the CEO will realize in the future, when their restrictions expire. However, we do not have explicit information on the vesting schedules of these grants, or the exact date when the vested stocks are sold or the options exercised, or the market price of the stock at those times. This information is key to compute the actual cash the CEO receives as a result of the original grant. Our construction of a realized pay measure will necessarily involve assumptions on these unknown characteristics of the compensation, which we discuss in detail in the Appendix.

Larcker, McCall, and Tayan (2011) have a short and interesting essay in which they also point out the differences in measuring expected and realized pay.¹³ The authors include illustrative examples of the difference between expected and realized compensation based on data for a handful of firms in the year 2010. In this article we will use a larger number of firms and a longer period of time to illustrate quantitatively the difference between the two measures.

2. CONSTRUCTING A MEASURE OF REALIZED PAY

In this section, we provide a framework for comparing different measures of compensation. For this, we describe the types and timing of the different components in a typical compensation package. Using this framework, we introduce our proposed measure of realized contingent pay, denoted I_t , which is defined as the sum of salary, bonus, and gains from selling stock and exercising options in the current year. To construct it, we use information on the several components of pay packages that is publicly available, along with some assumptions. We refer to the model to illustrate the need for these assumptions and to justify

¹³ Larcker, McCall, and Tayan (2011) also present a third measure that they call *earned pay* (the value of pay at the moment when all selling restrictions are lifted, which does not necessarily coincide with the value at the time the CEO decides to sell). We do not have enough information in Execucomp to calculate this measure.

our choices. Then we illustrate in the context of the model what the differences are between our measure and two alternative ones: (1) direct compensation, which is defined as the sum of salary, bonus, perks, and other compensation, and the value of stock and options at the time of grant, and (2) total yearly compensation, which is defined as direct compensation plus dividends, plus the change in the value of stock and options in the portfolio of the CEO.

Consider a CEO who lives for T years. He starts his tenure with a firm at year $t = 1$. He receives compensation for all the years he is working, and after he retires he consumes out of his accumulated wealth and pension payments. We assume he has no sources of income other than what he receives as payments for his job as CEO, which we denote as I_t . The value he attaches to his employment at the beginning of period 1, denoted V_0 , is equal to the *expected* stream of income that he expects to receive in exchange for his work in each of the periods of his life:¹⁴

$$V_0(\mathbf{e}^*) = E \left[\sum_{t=1}^T \frac{I_t(p_1, \dots, p_t)}{(1+r)^{t-1}} \mid \mathbf{e}^* \right], \tag{1}$$

where the expectation is with respect to stock price realizations (which summarize the performance of the firm in this simple model), conditional on the sequence of effort choices by the CEO (denoted \mathbf{e}^*) given the optimal contract. We denote the market interest as r .

In this article, we want to measure the *realized* value of I_t . A more ambitious objective, which would relate more directly to theoretical models of CEO compensation based on repeated moral hazard models (Wang 1997), would be to try to measure $V_t(\mathbf{e}^*)$. We discuss some of the added difficulties of this measurement at the end of this section.

Realized pay I_t will not all be delivered directly in cash. Rather, the executive will receive an annual compensation, C_t , that will consist of two elements: a cash-based portion, or current liquid payment, denoted L_t , and a grant-based portion, denoted G_t . We assume compensation is received only once per year, at the end of the fiscal year. We have that

$$C_t = L_t + G_t \quad \forall t, \tag{2}$$

where

$$L_t = W_t + B_t + D_t + K_t \quad \forall t.$$

¹⁴ Note that the utility the CEO may get from a given value of employment will also depend on his wealth from sources other than the executive's employment. There is typically no information on this outside wealth to be used in empirical studies of CEO compensation.

That is, L_t is the sum of annual salary W_t , bonus payment B_t , which usually will depend on the annual results of the firm, dividends D_t , and perks and contributions to pension plans K_t .¹⁵ Grants consist of both restricted stock of the firm, s_t^r , and options to buy stock, o_t^r , and are valued at any $t' \geq t$ as¹⁶

$$\begin{aligned} G_t^{t'} &= EV(s_t^r; p_{t'}) + EV(o_t^r; x_t, p_{t'}) \\ &= s_t^r p_{t'} + EV(o_t^r; x_t, p_{t'}). \end{aligned}$$

In this expression, $EV(s_t^r; p_{t'})$ is the estimated value of restricted stock, i.e., the amount of stock, s_t^r , valued at the stock price at the time of valuation, $p_{t'}$. The estimated value of options, $EV(o_t^r; x_t, p_{t'})$, stands for some version of the Black and Scholes (1973) option valuation formula and depends both on the market price at the time of valuation, $p_{t'}$, and the exercise price, x_t .

Our Measure of Realized Pay

The stream of realized pay I_t that the CEO will receive from the firm while working will be equal to the cash part of his compensation, L_t , plus whatever net gains from trade he gets from buying and selling unrestricted stock (or vested exercising options). To compute these gains from trade, it will be important to keep track of the accumulated number of stock and option grants that have vested, what we will refer to as the “portfolio” of the CEO.¹⁷ Let S_{t-1} denote his holdings of unrestricted stock at the beginning of period t , and O_{t-1} denote his holdings of vested options. Let $T_t(S_{t-1}, O_{t-1})$ denote the gains from the sales of stock and exercises of options at period t . Then, we can write realized pay as

$$I_t = L_t + T_t(S_{t-1}, O_{t-1}).$$

Tracking the holdings S_t and O_t involves understanding the law of motion of the quantities of vested stock and options available to the CEO. Under the assumption that the CEO did not own any stock or options of the firm before his employment as CEO started, we have

¹⁵ Note that dividends are not included in Execucomp’s TDC1 (which we will compare later to our own proposed measure of income). We include them because they are attached to the grants given to the CEO, and hence they are income that he receives because of his association with the firm.

¹⁶ Here and in the rest of the model description, we use capital letters to denote values and lowercase letters to denote quantities.

¹⁷ Note that option grants also come with expiration dates; we are abstracting from those in this discussion, since the information we have on expirations is limited.

that his holdings in the beginning of year 1 are equal to zero:

$$\begin{aligned} S_0 &= 0, \\ O_0 &= 0. \end{aligned}$$

Any subsequent year, the quantities available to trade will change for two main reasons:

1. some of the past grants will have vested, or the CEO may choose to buy unrestricted stock; these actions will increase his holdings;
2. some of the past grants in his holdings will be sold or exercised, decreasing his holdings.

It is worth noting here that accurately evaluating the evolution of the holdings of the CEO would necessitate a large amount of information. For example, the CEO may choose to buy or sell stock, or exercise options, at different times during the year—with different market prices for each transaction. Also, he may choose to exercise options and hold on to the stock that he obtains with this transaction. Moreover, he may inherit or donate stock at any time. Unfortunately, the only data we have for the holdings of stock and options is their quantities and value at the end of each fiscal year (see Table 3), and we are lacking the details on the specific transactions that determine their evolution. Hence, we make the following important simplifying assumptions. First, we assume each of the possible trades happens only once in the fiscal year. Note that this still accommodates for a given sale of options to include options from different past grants, which implies different exercise prices. Second, we assume that the executive never purchases options, and that he exercises options only if he plans to sell the stock immediately. Third, we ignore any inheritances or donations.

We can summarize the above discussion in a formal law of motion for the holdings of stock and options by introducing some notation. The vesting restrictions on the stock and option grants determine the available S_t and O_t in each period. Typically, only a portion of the previous years' restricted stock vests every t . Denoting the vested shares in year t by s_t^v and vested options in year t by o_t^v , the accumulated number of shares and options available for selling in year t is

$$\begin{aligned} S_t &= S_{t-1} - (s_t^s - s_t^b) + s_t^v, \\ O_t &= \sum_{o_g \in O_{t-1}} o_g - o_{g,t}^e + o_t^v, \end{aligned} \quad (3)$$

where we are denoting the three types of trades that can happen at time t as follows:

1. selling stock s_t^s of the unrestricted stock available at period t , S_{t-1} , at price p_{s_t} ,
2. buying an amount s_t^b of stock from the market, at price p_{b_t} ,
3. buying stock through the exercise of $o_{g,t}^e$ of any vested option grant g (with corresponding exercise x_g) at price p_{e_t} .

With this notation, we can write an expression for the gains from trade:

$$T_t(S_{t-1}, O_{t-1}) = s_t^s p_{s_t} - s_t^b p_{b_t} + \sum_{o_g \in O_{t-1}} \max \{0, o_{g,t}^e (p_{e_t} - x_g)\}. \quad (4)$$

This completes the description of our measure of realized pay, I_t . Next, before moving on to the estimates of I_t using data, we use the model in this section to compare our measure of realized pay with alternative measures used in the literature.

Alternative Measures: Expected Pay

As we discussed in Section 1, the literature has used compensation measures based on the expected value of pay. The theoretical measure of expected pay is described by (1). The employment value, V_t , is the sum of the expected stream of realized pay. For the measurement of V_t (\mathbf{e}^*) in the data, however, one would have to make assumptions about the terms of the contract offered to the CEO regarding compensation in future periods (i.e., what would trigger a wage increase, or what is the schedule of future grants contingent on realized performance). One would also need to understand the CEO's expectations about stock prices in the future, which will determine his future realized gains from trade. One would also need to understand his expectations regarding his transitions to other firms and their consequences for his realized pay. Moreover, one would need to model how performance during the CEO's working life will affect his pension payments. To the best of our knowledge, no study has provided a reliable measure of V_t . Instead, two different approximations to V_t have been widely used: "direct compensation" (TDC1) and "total yearly compensation" (TYC). We define each of these using our notation, in turn, and compare them to our measure of realized pay.

The Execucomp variable TDC1 can be written in terms of our notation as

$$TDC1_t = W_t + B_t + K_t + G_t^t.$$

This measure of expected pay does not closely correspond to the theoretical V_t , since it does not include any estimation of future wages,

bonuses, and new grants. It includes an estimate of the expected future value of the grants given to the CEO *in the current year*, $G_t^t = s_t^r p_t + EV(o_t^r; x_t, p_t)$, but it ignores the changes in the value of past grants, or the realized gains from exercising them once they are vested, as well as the dividends that correspond to the CEO from holding stock. The main difference between our I measure and TDC1 is that we do not include the value of grants, G_t , but rather the realized net gains from trade, T_t . Also, dividends are included in I_t but not in $TDC1_t$.

A second alternative measure of expected pay, TYC, has been used in the literature since Antle and Smith (1985) proposed it. The idea behind it is to calculate the expected value that the CEO attaches to working in his firm, every period, as the current expected value of stock and option holdings plus the expected future compensation; then one can interpret the annual change in this expected value from one period to the next as the TYC of the executive.¹⁸ Because the expected value of grants is updated every year, this measure presents a more accurate picture of the incentive value of the CEO's contract. However, the measure is not without problems. For example, a common simplifying assumption when computing this measure is to assume that salary and bonus payments remain constant in future years and that the expected value of future grants is zero.¹⁹

We follow the description in the Appendix of Clementi and Cooley (2009) to replicate their measure of TYC, assuming wages, bonuses, and perks remain constant throughout the work life of the CEO, and no turnover. We graph it for comparison purposes in Figures 1, 2, and 5. In terms of our notation, TYC can be written as

$$TYC_t = W_t + B_t + K_t + D_t + \sum_{\tau=1}^t (G_\tau^t - G_\tau^{t-1}),$$

where G_τ^t in this case denotes the updated expected value during period t of stock and (unexpired) option grants that were given at period $\tau \leq t$ and are still unexercised.²⁰

The measure TYC attributes initial grants as compensation in the year when they are granted, and then subsequent appreciations and

¹⁸ Examples of different implementations of this concept of expected pay include Jensen and Murphy (1990); Garen (1994); Haubrich (1994); Hall and Liebman (1998); Haubrich and Popova (1998); Schaefer (1998); Aggarwal and Samwick (1999); Baker and Hall (2004); Clementi and Cooley (2009); Edmans, Gabaix, and Landier (2009); and Gayle and Miller (2009).

¹⁹ See, for example, Clementi and Cooley (2009; 2, 29).

²⁰ Note that $G_\tau^{t-1} = 0$ whenever $\tau > t$. Also, note that this re-evaluation of grants coincides conceptually with our measure of gains from trade, for the portion of the vested portfolio that is converted to cash in period t . That is, if, for example, only grants given at $t - 4$ are exercised at t , then $T_t(S_{t-1}, O_{t-1}) = G_{t-4}^t$.

depreciations of the grants to the periods when they happen—even if they do not translate into realized pay in that particular period. In comparison, our measure I of realized pay records only the realized value of grants when they get exercised, and it attributes the gains from trade to the particular period when they happen. It is easy to see that the simple sum of $\sum_{t=1}^T I_t = \sum_{t=1}^T TYC_t$; however, the individual year entries will differ, and hence the properly discounted sum will differ as well.

3. MEASUREMENTS

In this section, we present the empirical measurement of pay according to the methodology described above. In the Appendix, we provide the details on how to map the elements of pay described in the previous section to the data available in Execucomp.

In this article, we work with the August 2013 release of Execucomp, which includes annual observations through the fiscal year 2012. We drop CEOs who own 50 percent or more of the shares of their company, since we want to focus on measuring incentives in relationships for which there is an agency problem. Our final sample includes 3,345 different firms, for a total 34,497 firm-CEO-year observations.^{21,22}

Figure 1 presented the median of our measure of realized pay from 1993 to 2012. We compare it to the two measures of expected pay discussed earlier in this article: “total compensation” reported in Execucomp as the variable TDC1 and our own calculation of TYC following Clementi and Cooley (2009).²³

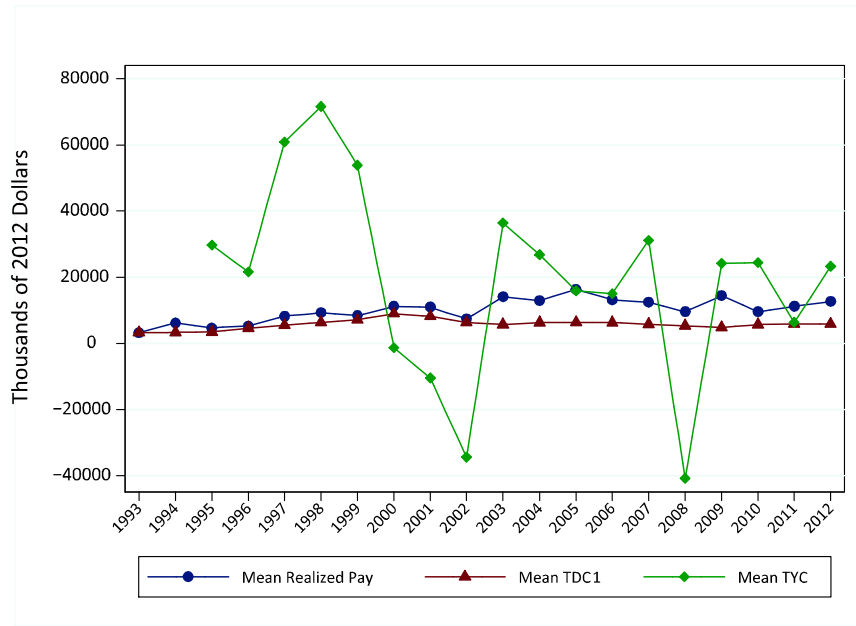
Two features emerge from Figure 2. First, averages are much larger than medians. This is well known for the measure TDC1, and it is confirmed for our measure of realized pay, I . Second, average realized pay is more volatile over time than average total compensation, and it is typically above $TDC1_t$, while it was typically below it when we looked at the medians in Figure 1. However, TYC_t is more volatile than either of the other two measures. This is true both when looking at medians, in Figure 1, or when looking at means, here. Our analysis of the

²¹ The database includes up to five executives of a firm per year, but we restrict our sample to those designated as the CEO by the Execucomp variable CEOANN.

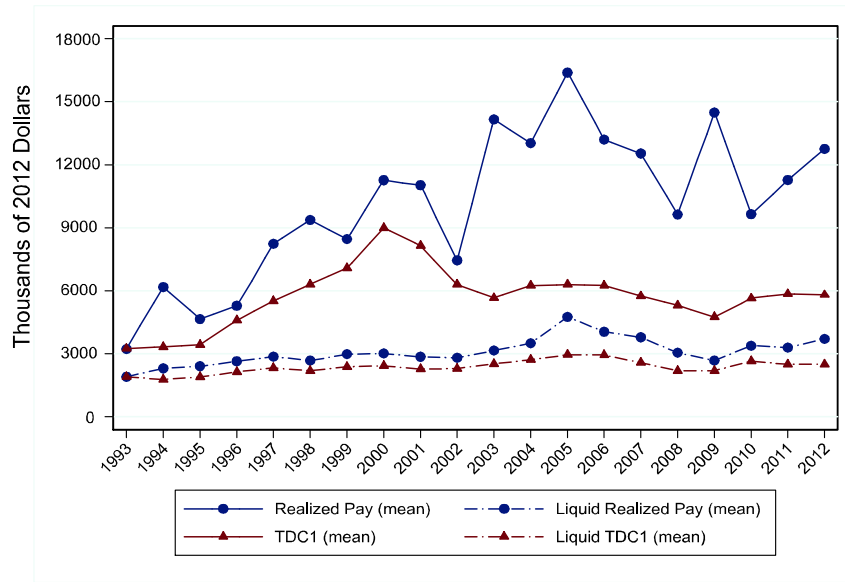
²² We also exclude from our analysis Warren Buffett, the CEO of Berkshire Hathaway, and Larry Ellison, the CEO of Oracle Corporation, because their values of trades are extreme outliers.

²³ We replicate Clementi and Cooley’s simpler calculation of TYC, which uses intrinsic valuations for options when their value is updated with new stock prices at the end of the fiscal year. Clementi and Cooley report in their manuscript that their results do not change substantially when they use Black and Scholes to produce those revaluations.

Figure 2 Mean Realized Pay and Mean Expected Pay as Measured by TDC1 and TYC



different components of pay shows that the estimated gains from trading stock are causing the volatility in realized pay. Also, every year there are a few CEOs who realize very large gains from trading stock, making the averages of the two measures of compensation differ more than the medians. Moreover, the large revaluations of the portfolio of the CEOs with changes in the stock price do not seem to translate into gains from trades, causing the large deviation of the measure TYC from the measure I . One potential explanation would be that CEOs have in their portfolios a large fraction of restricted stock and options, so even if their value increases they are not able to realize those gains. However, the information available in Execucomp about restricted stock and options does not seem to support this hypothesis (the restricted grants are a small part of the portfolio of the CEO at any point in time). However, it is still plausible that implicit selling restrictions are in place even after the explicit vesting period expires, presumably with the objective of strengthening the market perception about the confidence of the CEO in the performance of his own firm.

Figure 3 Liquid Portion of Compensation

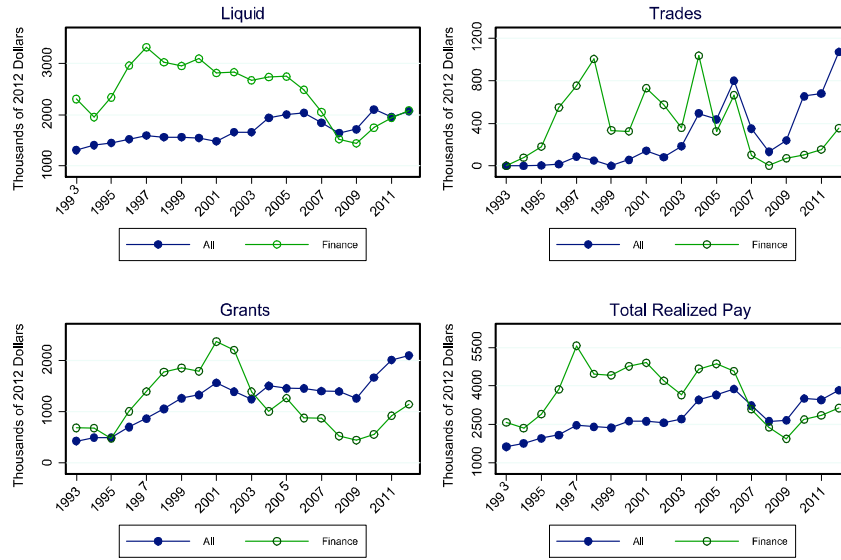
Notes: The blue line presents mean total realized pay, I_t , and its liquid component, L_t (wage, bonus, perks, and dividends). The difference equals mean trades, T_t . The red line presents mean total expected pay as measured in $TDC1_t$ and its liquid component (wage, bonus, and perks). The difference equals grants, G_t .

In Figure 3, we display the liquid portion of compensation for mean realized pay, I_t , and for mean total expected pay as measured in $TDC1_t$. We see that the higher volatility of mean I_t compared to that of mean $TDC1_t$ is mainly driven by the volatility of trades. Figure 4 plots separately the medians of the different components of realized pay, L_t and T_t , and the median of I_t . (Figure 4 plots also these statistics for finance firms, which we will discuss in the next subsection.) Both components, as well as the total I_t , are increasing over time. For comparison, the median value of grants, G_t , is included as well. The value of grants is also increasing over time.

As a robustness check, we replicate Figure 2 in Figure 5 for a subsample of the firms including only the CEOs that own less than 1 percent of the shares of their company.²⁴ The level of TYC_t is much

²⁴ This subsample includes 2,169 out of our 3,345 firms, and 16,302 out of our 34,497 observations.

Figure 4 All CEOs versus Finance CEOs



Notes: A comparison of the medians of liquid compensation, L_t , net gains from trading and stock options, T_t , the expected liquid value of stock and option grants, G_t , and total realized pay, I_t . Note that although $I_t = L_t + T_t$, the sum of the median of L_t and T_t is not equal to the median of I_t .

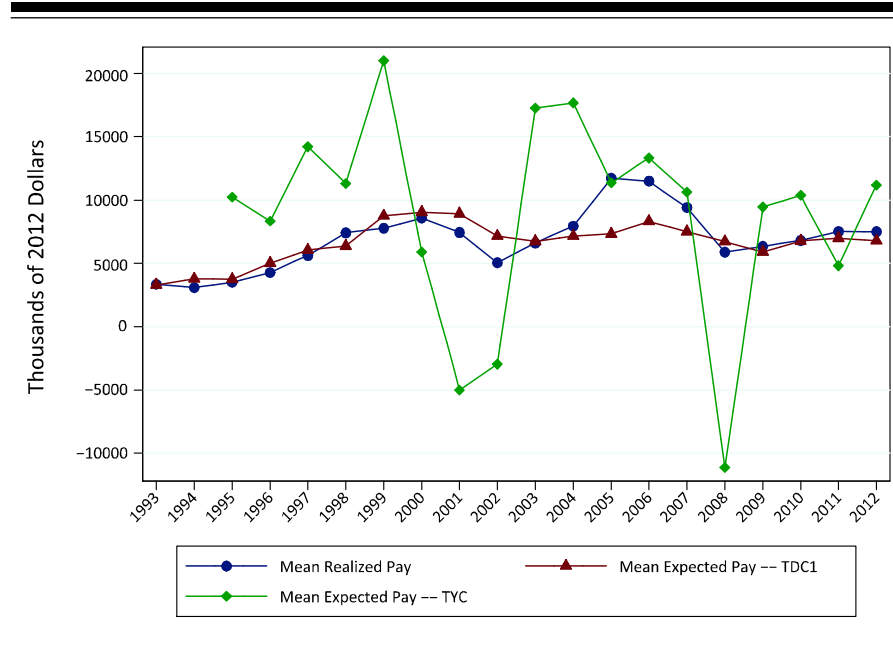
lower, and mean realized pay is sometimes above $TDC1_t$. The main difference for this sample continues to be the higher volatility of TYC_t .

Finance Firms

In Figure 4, we include statistics for firms in the finance sector with the statistics for firms in all sectors.²⁵ Note that firms in the finance sector are, on average, larger (in the sample, the average size in finance is between five and six times larger than the average size for all firms, year by year, with a decreasing trend between 2004 and 2009). Because the level of total compensation (TDC1) has been shown to be positively

²⁵ Firms in the finance sector are those with SIC classification in the 6,000–6,300 range. There are 144 firms per year, on average, in our subsample of finance. We performed the same analysis with a broader category including real estate firms as well as insurance, and the plots looked qualitatively similar.

Figure 5 Mean Realized Pay and Expected Pay, as Measured both by TDC1 and TYC, for CEOs Who Own Less Than 1 Percent of the Stock of Their Firm

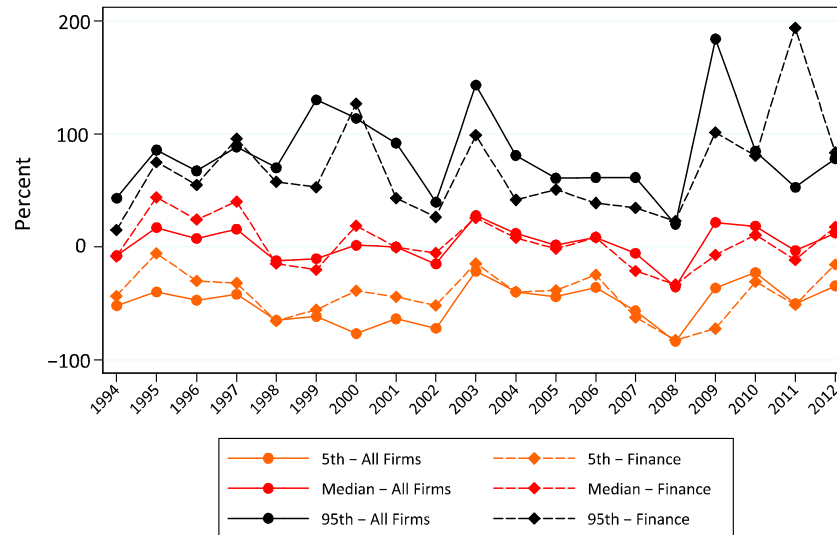


correlated with size, we expect a higher realized pay for CEOs in finance. This is confirmed in the data up to the financial crisis of 2008. Figure 4 shows that the composition of realized pay is slightly different among finance firms, with higher liquid compensation and higher value of trades (which are also more volatile, although this could be due to the smaller number of firms).

When looking in detail at the period since the 2008 financial crisis, it is apparent in the graphs that there has been a steeper decline in median realized pay—both for liquid compensation and trades—for firms in finance than for the full sample of firms. It is worth noting that the median value of grants is, for both groups of firms, well above the median value of trades. The adjustment pattern of median grants during the crisis is similar to that of realized pay, i.e., we see a steeper decline for firms in finance.

Sensitivity of Realized Pay to Performance

Hall and Liebman (1998) provide a measure of sensitivity of pay to performance by using information on stock holdings to construct

Figure 6 Stock Returns by Percentile

Notes: Evolution of the 5th percentile, median, and 95th percentile stock returns for the largest 1,500 firms in our sample. For comparison, the same percentiles of returns for all firms in finance are included as well.

counterfactuals.²⁶ First, they construct a measure of the portfolio of the CEOs, similar to our S_t and O_t holdings of stock and options. Then, using the realized distribution of performances (stock returns), they evaluate the holdings of each CEO in the data for different performance scenarios corresponding to different percentiles of the distribution of returns. We follow this methodology and provide a similar counterfactual for our measure of annual realized pay. An important caveat of this measure is that the quantities of stock traded and of options exercised are assumed to remain constant when stock prices vary in the counterfactual. A model of how these trades would vary in a more realistic setup is beyond the scope of this article.

For our performance counterfactuals, we need to propose the support and distribution of stock returns. For this, we use the observed distribution of stock returns in each given year. We denote the annual

²⁶ Given the limited quantitative importance of bonuses in total compensation, we will ignore changes in bonus payments in our sensitivity analyses.

stock price return as

$$r_t = \frac{p_t - p_{t-1}}{p_{t-1}}. \quad (5)$$

This measure has the advantage of being comparable across firms, as opposed to the stock price itself. In Figure 6, we summarize the evolution of these distributions of returns r_t of the 1,500 largest firms in our sample over time by plotting the return value for the median, and the 5th and 95th percentiles.

Each realization of returns in the support of the distribution can be translated into a stock price for each individual firm using (5). That is, when calculating the counterfactual value of T_t for an individual executive working for firm j , we will construct a counterfactual stock price for various percentiles of the return distribution. We use a hat to denote a variable's counterfactual value, and a superscript nth to indicate the percentile to which we are setting the performance of the firm. For the nth percentile, the counterfactual price for firm j at time t is

$$\hat{p}_{j,t}^{nth} = (1 + r_t^{nth}) p_{j,t-1}.$$

With this price $\hat{p}_{j,t}^{nth}$, a new valuation of $T_{j,t}$ can be produced, assuming the return of the firm was equal to the nth percentile return, r_t^{nth} . Recall that we approximate the gains from trade coming from stock purchases and sales as $\max[0, \bar{p}_t q_t]$, where \bar{p}_t is the average price within the year. We will set the counterfactual for this average price to

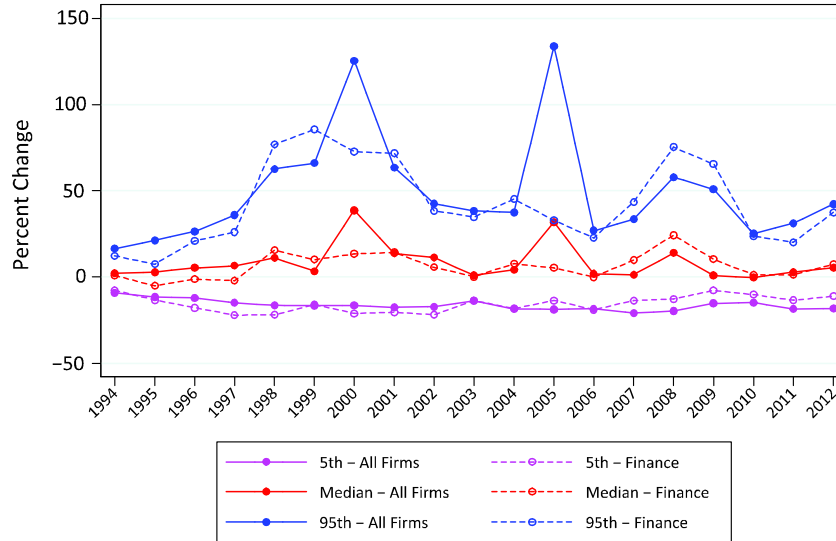
$$\widehat{\bar{p}}_t^{nth} = \frac{\bar{p}_t}{p_t} \hat{p}_t^{nth}, \quad (6)$$

that is, we assume that the proportionality between the average price and the end-of-the-year price is maintained in the counterfactual.

For the portion of the gains from trade that comes from exercising options, we will need several pieces of information. First, in order to compute the net benefit per option exercised, $(\hat{p}_{e_t} - x_g)$, we would need to construct the counterfactual for the stock price at the time of exercise, \hat{p}_{e_t} , possibly using p_{e_t} , and we would need to know the exercise price, x_g , corresponding to each option exercised. Unfortunately, as discussed earlier, we do not know p_{e_t} or x_g (we do not know which particular past grant g was used to purchase the shares). The value of exercised options is recorded in Execucomp:

$$\sum_{o_g \in O_0} o_{g,t}^e (p_{e_t} - x_g) \equiv OPT_EXER_VAL_t \quad \forall t.$$

Figure 7 Mean Counterfactual Income



Notes: Average percentage change in income for three different performance counterfactuals, for all firms and for firms in finance only.

We also have the number of options exercised within the year:

$$o_t^e = \sum_{o_g \in O_0} o_{g,t}^e \equiv OPT_EXER_NUM_t \quad \forall t.$$

To produce an estimate for the counterfactual value of exercising options, we assume $p_{e_t} = \bar{p}$, the average price during the year, and we solve for an “effective” exercise price \tilde{x} using

$$o_t^e (\bar{p} - \tilde{x}) = \sum_{o_g \in O_0} o_{g,t}^e (p_{e_t} - x_g).$$

Finally, we also assume that CEOs do not exercise options in the counterfactual if they are “out of the money” (that is, if $\widehat{p}_t^{nth} < \tilde{x}$). With these assumptions, we have that our counterfactual for gains of trade is

$$\hat{T}_{j,t}^{nth} (S_{j,t}, O_{j,t}) = \max[0, \widehat{p}_t^{nth} q_t] + \max \left[0, o_t^e \left(\widehat{p}_t^{nth} - \tilde{x} \right) \right].$$

This, together with the actual liquid compensation for the executive in the data, L_t , which is not contingent on stock price realizations, amounts to a calculation of a counterfactual $\hat{I}_{j,t}^{nth}$.

The numerical results are listed in Tables 4 (levels) and 5 (percentage changes). We display the percentage changes for the 5th, median, and 95th percentile counterfactuals graphically in Figure 7. Keeping in mind that percentage changes are bounded below by -100 percent, we see that there is an obvious asymmetry in changes when the firm performs better rather than worse. This responds to the uncontingent nature of the wage and the bonus in our calculations. Also, we see in Figure 7 that the gains for the 95th percentile (i.e., outstanding stock return performance) is very extreme in particular years. Two things can lead to high net gains from trade: particularly good stock returns in the given year (i.e., the 95th percentile stock return is an outlier when compared to the other 95th percentile returns in other years) or particularly generous past grants that imply a large number of stock or options are available for trade. We can use the distribution of stock returns, plotted in Figure 5, to track which of the two explanations seems more plausible. The years 2000, 2003, and 2009 represent examples of outlier stock return performance in the 95th percentile; however, only in the year 2000 does this translate into a very large counterfactual mean realized pay in the 95th percentile. The spikes in income for the years 2005 and, to a lesser extent, 2008–09 may correspond instead to particularly large net quantities traded, as computed by us from the portfolios of the CEOs.

Sensitivity for Finance Firms

We observed a sharper decrease in median realized pay for firms in finance during the recent financial crisis (see Figure 4). However, this does not seem to correspond to a very different sensitivity of realized pay to performance for financial firms during the crisis. Tables 5 and 7 replicate the sensitivity analysis of Tables 4 and 6 for firms in finance. That is, using the stock and option holdings of financial firms, we feed in the same percentile stock returns used in Tables 4 and 6 (i.e., those from the distribution of stock for the overall population of firms) to calculate their counterfactual realized pays. We find that the sensitivity estimates align with those of the general sample for the whole sample period.²⁷ It is worth referring back to Figure 4 and noting that the median liquid (uncontingent) compensation of CEOs in finance is

²⁷ Given the way we construct the counterfactuals, any differences in level between Tables 1 and 3 is due to the original differences in the level of actual compensation between the average finance firm and the average firm in the sample.

**Table 4 Counterfactual Income: Mean Level of Income if
Certain Percentile Stock Return Had Been
Achieved—All Firms**

Year	5th	25th	Median	75th	95th	Actual
1994	4,301	5,630	6,378	7,203	8,821	6,182
1995	3,438	4,296	4,926	5,562	6,832	4,659
1996	3,694	4,923	5,734	6,554	8,157	5,286
1997	5,291	7,231	9,083	10,809	14,289	8,243
1998	5,246	9,150	12,397	15,911	24,021	9,364
1999	4,775	7,060	8,668	11,217	20,479	8,460
2000	10,618	27,698	41,383	55,636	87,588	11,268
2001	6,859	11,909	14,968	18,089	27,074	11,022
2002	4,439	6,956	8,910	10,472	13,455	7,448
2003	9,840	12,994	14,718	17,314	26,321	14,156
2004	7,917	11,463	13,211	15,242	20,491	13,023
2005	10,266	14,414	17,072	20,330	26,911	16,382
2006	8,883	11,849	13,802	15,503	19,754	13,200
2007	6,991	10,090	12,326	14,769	19,817	12,531
2008	5,076	8,934	12,177	15,324	20,812	9,636
2009	8,078	11,230	13,450	17,288	28,866	14,474
2010	6,899	8,447	9,459	10,749	13,825	9,640
2011	6,443	8,809	10,325	11,913	15,215	11,270
2012	7,996	10,718	12,080	13,623	18,149	12,747

**Table 5 Counterfactual Income: Mean Level of Income if
Certain Percentile Stock Return Had Been
Achieved—Finance Firms Only**

Year	5th	25th	Median	75th	95th	Actual
1994	3,687	3,987	4,190	4,414	4,851	4,228
1995	5,256	5,700	6,072	6,488	7,679	7,047
1996	6,515	9,468	11,628	13,792	18,017	9,881
1997	6,656	8,323	11,956	15,389	22,304	12,473
1998	5,664	8,173	10,442	12,902	18,538	9,452
1999	6,341	8,800	10,453	12,996	22,127	9,485
2000	6,189	10,105	16,523	24,242	41,568	12,604
2001	8,507	13,528	16,610	19,757	28,852	14,333
2002	6,345	9,544	12,237	14,405	18,536	10,947
2003	8,898	11,051	12,293	14,159	20,626	12,467
2004	8,933	13,099	15,118	17,452	23,474	13,744
2005	11,591	15,828	18,226	21,159	27,077	17,473
2006	9,153	12,596	14,916	16,925	21,937	13,284
2007	10,455	14,958	18,105	21,476	28,427	14,184
2008	4,957	8,523	11,570	14,561	19,803	7,918
2009	5,600	7,378	8,645	10,847	17,502	8,275
2010	5,291	6,322	7,025	7,910	10,125	6,621
2011	4,314	5,350	6,024	6,719	8,152	8,980
2012	5,535	7,174	8,023	8,983	11,791	7,594

Table 6 Counterfactual Income: Mean Percent Change in Income if Certain Percentile Stock Return Had Been Achieved—All Firms

Year	5th	25th	Median	75th	95th
1994	-9.2	-2.2	2.1	6.8	16.4
1995	-11.5	-3.5	2.7	9.0	21.4
1996	-12.1	-1.6	5.4	12.5	26.5
1997	-15.0	-3.7	6.6	16.3	35.9
1998	-16.4	-1.7	11.2	25.5	62.6
1999	-16.6	-5.0	3.4	16.8	66.1
2000	-16.5	13.7	38.8	65.3	125.3
2001	-17.6	1.4	13.7	26.5	63.6
2002	-17.2	-1.5	11.5	22.1	42.4
2003	-13.8	-4.3	1.1	9.4	38.3
2004	-18.6	-3.7	4.2	13.4	37.5
2005	-18.7	4.3	31.8	65.6	133.9
2006	-18.4	-6.4	1.7	8.9	26.9
2007	-20.8	-8.2	1.3	11.8	33.5
2008	-19.7	-1.9	14.0	29.9	57.8
2009	-15.3	-6.1	0.8	13.1	50.8
2010	-14.8	-6.2	-0.4	7.1	25.2
2011	-18.6	-5.8	2.8	12.0	31.3
2012	-18.2	-2.8	5.5	14.8	42.1

particularly large compared to the entire sample, up until the recent crisis. This, together with the fact that sensitivity estimates are similar to those of the overall sample, suggests that the quantities of stock and options held by finance CEOs are larger than those in other industries, hence implementing a similar risk in their realized pay in spite of larger uncontingent compensation levels.

4. CONCLUSION

Information on CEO pay is typically obtained from the mandatory disclosure of compensation required by the SEC for large public firms. A good measure of *realized* pay for CEOs, which includes the actual gains from trading stock rather than their expected value at the time when the firm awards them to the CEO, is not readily in this source. This article discusses how to construct an approximation to the value of realized pay using the partial information compiled in the database Execucomp on the stock owned, bought, and sold by CEOs each year. We present our estimates for the period 1993–2012 and compare them to two alternative measures of *expected* annual total compensation that are frequently used in the media and the academic literature: direct compensation (the sum of salary, bonus, other compensation, and the

Table 7 Counterfactual Income: Mean Percent Change in Income if Certain Percentile Stock Return Had Been Achieved—Finance Firms Only

Year	5th	25th	Median	75th	95th
1994	-7.7	-2.6	0.9	4.8	12.5
1995	-13.3	-8.9	-5.2	-1.1	7.5
1996	-17.8	-8.2	-1.2	6.3	21.0
1997	-22.1	-11.9	-2.2	7.2	26.1
1998	-21.9	-1.6	15.6	34.2	76.9
1999	-16.0	-0.5	10.1	26.6	85.6
2000	-21.0	-3.2	13.5	31.6	72.8
2001	-20.4	0.6	14.4	29.0	71.9
2002	-21.8	-8.1	5.7	17.0	38.5
2003	-13.7	-5.0	0.1	7.9	34.8
2004	-18.3	-1.1	7.9	18.3	45.1
2005	-13.6	-1.9	5.4	14.5	32.9
2006	-18.9	-7.8	-0.2	6.4	22.8
2007	-13.7	-0.2	10.0	20.9	43.4
2008	-12.7	6.8	24.3	42.5	75.4
2009	-7.8	2.6	10.4	24.1	65.5
2010	-10.2	-3.4	1.2	7.1	23.8
2011	-13.5	-4.9	1.1	7.3	20.2
2012	-11.1	0.9	7.6	15.2	37.5

market value of new grants) and total yearly compensation (which includes the year-on-year change in the value of the stock holdings of the CEO). Our measure of realized pay tends to be more volatile over time than direct compensation, mainly due to the volatility of the gains that CEOs realize from trading stock. However, total yearly compensation is markedly more volatile than the other two measures. We find that, while the average realized pay level has historically been at or above that of direct compensation, its median has consistently been lower. We provide descriptive statistics of realized pay for firms in the finance sector. In the aftermath of the crisis the realized pay of CEOs of finance firms seems to have decreased in level relative to the realized pay of CEOs in all industries. Our calculations suggest, however, that realized pay of finance CEOs changes with the performance of their firm in similar magnitudes to that of the average CEO for the whole 1993–2012 period.

APPENDIX

In this Appendix, we show how to map the variables defined in Section 2 to the Execucomp database. We discuss the elements of our ideal measure of compensation that are missing in the data, and what assumptions we make to go around these difficulties.

As we list the objects needed to calculate I_t , we will note how the change in reporting requirements of the SEC in 2006 changes the availability of data (or, sometimes, simply the name of the Execucomp variable that corresponds to a given concept). For this purpose, we will refer to the reporting period before 2006 as P_1 , and the one after as P_2 .

Measuring Liquid Compensation, L_t

Our measure of liquid or cash-based compensation, L_t , is the sum of the executives' annual salary, bonus, dividends, and any perks received within the year, such as contributions to pension plans. Data on annual salary W_t is directly available in Execucomp:

$$W_t \equiv SALARY_t, \forall t.$$

Our measure of bonus, B_t , is the sum of the Execucomp variable BONUS and two variables that capture payments received from hitting "objective" performance targets such as sales growth or stock price performance.²⁸

$$B_t \equiv \begin{cases} BONUS_t + LTIP_t & \text{if } t \in P_1 \\ BONUS_t + NONEQ_INCENT_t & \text{if } t \in P_2. \end{cases}$$

We also have information in the data about the dividend yield (dividends per share, divided by p_t , times 100) that the executive receives from his stock ownership of the company. We back out the total dividend payments as follows:

$$D_t \equiv \frac{DIV_YIELD_t}{100} \times PRCCF_t \times SHROWN_EXCL_OPTS_t \quad \forall t,$$

²⁸ Specifically, after 2005 Execucomp's BONUS variable was modified to only include discretionary or guaranteed bonuses. So to include payments from objective targets, we sum BONUS with NONEQ_INCENT, the amount of income received in the year pursuant to non-equity incentive plans being satisfied. Whenever NONEQ_INCENT is missing (i.e., prior to 2006), we add BONUS with LTIP, the amount of income received in the year pursuant to long-term incentive plans that measure performance over more than one year.

where $PRCCF_t$ is Execucomp's record of the stock price at the closing of the fiscal year:

$$p_t = PRCCF_t \quad \forall t.$$

Finally, our measure of perks and pension payments K_t is the sum of Execucomp variables related to "other compensation":

$$K_t \equiv \begin{cases} ALLOTHTOT_t + OTHANN_t & \text{if } t \in P_1 \\ DEFER_RPT_AS_COMP_t + OTHCOMP_t & \text{if } t \in P_2. \end{cases}$$

Tracking Grants, G_t

Our measure of grant-based compensation G_t is the sum of the value of restricted stock grants and options in the period. We have data on the value of the stock component of that sum, $EV(s_t^r; p_t)$, with the following variables:²⁹

$$EV(s_t^r; p_t) \equiv \begin{cases} RSTKGRNT_t & \text{if } t \in P_1 \\ STOCK_AWARDS_FV_t & \text{if } t \in P_2. \end{cases}$$

In reality, there may be N grants within the year, each with a quantity $s_{t,n}$ and a market price at the time of granting of $p_{t,n}$, for $n = 1 : N$. The variables above that we observe in Execucomp will not have the disaggregated information grant by grant, but rather they correspond to

$$EV(s_t^r; p_t) = \sum_{n=1}^N s_{t,n} p_{t,n}.$$

The value of options awarded in the period is recorded in the data as follows:³⁰

$$EV(o_t^r; x_t, p_t) \equiv \begin{cases} OPTION_AWARDS_BLK_VALUE_t & \text{if } t \in P_1 \\ OPTION_AWARDS_FV_t & \text{if } t \in P_2. \end{cases}$$

²⁹ Both variables measure the value of stock awards as of the grant date. RSTKGRNT was reported by the companies themselves in the Summary Compensation Table, while STOCK_AWARDS_FV is calculated by Execucomp. Strictly speaking, each also contains restricted stock units and phantom stocks.

³⁰ OPTION_AWARDS_BLK_VALUE is calculated by Compustat, during that period of time when—prior to FAS 123R—companies typically expensed options using the "intrinsic value" method, i.e., the difference between grant date stock price and exercise price of the option, which nearly always led to no expensing of options. OPTION_AWARDS_FV is the grant date fair value of option awards in the year, reported by the company per FAS 123R using some version of Black and Scholes (1973) or a similarly accepted calculation.

Again, these variables aggregate all grants within a year, so effectively we will set

$$EV(o_t^r; x_t, p_t) = \sum_{g=1}^M EV(o_{g,t}^r; x_{tg}, p_{g,t}),$$

where M is the total number of option grants in the year. There is some partial information in Execucomp about the date and exercise price of the different grants for an executive in a given year. However, we do not have their vesting schedule or the date of their exercise (that is, we do not know what the stock market price was at the time when the executive exercised the options). See the related discussion in the realized pay sensitivity analysis in Section 3.

Computing Net Gains from Trading Stock, T_t

We will now define the components of our net gains from trade measure, T_t . To begin, recall that we assume each of these trades happens only once in the fiscal year, and if the executive exercises options, he sells the acquired shares immediately.

The portion of T_t that comes from exercising options is captured by the Execucomp variable `OPT_EXER_VAL`:³¹

$$\sum_{o_{g,t}^e \in O_{t-1}} o_{g,t}^e (p_{e,t} - x_g) \equiv OPT_EXER_VAL_t, \forall t.$$

The portion of T_t that comes instead from buying and selling stock on the open market, $s_1^s p_{s_1} - s_1^b p_{b_1}$, must be estimated, because we cannot observe in the data the quantities s_t^s or s_t^b (and, correspondingly, the prices p_t^s or p_t^b). We use an algorithm similar to Clementi and Cooley (2009) to estimate this difference, with slightly different assumptions that we discuss later in this section. From the law of motion for vested stock in (3), we have that the difference between last year's unrestricted stock holdings and this year's is either coming from the newly vested stock this year, s_t^v , or net purchases. We denote the net quantity of shares sold in t as $q_t \equiv s_t^s - s_t^b$. Rearranging (3) and substituting q_t , we have

$$q_t = S_{t-1} - S_t + s_t^v, \forall t. \tag{7}$$

Typically, q_t will be positive in the data, i.e., the CEO will sell more shares than he buys in a given year. Occasionally, however, q_t

³¹ `OPT_EXER_VAL` is the total value realized from option exercises in the year, and is measured (for each g award, in our notation) as the difference between the exercise price and stock price on the date of exercise.

calculated as in (7) will be negative. This could be due to violations of our assumption that the CEO immediately sells stock acquired through the exercise of options.³² Because we would rather bias our measure of realized pay upward, we set q_t in our calculations equal to the maximum of q_t from (7) and 0.

To calculate q_t using (7) we need S_{t-1} and S_t , which correspond to the CEO's holdings of unrestricted stock. We observe this variable directly in Execucomp.³³

$$S_t \equiv SHROWN_EXCL_OPTS_t, \forall t.$$

We also need the variable s_t^v , the stock vested within the year. This variable maps directly into Execucomp's SHRS_VEST_NUM in the reporting period P_2 . For observations in P_1 , when it is missing, we estimate it by examining annual changes in aggregate restricted stock holdings and annual grants. Specifically:

$$s_t^v \equiv \begin{cases} \left[\begin{array}{l} STOCK_UNVEST_NUM_{t-1} \\ -STOCK_UNVEST_NUM_t + s_t^r \end{array} \right] & \text{if } t \in P_1, \\ SHRS_VEST_NUM_t & \text{if } t \in P_2. \end{cases},$$

where our measurement of the number of stocks granted within the year, s_t^r , is an approximation to the real total number of stock (unavailable in the data) that we recover from $EV(s_t^r)$ by assuming all grants are valued at the average price within the year, denoted \bar{p}_t .³⁴

$$s_t^r = \frac{EV(s_t^r)}{\bar{p}_t}.$$

Note that \bar{p}_t is not in Execucomp. We match the firms in Execucomp to a different database from the Center for Research in Security Prices (CRSP) containing daily stock prices, and we construct the average price ourselves. For this, we take the 12-month window of each firm's fiscal year. To summarize, in our notation, our estimate for the amount of stock vested within t is

$$s_t^v = S_{t-1}^r - S_t^r + s_t^r.$$

Once we get q_t from (7), we estimate the value $s_t^s p_{s_1} - s_t^b p_{b_1}$ by assuming the q_t shares were traded at the average market price over

³² In addition to what we have described, there are two other types of transactions that will change CEO holdings: stock inheritances and stock donations. We abstract from them, as these transactions will typically be small, if non-zero. However, these could also be behind some of the negative q_t in the data.

³³ SHROWN_EXCL_OPTS reports shares of the firm owned by the CEO, excluding options that are exercisable or will become so within 60 days. This amount is reported as of some date between the fiscal year-end and proxy publication.

³⁴ Clementi and Cooley (2009) use the end-of-the-fiscal-year price for this calculation. We choose average price hoping to avoid some of the idiosyncrasy of p_t due to volatility of stocks.

the year, i.e., $p_{s_1} = p_{b_1} = \bar{p}_t$. Given our assumption of non-negative net quantities traded, this amounts to stating

$$s_t^s p_{s,t} - s_t^b p_{b,t} \equiv \max[0, \bar{p}_t q_t].$$

Thus, adding the stock and option portions of T_t , we get

$$T_t(S_{t-1}, O_{t-1}) \equiv \max[0, \bar{p}_t q_t] + OPT_EXER_VAL_t, \forall t.$$

Note that there are two differences between our estimation of net revenue from trade and the calculations in Clementi and Cooley (2009). First, we use average instead of end-of-year prices to recover the quantity of shares granted in a given year, s_t^x , from the value of the grants; this influences our estimate of the net quantities traded, q_t . Second, we use `OPT_EXER_VAL` directly to account for the proceeds of options sales during the year: This variable is the true value of option exercises collected in `Execucomp` and hence uses actual exercise prices and actual stock prices on date of exercise. Clementi and Cooley (2009) instead choose to lump the stock purchases resulting from option exercises in with other stock sales, and they assume that they are acquired at the average price.

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