

Data Appendix to Executive Compensation: A New View from a Long-Run Perspective 1936-2005

1. Sample Selection

1.1 Selecting Firms

Our sample includes data on executives working in the largest 50 firms in 1940, 1960 and 1990. For 1960 and 1990, we measure firm size by the total value of sales and obtain company rankings from Compustat.¹ Because Compustat's coverage is incomplete prior to 1978, we crosscheck the 1960 ranking with a list of the largest manufacturing firms published by *Fortune* magazine and add firms that are missing from Compustat.² For 1940, a rank ordering of firms by the value of total sales was not available from either Compustat or any other published surveys. Therefore, we rank firms by their total market value using the Center for Research in Security Prices (CRSP) database.³

Our information on executive compensation comes from historical proxy statements and 10-K reports, which were mainly obtained from the collection at Harvard Business School's Baker Library. To facilitate the data collection process we limit our sample to firms for which the Baker Library has proxy statements for a large number of years. To be specific, we only use firms for which we can find information for at least 20 years in a 30-year window. These 30-year windows are 1936-1966 for the 1940 sample, 1943-1973 for the 1960 sample, and 1970-2000 for the 1990 sample. In addition, we also require that annual data must be available for at least three blocks of five consecutive years within this 30-year period. This requirement is necessary because only consecutive data on stock option grants and exercises can allow us to reliably estimate an individual's holdings of unexercised stock options. If a firm does not meet these criteria, we replace it with the next largest firm on the list. In this manner, we move down the rankings until we have a total of 50 firms for each list of rankings. Because the ranking of firms is fairly consistent over time, our final sample includes a total of 101 firms. For each firm that meets our selection criteria, we collect annual data for all of the years from 1936 to 2005 for which proxy statements or 10-Ks are available. Appendix Table A1 lists the firms in our sample, the years they appear and their industrial classification.

An important issue related to the selection of firms is how to treat mergers. Our intent is to keep a post-merger company in the sample if the new firm is similar to the original company. Therefore, we continue to follow a company for as long as the firm maintains the same permanent company identification number (PERMNO) in the CRSP database. We also include a post-merger firm with a different permanent number if either (1) all or part of the name of the old company is retained in the new company's name, or (2) the 2-digit SIC code of the new and the old company are the same. Out of the 101 firms in our sample, there are seven cases where a firm's identification number changes but it retains the name of the original firm, and 25 cases where the identification number and name changes but the industrial classification remains the same. There are 11 cases where we stop following a firm after a merger because the new firm takes on an entirely new name and operates in a different industry. There are also another 14

¹ Although we select firms based on rankings in three particular years, we intend to select companies that were large for a reasonable period of time. Therefore, we use the value sales to measure firm size whenever possible, since it is less susceptible to transitory shocks than market value.

² We find three firms that are listed in *Fortune's* ranking but do not appear in Compustat. See Kothari, Shanken and Sloan (1995) for a more detailed description of survivorship bias in Compustat.

³ In 1951 (the first year with a reliably large number of firms reporting sales in Compustat), the correlation between a firm's rank by sales and its rank by market value is 0.76 (based on 423 firms). Thus, it is unlikely that the change in our selection criteria introduces a large bias in our sample.

cases where we cease to follow a firm because it becomes foreign-owned (and therefore not subject to the Securities and Exchange Commission (SEC) reporting requirements) or because the firm has gone out of business.

1.2 Selecting Executives in Each Firm

During the 1930s, the SEC required firms to report remuneration for each of their three highest paid officers. This requirement was extended in 1943 to include any additional officers who earned above a nominal cutoff, which was subsequently raised over time. From 1978 to the present, the disclosure requirements were extended to the five most highly compensated officers. We collected information on the 5-highest paid officers in each firm whenever possible, but present information only on the three highest paid executives to maintain consistency over time.⁴ We also exclude executives who did not work for the entire fiscal year.

1.3 Collecting Firm-Level Data

We measure the market value of each firm in our sample as the number of shares outstanding multiplied by the end-of-fiscal year market price, both of which are reported in CRSP. The total value of sales in each firm is from Compustat (data12), which is available for most companies from 1950 to the present. For years prior to 1950, we collected data on total sales from various editions of *Moody's Industrial Manual*, *Moody's Transportation Manual*, and *Moody's Public Utility Manual*.

2. Measuring Executive Compensation

2.1 Collecting Information from Proxy Statements

Our compensation data were hand-collected from corporate reports that were filed with the SEC, which has required firms to disclose this information since 1934. Prior to 1942, the information was disclosed in 10-K reports, which included the name, job title, and aggregate remuneration (normally defined as cash salary and bonuses) paid to each of the three highest-paid officers. In 1942, the SEC introduced executive compensation as an item in proxy statements and began to require detailed quantitative and qualitative information on the major forms of remuneration. Therefore, we collect data from proxy statements between 1943 and 1992 (thus for data pertaining to 1942 to 1991), and extend our sample back to 1936 using 10-K reports.⁵ From 1992 to 2005, we use information on executive pay from Compustat's Executive Compensation (ExecuComp) database. These data are also obtained from proxy statements, and so are comparable to our hand-collected data.

We obtain information on executive pay from several parts of the proxy statement. As required by the SEC, each proxy statement contains a table listing the remuneration of the highest paid officers in the firm. This table provides data on cash remuneration, long-term bonuses and, frequently, job titles. Information on stock option grants and exercises generally follows this table. Many proxy statements also include a description of incentive pay or stock option plans that were in effect at the time. These descriptions include details on the characteristics of stock option and bonus awards (for example, the vesting structure of options

⁴ In accordance with SEC guidelines, the highest-paid officers are identified according to total cash remuneration (i.e. total cash and bonus payments, but not the value stock or stock option grants).

⁵ We begin our sample in 1936 because this is the first year that provides us with a large enough sample size, as many firms refused to disclose information on pay in 1934 and 1935. Moreover, the collection of 10-Ks at Baker Library includes fewer companies in the earliest years of the SEC's operations. Due to the limitations of Baker Library's collection, we were able to find information pertaining to the 1936-42 period for 63 out of the 85 firms in our sample that were operating during those years.

and deferred bonuses, the tax status of stock options, and the method used to calculate incentive compensation). Proxy statements also contain a table listing the holdings of company stock for nominees for director. This table allows us to record the equity holdings of officers who were also directors, which comprises more than 80 percent of the executives in our sample.

2.2 Measurement of salary and bonus payments

Salary and current bonus payments: Salary plus any bonus both awarded and paid out in the same year. These bonuses were generally in the form of cash, although some were given in stock. Stock bonuses are valued using the stock price on the day the stock was given to the executive. When the stock price on the grant date is missing, we use the stock price at the end of the fiscal year. In many cases cash compensation is reported as one lump-sum, so we are unable to separate salary from bonus payments. In about five percent of the sample, cash remuneration also includes payments from long-term incentive awards as well as current-year bonuses.

Long-term incentive payments: Payments made to the executive for bonuses awarded in prior years. Many long-term incentive plans were structured to pay bonuses in equal installments during the four to five years after they are awarded. Although we would prefer to attribute all bonus awards to the year in which they are granted, most firms only report the cash amounts paid in each year. In cases where the firm reports the amount awarded, we convert the award into future payments using the structure of the bonus plan to estimate the amount paid out each year. In earlier decades, the majority of these bonuses were paid in cash. Bonuses awarded in stock became more common over time as restricted stock grants became more prevalent.⁶ Stock bonuses are valued using the stock price at the end of the fiscal year in which the stock is received. Since the realization of performance measures for contingent awards are usually not observable, contingent bonuses are only included when the amounts paid out are reported.

2.3 Measurement of stock options

Options granted: We value options on the day they were granted using the following Black-Scholes formula:

$$\text{Award value} = N[Pe^{dT}\Phi(Z) - Ee^{rT}\Phi(Z - \sigma\sqrt{T})]$$

$$Z = \frac{\ln\left(\frac{P}{E}\right) + T(r - d - \frac{1}{2}\sigma^2)}{\sigma\sqrt{T}}$$

N = number of shares awarded

P = stock price on the date of the award. In most cases we assume this price is equal to the exercise price of the stock (see below for details).

E = exercise price of the stock option.

d = monthly dividend rate = $1/12 * \ln(1+D/S)$ where D is the total value of dividends paid in the previous year and S is the average stock price in the previous year.

T = time to expiration of the option, measured in months.

r = monthly yield on US treasury securities. We use the 3-year constant maturity interest rate from Global Insight's DRI-WEFA Basic Economic Database.

⁶ From 1992 to 2005, restricted stock is valued in the year it is granted because Compustat does not report the vesting schedule of these grants. The long-run trends in long-term pay are the same when we value pre-1992 stock bonuses in the year they are granted (to match Compustat) instead of in the year they are disbursed.

Σ = standard deviation of monthly stock returns. Monthly stock returns are obtained from the CRSP database and are corrected for stock splits and dividend payments. We calculate the standard deviation using the three prior years of monthly data.

$\Phi(Z)$ = cumulative probability function for the normal distribution

Except for the dividend rate, the interest rate, and the standard deviation of stock returns, the proxy statements generally contain all of the information necessary to implement the Black-Scholes formula. However, we impute the values of an option's duration or exercise price in some cases where this information is missing. Before 1964, options under a typical stock option plan expired after ten years and had an exercise price ranging from 95 to 100 percent of the market price of the stock on the day of grant. These specifications were fairly standard because an option with these characteristics was subject to capital gains tax rates instead of income tax rates under the 1950 Revenue Act. The 1964 Revenue Act replaced "restricted" with "qualified" stock options and changed these requirements to an exercise price of 100% and duration of five years. The majority of the firms in our sample revised their plans to conform to these new rules. As the tax incentive to grant stock options diminished during the 1970s, firms began granting a larger number of non-qualified options with a 10-year duration. Therefore, when information on the duration of an option is missing, we assume that it was ten years if the option was granted prior to 1964 or between 1974 and 1992, and five years if it was granted between 1964 and 1973. This imputation is made for 16 percent of the sample prior to 1992, with most missing information occurring during the 1970s and 1980s. Compustat does not report the duration of option grants, so we assume a horizon of seven years for all options granted after 1992.⁷ Because the vast majority of the options were granted at-the-money after 1950, we assume that the stock price on the day of the award is equal to the exercise price when the exercise price is missing after this year.⁸ For years prior to 1950, a much larger number of options were granted in-the-money. Since we frequently do not know the exact grant date of these options, we value these options using the end-of-fiscal year market price.

We also impute the number of options granted in cases where the firm reported only the total number of options awarded to each executive during the previous three or five years, a reporting practice what was common from the late 1960s to the late 1980s. Wherever possible, we combine these cumulative option awards with information on annual grants and exercises from previous proxy statements to estimate the amounts granted for each executive in an individual year. However, this imputation cannot be made for executives who do not appear in all of the previous three or five proxy statements, or if the proxy statement for an intervening year is missing.⁹ Because roughly 27 percent of the firms in the 1970s and 20 percent of the firms in the 1980s reported options in this manner, excluding this information would severely bias downward our estimates of option grants. Instead, when we can not impute the grants and exercises for a given year, we assume that one-fifth of the 5-year totals were granted in each of the past five years, or one-third of the 3-year totals in each of the past three years. We assume that the exercise price of these options was equal to the end-of-fiscal-year stock price.

Appendix Figure A1 shows the frequency of stock option grants both including and excluding these imputed values. Our procedure raises the probability of receiving an option by 20 to 30 percentage points during the 1970s and 1980s. Including the imputations also alters the trend in the use of options, making the rise in stock option grants steeper in the 1960s and flatter in the 1980s. During periods when a large fraction of option grants are imputed, our assessment

⁷ We assume 7 years instead of 10 to be consistent with prior work (for example, Hall and Liebman 1998).

⁸ See Smith and Zimmerman (1976) and Murphy (1985) for further evidence that firms fix the exercise price equal to the current stock price.

⁹ We are able to back out annual data for 11 percent of the cases where only multi-year totals are reported.

of the correlation between annual option grants (and therefore total compensation) and firm performance will be less accurate.¹⁰ Despite the substantial impact on our estimates of the *frequency* of option grants, this imputation strategy has only a minor effect on the *value* of total compensation (see Appendix Figure A2). These imputations raise the median real value of total compensation by less than \$0.1 million for most of our sample, and do not appreciably alter the long-run trend.

Options exercised: Proxy statements issued from the 1950s to the 1970s generally report the number of options exercised, the exercise price (adjusted for stock splits) and the market value of the stock on the date of purchase. Using this information, we value gains from exercising options as the difference between the exercise price and the average stock price on the day the option was exercised. The exercise price is only missing for less than two percent of the observations on stock option exercises, so we do not impute values for these cases. Proxy statements issued during the 1980s and 1990s generally report the total gains from exercising options, but not the number. In these cases, we assume the executive exercised his oldest options first in order to back out the number exercised (which is needed to estimate each executive's stock option holdings).

Analogous to the reporting of option grants, the number of options exercised were also reported in 3- and 5-year totals during the 1970s and 1980s. We impute the number exercised from these totals using a procedure similar to the one used for option grants. Appendix Figure A3 shows the frequency of option exercises including and excluding these imputations. In this case, the biggest effect of our imputations is from the late 1960s to the late 1970s, when it raises our estimates of the frequency of options exercised by about ten percentage points.

Stock option holdings: We calculate the number of options held by an executive as the number he held the previous year plus the number granted, less the number exercised and the number that expired during the year. To value these holdings using the Black-Scholes formula, we need the exercise price and remaining duration of each option included in these holdings. These statistics are not generally reported in proxy statements, so we gather this information by following the exercise price and duration of the options each executive receives and exercises in each year. In cases for which information on the exercise price or remaining duration of an option grant is missing, we assume that the exercise price is the closing price at the end of the fiscal year of the grant year and that options granted before 1964 or after 1974 have a duration of ten years, while options granted between 1964 and 1974 have a duration of five years. This method may underestimate an executive's total stock option holdings because many executives are likely to have been granted stock options before we observe them in our data. However, during the 1970s most firms also began to report the total number of options held by each executive. About one third of our estimates match the reported totals exactly, and we adjust our calculated holdings to match the reported totals for the other two thirds (following Hall and Liebman 1998). Our estimates do not appear to be significantly biased, as the average difference between our estimates and the reported totals is 586 options (0.2 percent of the average number of options held for executives with positive holdings) and the median difference is zero. In cases where our estimates are greater than the reported totals, we assume that the oldest options in the portfolio were exercised first. In cases where we calculate fewer option holdings than reported,

¹⁰ For example, it is possible that many of the grants we attribute to the mid-1970s were actually granted in the late 1960s or early 1970s, which were times when firms were earning higher rates of return.

we assume that the missing options were granted in the year prior to the first year that we observe the executive.

2.4 Equity holdings

Equity holdings are valued with the stock price at the end of the fiscal year. We include shares that are held by family members and associates. Equity holdings were only reported in proxy statements for officers who were also directors, and occasionally only for directors who were also up for re-election. Nonetheless, we observe stock holdings for 88 percent of our sample from 1942-2005. Because 10-K reports did not list the equity held by officers and directors, stock holdings for the 1935-41 period are based on the bi-monthly reports of the SEC, *Official Summary of Security Transactions and Holdings*. These reports record the equity purchases and sales of every officer and director in publicly-traded corporations and public utilities. At the time of a transaction, an officer's total holdings of company stock are also reported. Using these reports, we collected information on the holdings of company stock of any officer who made a transaction during a year. If an officer did not appear in any reports for a given year, we assume he owned the same amount of stock as in the previous year. We obtain an initial estimate of stock holdings in 1935 from the *Official Summary of Holdings of Officers, Directors and Principal Stockholders*, which reports the holdings of all officers in each firm for that year. If an individual was not an officer or director in 1935, we will not observe his equity holdings until the first year in which he makes a transaction. Thus, our estimates during the 1936-41 period may be biased upward if officers with less tenure in the company held smaller shares of stock. We are able to assess the magnitude of this bias by comparing our estimated stock holding to the proxy statements issued in the 1936-41 period that did report officers' equity holdings. Our estimated stock holdings match the proxy statements' data about 50 percent of the time, and they do not appear to be significantly biased. The average difference between our estimates and the reported totals is 2000 shares (20 percent of the average number of shares held) and the median difference is 50 shares (three percent of the median number of shares held).

3. Evaluating the Representativeness of our Sample

3.1 Salary and Bonus

Appendix Table A3 shows the distribution of the firms in our sample ranked by their market value.¹¹ To calculate these rankings, we define the universe of firms as those in Compustat listed as being traded on the S&P, NYSE, ASE or NASDAQ. For the years prior to 1951, the universe is all firms listed in CRSP. Most firms are ranked among the 100 largest, but the sample also includes smaller firms that will either become large in future years or that were large in the past. Despite a decline in our firms' rankings over time, nearly half of them still ranked among the top 100 by the end of our sample period.

Because our sample is heavily weighted towards large firms, a natural concern is that the trends we document are not representative of the typical publicly-traded firm.¹² Therefore, we evaluate the representativeness of our sample by comparing it to three other datasets that reflect compensation in the S&P 500. The first sample is the Forbes survey, which has reported the pay levels for CEOs in the 800 largest publicly-traded corporations since 1970. The second sample is from Hall & Liebman (1998), who collected data on CEO compensation from 1980 to 1994

¹¹ Results are similar when we rank firms according to their sales.

¹² One potential worry is that our trends are biased by reflecting the compensation in firms that will become successful around 1940, 1960 and 1990. However, we do not find differential patterns when we split the firms into subsamples based on the year of selection into the sample, or when we restrict the data for each firm to the period after the year for which it was selected into the sample.

using a random sample of 478 firms from the Forbes 500 rankings.¹³ Finally, we use ExecuComp, which provides data on the compensation of the highest-paid officers in the S&P 500 for the 1992-1993 period, and in the S&P 1500 since 1994. As far as we are aware, no comprehensive dataset would provide us with a useful comparison group prior to the 1970s.

Appendix Figure A4 compares the median real value of salaries and bonuses of CEOs in our sample to these three other samples for firms in three different size categories according to their market value: firms among the largest 100, firms ranked 100 to 300, and firms ranked 300 to 500. Although the level of pay in the two smaller size categories is somewhat higher in our data than in the broader samples, the trends are similar.¹⁴ From 1970 to 2005, median salary and bonus in the largest firm-size category in our sample increased at an annual rate of 4.8 percent, compared with 4.0 percent in the more representative samples. The corresponding growth rates for the mid-sized category are 2.4 percent and 2.3 percent, respectively, while they are 2.6 percent and 2.1 percent respectively for the smallest category.¹⁵

If we assume that the differential between our data and the broader samples was similar in earlier time periods, we can estimate nationally-representative trends in cash compensation for our entire sample period by reweighting firms according to the national distribution of firm size. Appendix Figure A5 shows the trends in median compensation—again defined only as current salary and bonus payments—where each firm is assigned a weight inversely proportional to its probability of being in our sample.¹⁶ These probabilities are calculated as the fraction of firms of a given size category in our sample relative to the total number of firms in that group. We define five size categories: the largest 50, firms ranked 50-100, firms ranked 100-200, firms ranked 200-300 and firms ranked 300-500.¹⁷ Because the smallest firms in our sample are the least likely to be representative of other firms of similar size, we also consider weights scaled to reflect only the largest 300 publicly-traded firms. For most of our sample period, the median of our unweighted sample is similar to the median of the top 300 firms in the economy, while it is somewhat higher than the median of the top 500 firms. Therefore, we conclude that our data on salaries and bonuses are broadly representative of the largest 300 publicly-traded firms in the economy.

3.2 Stock Options

We are only able to evaluate the representativeness of stock option grants in our sample from 1980 to 2005 because the Forbes survey does not report information on option grants. Appendix Figure A6 compares the median value of stock option grants in our sample to the Hall-Liebman and ExecuComp datasets. Our data line up well with the other samples for firms ranked among the 100 largest, but our estimates of grants in smaller firms are somewhat larger than the Hall-Liebman sample in the 1980s. For the smallest group of firms, our estimates are also noisy due to the small sample size.

The discrepancy in the use of stock options can be partly attributed to our imputation of option grants from the multi-year totals reported in the proxy statements (see Section 2.3 above). This imputation smooths out grants over a period of several years, raising the frequency of stock

¹³ Hall and Liebman (1998) expanded on a sample of 792 firms constructed by Yermack (1995).

¹⁴ This difference can be partly explained by the larger size of the firms in our sample, but a small differential between the samples (about 10 to 15 percent) remains even after controlling for firm size in a regression framework.

¹⁵ Using ExecuComp we find that the trend in salaries and bonuses in our sample is similar to a broader set of publicly-traded firms not just for CEOs but also for the three highest-paid executives.

¹⁶ Results are similar when we use weights inversely proportional to a firm's market share.

¹⁷ For example, in 1950 we have 38 firms ranked among the largest 50, so any firm in this category is given a weight of 50/38.

option grants. In the Hall-Liebman sample, firms that reported multi-year totals were contacted by mail to provide annual information. Due to a high response rate to this inquiry, the Hall-Liebman sample has few cases where annual option grants are unknown.¹⁸ Although option grants were probably lumpier than our data suggest, the total value of options granted to each individual in our sample should be accurate. Among the 45 firms that appear in both our sample and the Hall-Liebman datasets, the average value of options granted from 1980 to 1989 was \$0.42 million in our data, compared with \$0.40 million in the Hall-Liebman data.

A second reason why we find a greater extent of option use in the 1980s may be that the use of stock options in the smaller firms in our sample may not be representative of a typical publicly-traded firm of a similar size. Since our sample consists of firms that were successful in at least one point in time, some of the smaller firms in our sample may be experiencing a temporary negative shock. Because stock option policies typically last for several years, option grants in these firms may look more similar to larger firms than to firms that have always been small. Indeed, the Hall-Liebman sample shows a more pronounced positive correlation of option grants with firm size (see Appendix Table A4). Thus, the composition of pay in firms smaller than the top 100 in our data may be more heavily weighted towards options than the typical publicly-traded firm in the economy.

Although no nationally-representative data on stock option grants exist prior to the 1980s, Lewellen (1968) calculates the value of options in a sample of 50 large manufacturing firms from 1940 to 1963. He finds a much higher value of stock options than we find in our sample. This disparity can be explained by differences in the methodologies of valuing options. Whereas we use the Black-Scholes formula to value options in the year they are granted, Lewellen calculates the difference between an option's exercise price and the market price of the company's stock at the end of each fiscal year, and then spreads these potential gains from stock appreciation over the duration of the option.¹⁹ Gains from exercising options were significantly higher than the value of grants during this period, so this ex-post valuation method overstates the value of option grants. More importantly, Lewellen's statistics greatly overstate the value of options because he reports a "before-tax equivalent value," which he defines as the before-tax value of salaries that an executive would need to receive in order to achieve an after-tax level of pay equivalent to the potential gains from exercising his stock options. Because options were taxed at a much lower rate than cash salaries, this valuation is substantially larger than the simple (before-tax) value of option grants that we use in our analysis.

3.3 Total Compensation

To assess the effect that the possible overestimation of stock option grants in small firms may have on our measure of total compensation, we calculate an alternative value of grants using the relationship between option grants, total pay, and firm size in the Hall-Liebman sample. For all firms ranked lower than 100, we assume the share of option grants in total compensation to be proportional to the average share of grants in firms ranked in the top 100 in that year. This proportion is based on the Hall-Liebman sample, which we calculate separately for the periods 1980-84 and 1985-89. By splitting the data into these two periods, we smooth through the noise in annual grants while still accounting for the spread of options to smaller firms over time. Because we have no other evidence on option grants prior to 1980, we apply the 1980-84 shares

¹⁸ We thank David Yermack for providing information on this topic.

¹⁹ A potential concern is that investors did not have access to the Black-Scholes formula prior to 1973. However, this does not imply that investors did not have an understanding of derivative pricing. For example, Moore and Juh (2006) find that investors were able to determine the fair value of warrants traded in the Johannesburg Stock Exchange in the early twentieth century.

in the Hall-Liebman data to all years prior to 1980. For example, for a firm ranked 150th in 1984 or in any prior year, we assume that the share of options in total pay is 0.101/0.164=62 percent of the share of option grants in the largest 100 firms in that year (see Appendix Table A4). For 1990 onwards we use actual option grants because our data are similar to the Hall-Liebman and ExecuComp data in that period. We also use actual option grants for firms ranked in the top 100 because our data are not biased in large firms.

Appendix Figure A7 compares median compensation of the three highest-paid officers in each firm in our unweighted sample to total pay using this alternative assumption for stock option grants. The alternative assumption reduces the level of pay a bit in the 1950s through the 1980s, but the effect is minor. The figure also shows the alternative compensation measure weighted to reflect the largest 300 publicly-traded firms using the probability weights discussed in Appendix Section 3.1. By using both the probability weights and the alternate stock option assumption, this series reflects our best estimate of the long-run trend in compensation in large publicly-traded firms. Although the combination of reweighting and adjusted stock option grants reduces our estimates of compensation by about ten percent in the years prior to 1990, this decrease does not alter the long-run trend in executive pay in any meaningful way. Therefore, we conclude that the unweighted statistics we present in the main body of the paper accurately reflect the trends in compensation in the 300 largest publicly-traded firms in the economy.

Because our data present a reasonably accurate picture of compensation in large firms, we can approximate alternate sampling schemes by assigning different weights to the firms in our sample. In Appendix Table A5, we report sampling schemes that are inversely proportional to either the firm's market share or the firm's share of aggregate sales. These weights would be appropriate if a firm's probability of selection was proportional to its market value or to its value of sales, respectively. The table reports median total pay separately for firms ranked in the top 100 and for firms ranked between 100 and 300. For comparison, we also report medians for each of these groups using weights based on the probability of selection into our sample, as described in Section 3.1. All columns in the table use the alternate estimate of option grants based on the Hall-Liebman data. The trends in pay are similar for all weighting schemes.

Appendix Table A5 reveals some interesting differences between the largest publicly-traded firms and the somewhat smaller firms. The differential in pay between these two groups was roughly stable from 1950 to 1979, but has widened noticeably during the past 25 years. This gap was also larger prior to World War II. In fact, median compensation in the smaller group increased from the 1930s to the 1940s while the level of pay in the largest firms fell. Therefore, the decline in the real value of compensation that we document for this period in the main body of this paper was concentrated in the very largest firms in the economy. More generally, differentials in pay by firm size have followed the well-documented U-shaped pattern in income inequality over the course of the century, contracting during World War II and widening in recent decades.

4. Correcting pay-to-performance estimates for growth in firm size

We use a regression-based method to correct our pay-to-performance estimates for changes in the size of firms. The basic idea of this strategy is to estimate pay-to-performance for a firm of a given size in two adjacent time periods, and then to examine the change in pay-to-performance for this firm during this period.

We split our sample into 35 overlapping 4-year windows (1936-1939, 1938-1941, etc.) and estimate the following regression in each period:

$$Pay - to - performance_{ijt} = \alpha + \delta I_t + \sum_s \beta^s f(FirmSize_{jt}) + \varepsilon_{ijt}$$

where pay-to-performance is either the Jensen-Murphy statistic or the value of equity at stake, which is computed for each individual from the *ex-ante* revaluation of their stock and option holdings. $f(FirmSize_{jt})$ is a spline function based on the quintiles of the distribution of firm sizes included in the 4-year estimation period. We measure firm size as the average market value of the firm in the preceding 3 years. I_t is a dummy variable that equals 1 for the second half of the 4-year estimation period. The 2-year growth rate in pay-to-performance can then be computed as:

$$\% \Delta \text{pay-to-performance} = 100 * \left(\frac{\alpha + \delta + \beta^S}{\alpha + \beta^S} - 1 \right)$$

where β^S is the coefficient on the indicator variable that includes a firm in the S^{th} quintile of firm size. We estimate 2-year growth rates (based on 4-year sample periods) instead of 1-year growth rates (which would be based on 2-year sample periods) in order to increase the sample size of each regression. Results are similar—but noisier—when estimating 1-year changes.

This method generates a predicted 2-year change in pay-to-performance for each executive in our sample based on the size of his firm. We use these predicted 2-year changes to examine the relationship between changes in pay-to-performance and changes in salaries in Section 7. To obtain the long-run trend in pay-to-performance shown in Figure 6, we create an index equal to median pay-to-performance in 1936-1937. The growth rate in this index is equal to the predicted change in pay-to-performance at median firm size.

Table A1
Firms Included in the Sample

Company Name	First Year in Sample	Last Year in Sample	Rank in 1940	Rank in 1960	Rank in 1990	Industry
AETNA LIFE & CASUALTY CO	1964	2005	--	--	48	Insurance carriers
ALLIED CHEMICAL CORP	1936	2005	16	65	82	Chemical mfg
AMERICAN CAN CO	1936	2005	34	42	200	Fabricated metal products
AMERICAN EXPRESS CO	1977	2005	--	--	36	Depository institutions
AMERICAN INTERNATIONAL GROUP INC	1970	2005	--	--	59	Holding and other investment offices
AMERICAN MOTORS CORP	1937	1986	302	43	--	Motor vehicles
AMERICAN STORES CO	1936	1998	263	48	39	Food stores
AMERICAN TELEPHONE & TELEG CO	1942	2004	1	3	10	Communications
AMERICAN TOB CO	1936	2005	36	71	146	Tobacco mfg
ANACONDA COPPER MNG CO	1936	1975	31	82	--	Primary metals
ARMCO INC	1937	2005	212	55	534	Primary metals
ARMOUR & CO	1936	1969	228	22	--	Food mfg
ATLANTIC RICHFIELD CO	1936	1999	104	90	52	Petroleum mfg
BELLSOUTH CORP	1984	2005	--	--	66	Holding and other investment offices
BETHLEHEM STEEL CORP	1936	2000	25	15	246	Primary metals
BOEING CO	1936	2005	234	26	32	Motor vehicles
BORDEN CO	1936	1992	84	53	163	Food mfg
C I G N A CORP	1982	2005	--	--	51	Holding and other investment offices
C I T FINANCIAL CORP	1938	1976	62	198	--	Nondepository credit institutions
C P C INTERNATIONAL INC	1936	1999	63	74	215	Food mfg
CHASE MANHATTAN CORP	1972	2005	--	--	67	Depository institutions
CHESAPEAKE & OHIO RAILWAY CO	1938	2005	19	--	149	Transportation
CHRYSLER CORP	1936	1997	21	10	29	Motor vehicles
CITICORP	1971	1997	--	--	20	Depository institutions
CITIES SERVICE CO	1939	1981	--	50	--	Petroleum mfg
COCA COLA CO	1936	2005	10	104	114	Food mfg
COMMONWEALTH EDISON CO	1938	1999	14	110	236	Electric, Gas, Sanitary
CONAGRA INC	1972	2004	--	--	46	Food mfg
CONSOLIDATED EDISON CO NY INC	1938	2005	28	79	217	Electric, Gas, Sanitary
CONTINENTAL CAN INC	1936	1983	68	41	--	Fabricated metal products
DAYTON HUDSON CORP	1970	2005	--	--	64	General merchandise stores
DETROIT EDISON CO	1938	2005	52	181	331	Electric, Gas, Sanitary
DIGITAL EQUIPMENT CORP	1971	1997	--	--	75	Industrial machinery
DOW CHEMICAL CO	1936	2005	45	60	45	Chemical mfg
DU PONT E I DE NEMOURS & CO	1937	2005	3	16	18	Chemical mfg
EASTMAN KODAK CO	1936	2005	18	54	49	Instruments
ENRON CORP	1970	2000	--	--	71	Electric, Gas, Sanitary
FIRESTONE TIRE & RUBBER CO	1936	1987	162	35	--	Rubber
FORD MOTOR CO DEL	1955	2005	--	5	4	Motor vehicles
GENERAL DYNAMICS CORP	1951	2005	--	18	117	Motor vehicles
GENERAL ELECTRIC CO	1942	2005	4	6	9	Electronic equipment
GENERAL FOODS CORP	1937	1984	39	40	--	Food mfg
GENERAL MOTORS CORP	1936	2005	2	1	2	Motor vehicles

GENERAL TEL & ELECTRS CORP	1941	2005	277	37	50	Communications
GEORGIA PACIFIC CORP	1951	2004	--	220	79	Lumber/wood mfg
GOODYEAR TIRE & RUBR CO	1936	2005	185	27	99	Rubber
GULF OIL CORP	1946	1982	--	12	--	Petroleum mfg
HEWLETT PACKARD CO	1970	2005	--	--	70	Instruments
INLAND STEEL CO	1936	2005	49	69	290	Primary metals
INTERNATIONAL BUSINESS MACHS COR	1936	2005	50	32	5	Industrial machinery
INTERNATIONAL HARVESTER CO	1936	2003	35	23	292	Industrial machinery
INTERNATIONAL PAPER CO	1936	2005	191	47	74	Paper
INTERNATIONAL TEL & TELEG CORP	1936	2005	326	61	42	Electronic equipment
KENNECOTT COPPER CORP	1936	1979	12	106	--	Primary metals
KRESGE S S CO	1936	2005	56	126	25	General merchandise stores
KROGER COMPANY	1970	2005	126	20	44	Food stores
LIGGETT & MYERS TOB CO	1937	1989	37	161	777	Tobacco mfg
LOCKHEED AIRCRAFT CORP	1936	2005	187	33	120	Motor vehicles
MCDONNELL DOUGLAS CORP	1936	1996	168	39	58	Motor vehicles
MINNESOTA MINING & MFG CO	1950	2005	--	94	73	Paper
MONTGOMERY WARD & CO	1936	1975	40	--	--	General merchandise stores
NATIONAL DAIRY PRODS CORP	1936	1987	86	24	--	Food mfg
NORFOLK & WESTERN RAILWAY CO	1938	2005	23	--	412	Transportation
OCCIDENTAL PETROLEUM CORP	1970	2005	--	--	40	Oil and gas extraction
OWENS ILLINOIS GLASS CO	1936	1985	60	88	--	Stone, clay, glass, concrete
PACIFIC GAS & ELEC CO	1938	2005	44	80	126	Electric, gas, sanitary
PACIFIC TELEPHONE & TELEG CO	1938	1980	33	--	--	Communications
PENNEY J C CO INC	1936	2005	30	30	55	Apparel and accessory stores
PENNSYLVANIA RAILROAD CO	1939	2004	22	--	473	Transportation
PEPSICO INC	1936	2005	198	274	53	Food stores
PHELPS DODGE CORP	1937	2005	42	177	400	Primary metals
PHILIP MORRIS INC	1936	2005	97	153	17	Tobacco mfg
PHILLIPS PETROLEUM CO	1936	2005	41	36	68	Petroleum mfg
PROCTER & GAMBLE CO	1936	2004	15	31	37	Chemical mfg
RADIO CORP AMER	1936	1984	102	29	--	Electronic equipment
REPUBLIC STEEL CORP	1936	1986	59	44	202	Primary metals
REYNOLDS R J TOBACCO CO	1936	1999	24	62	64*	Tobacco mfg
ROCKWELL INTERNATIONAL CORP	1940	2005	155	52	81	Motor vehicles
SAFWAY STORES INC	1937	2005	196	13	62	Food stores
SALOMON INC	1970	1996	--	308	21	Primary metals
SEARS ROEBUCK & CO	1970	2004	9	7	11	General merchandise stores
SHELL OIL CO	1936	1984	47	21	--	Petroleum mfg
SINCLAIR OIL CORP	1936	1967	89	34	--	Petroleum mfg
SOCONY VACUUM OIL INC	1936	1998	27	9	8	Petroleum mfg
SPERRY RAND CORP	1941	2005	492	38	119	Industrial machinery
STANDARD OIL CO CALIFORNIA	1936	2005	29	25	19	Petroleum mfg
STANDARD OIL CO IND	1937	1997	13	17	30	Petroleum mfg
STANDARD OIL CO N J	1936	2005	5	2	3	Petroleum mfg
SWIFT & CO	1937	1984	57	14	--	Food mfg
TENNECO INC	1955	2005	--	91	65	Electric, gas, sanitary

TEXACO INC	1970	2000	8	11	17	Petroleum mfg
UNION CARBIDE CORP	1938	1999	6	28	64	Chemical mfg
UNITED AIRCRAFT CORP	1936	2005	79	49	41	Motor vehicles
UNITED FRUIT CO	1938	2005	38	166	270	Food mfg
UNITED STATES RUBBER CO	1936	1985	152	51	--	Rubber
UNITED STATES STEEL CORP	1941	2005	7	8	47	Primary metals
WAL MART STORES INC	1973	2005	--	--	24	General merchandise stores
WARNER LAMBERT CO	1936	2005	48	237	254	Chemical mfg
WESTINGHOUSE ELECTRIC CORP	1936	1999	26	19	76	Electronic equipment
WOOLWORTH F W CO	1938	2005	20	45	124	General merchandise stores
WRIGLEY WILLIAM JR CO	1936	2005	46	360	712	Food mfg

Note. Rank in 1940 is defined according to market value (based on all firms appearing in the CRSP database) and ranks in 1960 and 1990 are defined according to total sales (based on all firms appearing in the Compustat database). Company names refer to the name most frequently used throughout the entire time period. * indicates rank in 1991 instead of 1990 because the company was not in Compustat in 1990. Industry definitions are the modal 2-digit SIC code reported in CRSP.

Table A2
Distribution of Sampled Firms by Industry

Industry	Percent of Firms
Mining	0.9
Manufacturing	
Food and kindred products	10.5
Tobacco	4.0
Lumber/wood products	0.8
Paper and allied products	2.2
Chemicals and allied products	7.0
Petroleum and coal products	10.8
Rubber and misc. plastics products	3.1
Stone, clay, glass, concrete products	0.8
Primary metal industries	8.6
Fabricated metal products	2.0
Industrial machinery and equipment	4.3
Electronic equipment	4.8
Transportation equipment	
Motor vehicles and equipment	5.0
Aircraft and parts	5.4
Ship and boat building	1.0
Instruments and related products	1.7
Transportation	2.7
Communications	2.3
Utilities	6.0
Wholesale trade	0.6
Retail trade	
General merchandise stores	5.8
Food stores	2.6
Other retail	1.0
Finance, insurance and real estate	6.2

Note. Industry definitions are the modal 2-digit SIC code from CRSP.

Table A3
Distribution of Firms by Size

	1936- 1939	1940- 1949	1950- 1959	1960- 1969	1970- 1979	1980- 1989	1990- 1999	2000- 2005
Fraction of Firms Ranked by Market Value								
Rank<=50	.51	.54	.43	.41	.33	.34	.31	.30
50<Rank<=100	.22	.22	.27	.19	.17	.20	.14	.13
100<Rank<=200	.16	.13	.17	.23	.21	.20	.25	.13
200<Rank<=500	.09	.11	.12	.16	.21	.17	.20	.27
500<Rank	.01	.00	.01	.01	.08	.08	.09	.17
Fraction of Firms Ranked by Total Sales								
Rank<=50	--	--	.62	.53	.40	.39	.33	.26
50<Rank<=100	--	--	.23	.25	.26	.27	.24	.16
100<Rank<=200	--	--	.11	.14	.21	.19	.18	.24
200<Rank<=500	--	--	.04	.07	.11	.12	.21	.21
500<Rank	--	--	0	.00	.03	.02	.04	.13
Average Market Share of Entire Sample in S&P 500								
	.39	.51	.49	.42	.37	.30	.24	.23

Note. Rankings by market value are based on all firms appearing in CRSP, which includes all publicly-traded firms in the NYSE, AMEX and NASDAQ stock markets. Rankings by sales are based on all firms appearing in Compustat, which does not have data prior to 1950.

Table A4
Stock Option Grants to CEOs by Firm Size
(Median Value of Option Grants / Total Compensation)

	1980-1984		1985-1989		1990-1994	
	Our Sample	Hall- Liebman	Our Sample	Hall- Liebman	Our Sample	Hall- Liebman
Entire sample	.120	0	.220	.086	.238	.194
Same firms in both samples	.118	.101	.215	.204	.214	.266
By firm size:						
Rank<=100	.139	.164	.230	.223	.282	.338
100<Rank<=200	.162	.101	.163	.213	.142	.201
200<Rank<=300	.125	0	.140	.076	.192	.283
300<Rank<=500	.074	0	.292	.051	.226	.196
500<Rank	.046	0	.228	.012	.238	.112

Note: Our sample is based on the CEOs of the largest 50 firms in 1940, 1960, and 1990. The Hall and Liebman sample is based on CEOs in a random sample of 478 firms from Forbes's top 500 rankings (see Hall and Liebman 1998 for details). There are 45 firms that appear in both samples. Rankings by size are determined by market value based on all firms appearing in the CRSP database, which includes all publicly-traded firms in the NYSE, AMEX and NASDAQ stock markets. Total compensation is the sum of salaries, bonuses, long-term bonus payments, and the Black-Scholes value of stock option grants. Annual stock option grants in our sample are imputed for cases when only the cumulative number of options granted over a multi-year period is disclosed. See Appendix Section 2.3 for a description of this imputation procedure.

Table A5
Median Total Compensation, Weighted to Reflect Different Groups
(Millions of \$2000)

	Firm Rank <=100			100<Firm Rank<=300		
	Ranked by market value, weighted by Pr(selected)	Ranked by market value, weighted by 1/market share	Ranked by sales, weighted by 1/sales	Ranked by market value, weighted by Pr(selected)	Ranked by market value, weighted by 1/market share	Ranked by sales, weighted by 1/sales
1936-1939	.908	.892	--	.539	.490	--
1940-1949	.758	.734	--	.712	.726	--
1950-1959	.817	.766	.787	.602	.596	.491
1960-1969	.887	.837	.841	.654	.661	.587
1970-1979	1.06	1.00	.958	.775	.776	.680
1980-1989	1.57	1.44	1.36	1.01	1.01	.827
1990-1999	3.29	3.06	2.68	1.91	1.95	1.92
2000-2005	7.33	6.58	5.62	3.65	3.40	3.95

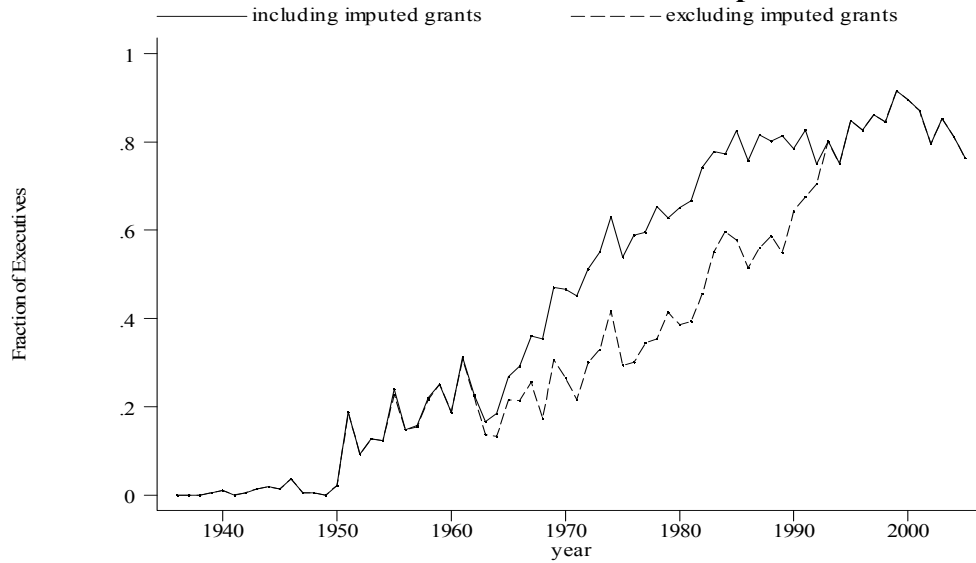
Note. Based on the three-highest paid executives in the 50 largest firms in 1940, 1960, and 1990. Total compensation is the sum of salaries, bonuses, long-term bonus payments, and the Black-Scholes value of stock option grants. The value of option grants is estimated from the relationship between firm size and the share of grants relative to total compensation in the Hall-Liebman data (see Appendix Sections 3.2 and 3.3 for details). The probability of selection is defined as the number of sampled firms in a size category (rank<=50, 50<rank<=100, 100<rank<=200 and 200<rank<=300) relative to the total number of potential firms in that category.

Table A6
Decomposition of the Variance of Ln(Compensation) by Decade

	Fraction of Explained By:		
	Average Firm Size in Year <i>t</i>	Average Firm Size in Decade	Size – Firm Avg. – Year Avg.
1936 - 1939	0.000	0.237	0.007
1940 - 1949	0.000	0.085	0.000
1950 - 1959	0.008	0.196	0.002
1960 - 1969	0.005	0.215	0.016
1970 - 1979	0.011	0.199	0.010
1980 - 1989	0.083	0.114	0.022
1990 - 1999	0.125	0.189	0.011
2000 - 2005	0.004	0.329	0.016

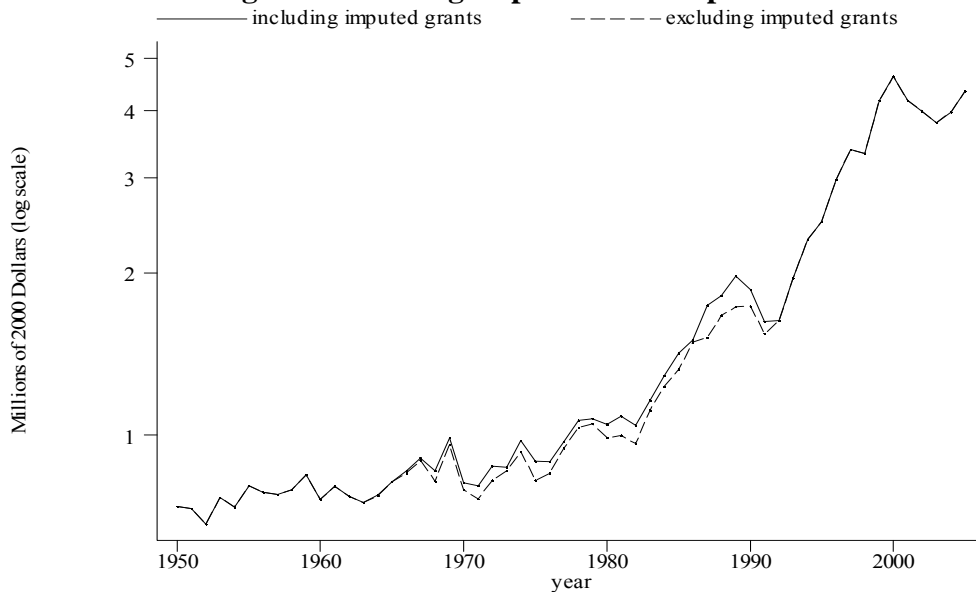
Note. Based on a separate ANOVA regression for each decade. Each cell shows the sum of squared residuals explained by the variable named in the column divided by the total sum of squared residuals. Based on the three-highest paid executives in the 50 largest firms in 1940, 1960, and 1990. Total compensation is the sum of salaries, bonuses, long-term bonus payments, and the Black-Scholes value of stock option grants. Firm size is measured by the firm's market value.

Figure A1
Fraction of Executives Granted Stock Options



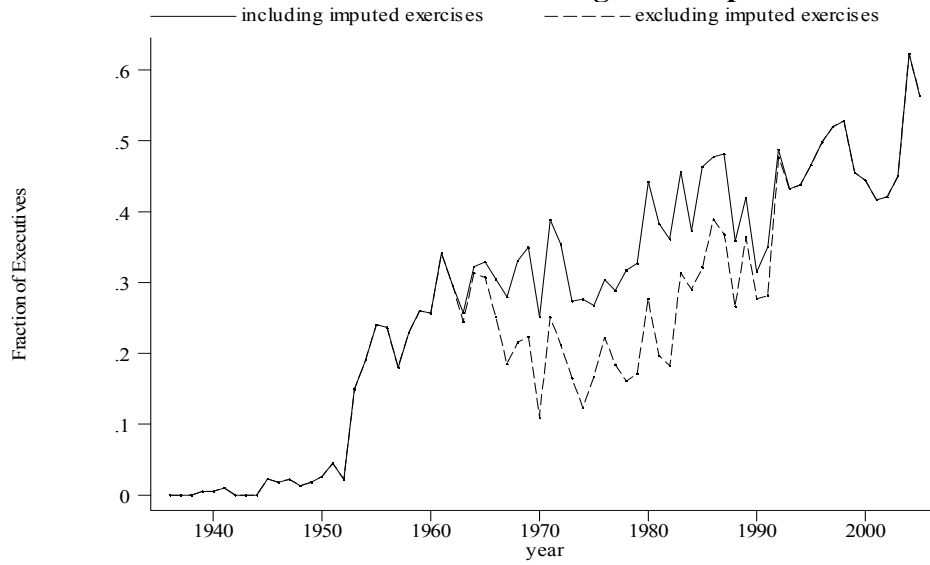
Note: Based on the three highest-paid executives in the largest 50 firms in 1940, 1960, and 1990. Annual stock option grants are imputed for cases when only the cumulative number of options granted in a multi-year period is disclosed in proxy statements. See Appendix Section 2.3 for details of this imputation procedure.

Figure A2
Median Value of Total Compensation
Including and Excluding Imputed Stock Option Grants



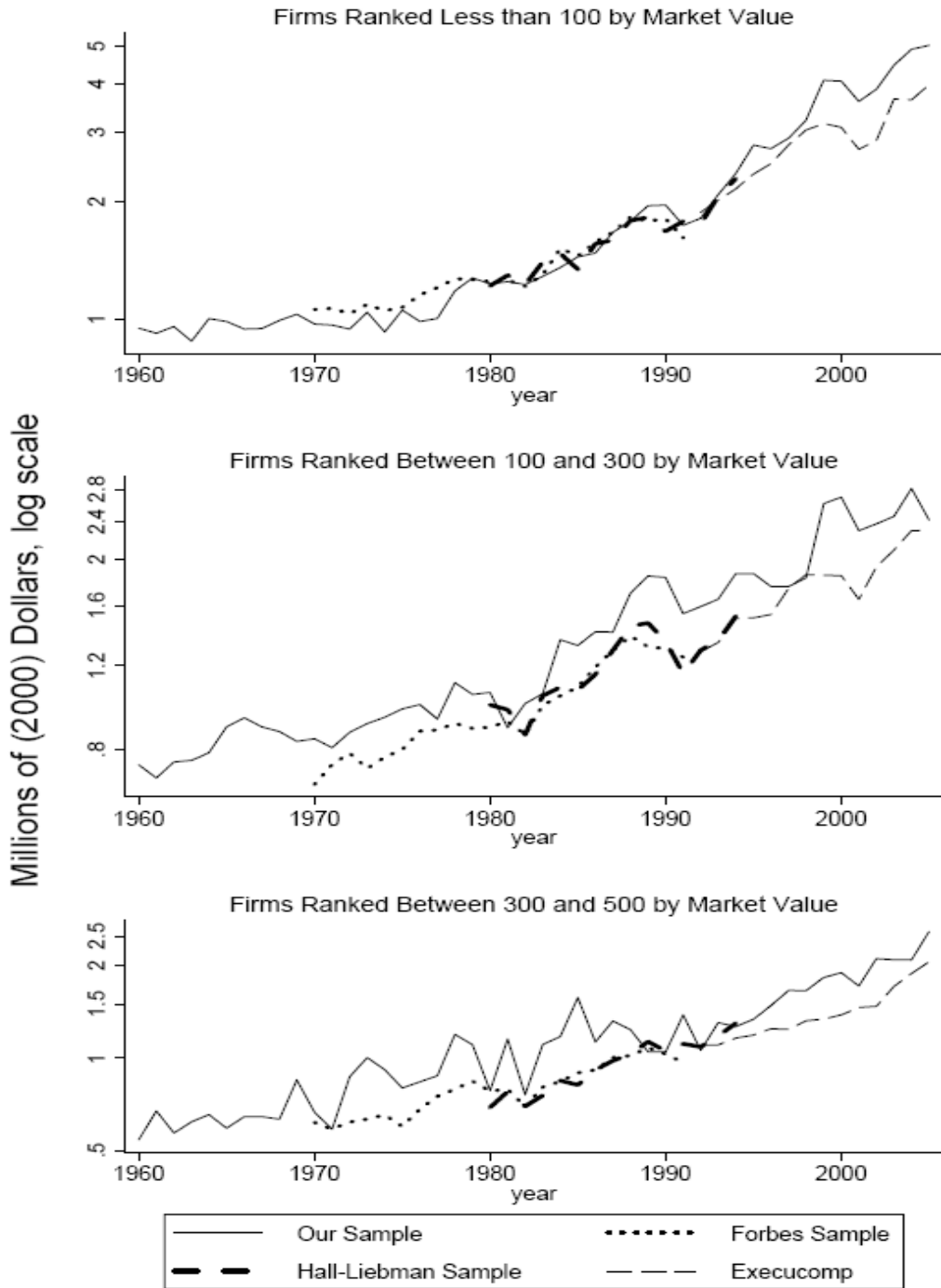
Note: Based on the three highest-paid executives in the largest 50 firms in 1940, 1960, and 1990. Total compensation is composed of salary, bonuses, long-term bonus payments, and stock option grants. Annual stock option grants are imputed for cases when only the cumulative number of options granted in a multi-year period is disclosed in proxy statements. See Appendix Section 2.3 for details of this imputation procedure.

Figure A3
Fraction of Executives Exercising Stock Options



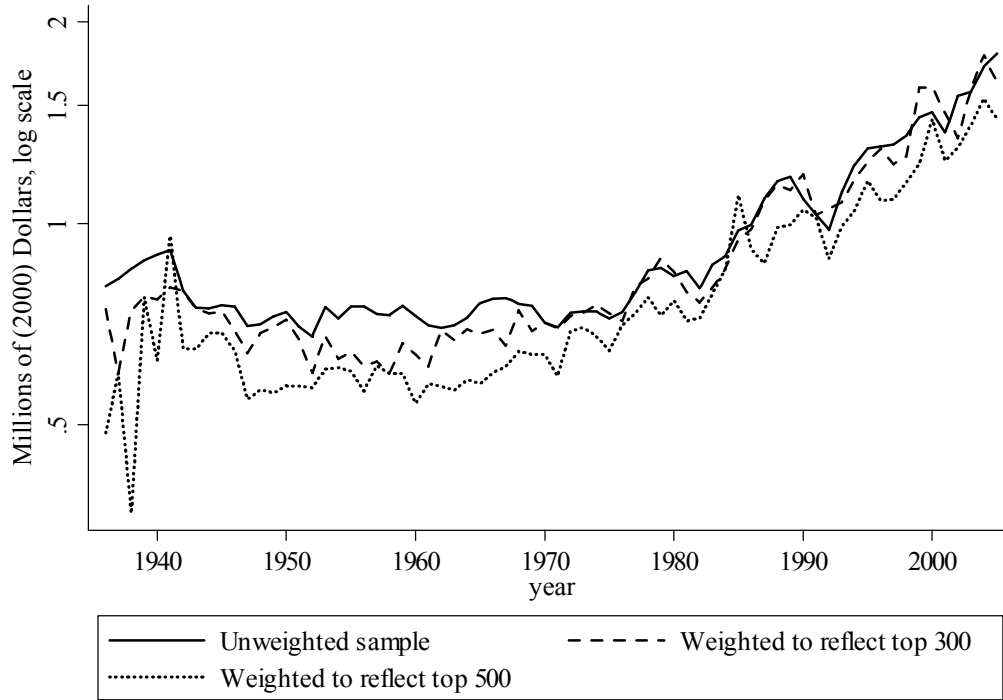
Note: Based on the three highest-paid executives in the largest 50 firms in 1940, 1960, and 1990. Total compensation is composed of salary, bonuses, long-term bonus payments, and stock option grants. Annual stock option exercises are imputed for cases when only the cumulative number of options exercised in a multi-year period is disclosed. See Appendix Section 2.3 for details of this imputation procedure.

Figure A4
Median Value of Salary & Bonus of CEOs



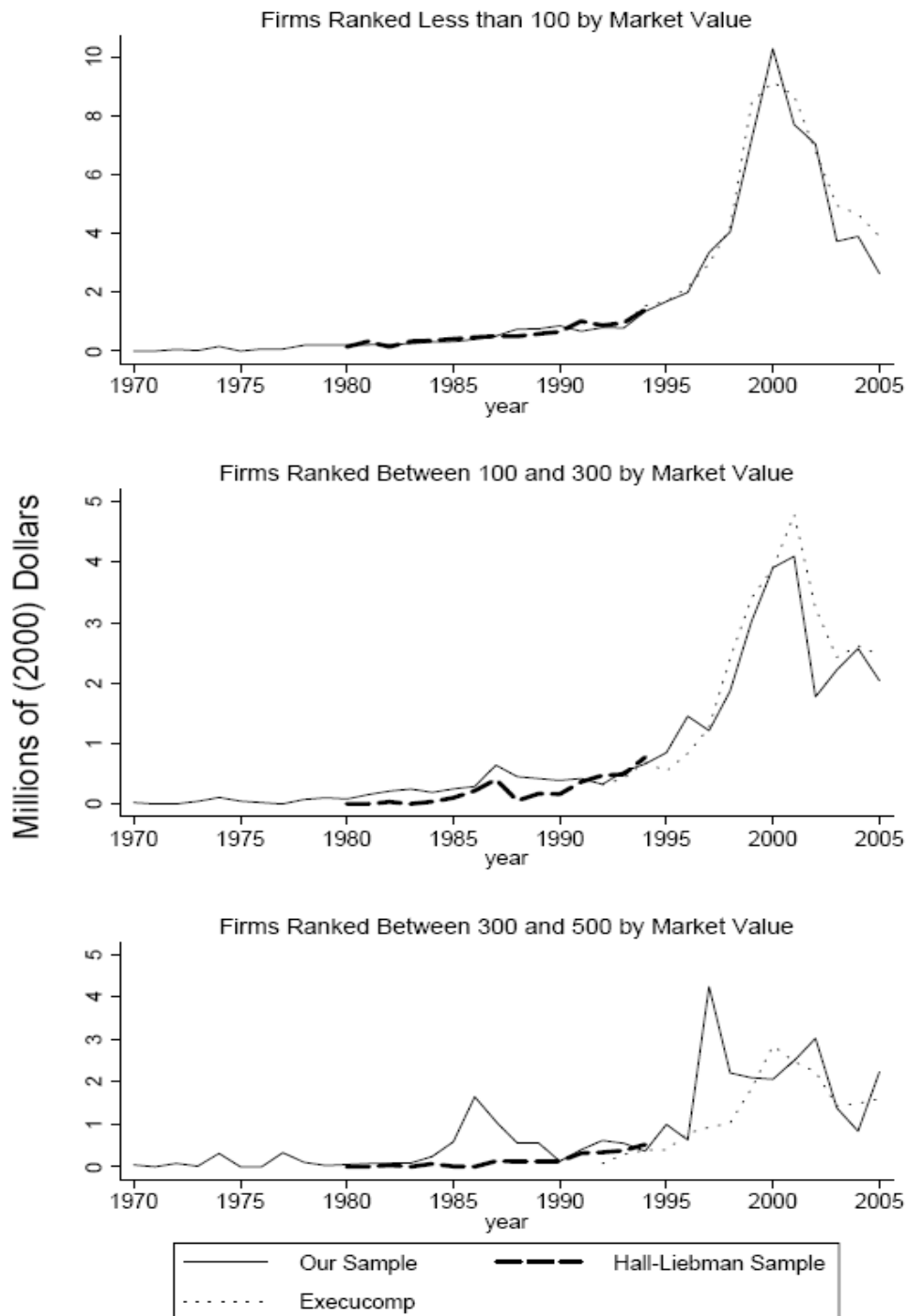
Note: Our sample is based on the CEOs of the largest 50 firms in 1940, 1960, and 1990. The Hall and Liebman sample is based on the CEOs of a random sample of 478 firms from Forbes's top 500 rankings from 1980 to 1994 (see Hall and Liebman 1998 for details). The Forbes sample is based on the CEOs of the 500 largest corporations listed in the Forbes compensation surveys from 1970 to 1992. ExecuComp is based on the CEOs of the 500 largest publicly-traded corporations. Rankings by size are determined by market value based on all firms appearing in the CRSP database, which includes all publicly-traded firms in the NYSE, AMEX and NASDAQ stock markets. The measure of compensation is the sum of salaries and current bonuses (granted in cash and in stock).

Figure A5
Median Salary & Bonus Reweighted by Firm Size



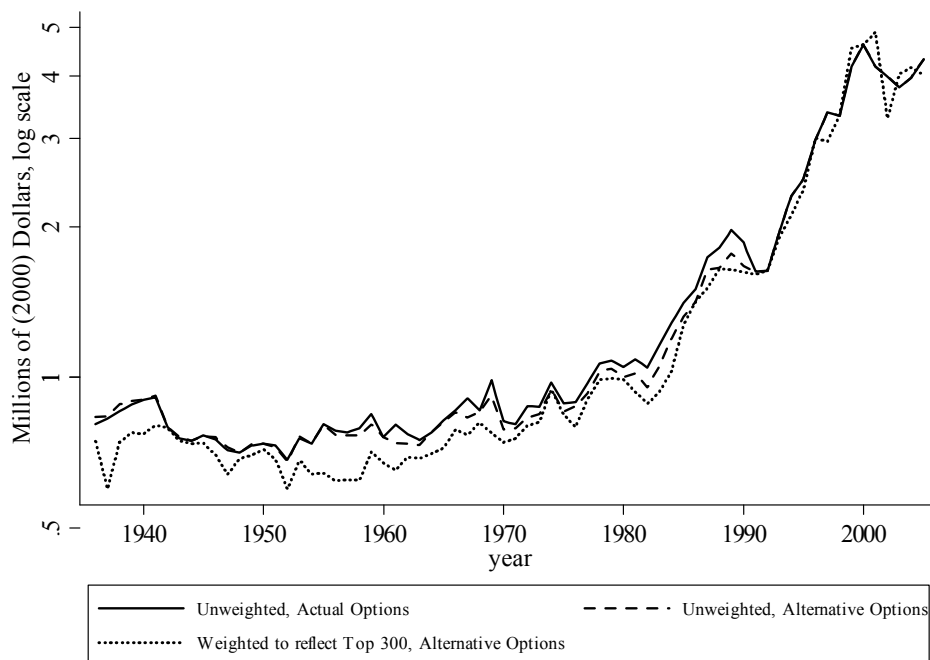
Note: Salary and bonus is defined as the amount received in salary + current bonuses in stock or cash. Based on the three highest-paid executives in the largest 50 firms in 1940, 1960, and 1990. Firms receive a weight inversely proportional to their probability of being in our sample, where this probability is defined as the number of sampled firms in each firm's size category ($\text{rank} \leq 50$, $50 < \text{rank} \leq 100$, $100 < \text{rank} \leq 200$ and $200 < \text{rank} \leq 500$) divided by the total number of firms in each category. Ranks are defined by market value based on all firms in CRSP. See Appendix Section 3.1 for details.

Figure A6
Median Value of Stock Option Grants to CEOs



Note: Based on the three highest-paid executives in the largest 50 firms in 1940, 1960, and 1990. Option grants are valued using the Black-Scholes formula. See the notes to Figure A4 for the source of each sample.

Figure A7
Median Total Compensation



Note: Based on the three highest-paid executives in the largest 50 firms in 1940, 1960, and 1990. Total compensation is composed of salary, bonuses, long-term bonus payments, and stock option grants. The alternative option scenario weights the fraction of options in total compensation using the relationship between firm size and the share of grants relative to total compensation in the Hall-Liebman data (see Appendix Sections 3.2 and 3.3 for details). For the weighted level of compensation, each firm is assigned a weight inversely proportional to its probability of being in our sample, where the weights are scaled to be representative to the 300 largest publicly-traded firms in the economy.