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The Effect of Employee Stock Options on the Evolution of Compensation in the 1990s

- As the labor market tightened in 1999, the growth rate of compensation per hour (CPH) unexpectedly slowed.
- The decline in CPH may be attributed to the rapid increase in new employee stock option grants relative to the realization of options awarded before 1999.
- Employee stock options are captured in the CPH measure on the exercise date, not on the date granted, and the options' value can change considerably over the several years that can elapse between these dates.
- A recalculation of CPH that reflects the value of options on the grant date suggests no downturn in compensation growth in 1999.

From an economic standpoint, the 1990s were a remarkable period. On the one hand, the decade produced the longest-running U.S. expansion. On the other hand, a by-product of this continued economic growth was a sharp tightening of the U.S. labor market. This growing scarcity of available workers raised the concern that accelerating wage demands would develop, possibly leading to renewed inflation.

The 1990s were also noteworthy for the emergence of two "wage puzzles." The first puzzle is associated with the 1992-95 period, when nominal compensation per hour (CPH) growth declined *and* the unemployment rate fell rapidly (Chart 1).[1] One explanation for this occurrence is that "worker insecurity" early in the expansion accounted for the tepid pay demands during this period.[2] From 1995 to 1998, the puzzle ceased to exist, as compensation growth accelerated and the unemployment rate fell below the 4 percent barrier. However, the second wage puzzle appeared in 1999, when compensation growth fell back below the 5 percent level despite continued labor market tightness during the year.

In this article, we examine the wage-puzzle phenomenon of the 1990s. Specifically, we explore whether changes in pay structure can account for the behavior of CPH during the decade. Labor markets have changed considerably over the past twenty years: workers today receive a higher portion of total

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compensation in such nontraditional forms as profit sharing and stock options.[3] CPH captures profit-sharing payments and stock option realizations. However, employee stock options are reflected in total compensation on the date they are exercised—not on the date granted—and several years can elapse between these dates. Accordingly, the growing use of these stock options could be affecting the time that tight labor markets are reflected in CPH growth.

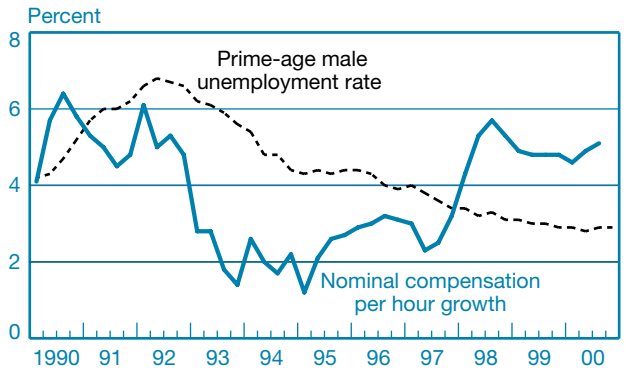
By analyzing the existing data, we determine how CPH growth is affected by the use of employee stock options. However, given the limitations of these data, we focus primarily on the second wage puzzle, that of the late 1990s. We find evidence that employee stock options may have had an appreciable impact on CPH during this period. In particular, when we recalculate compensation to reflect current stock option grants—rather than current realizations—we conclude that there was likely no downturn in CPH growth in 1999.[4]

The article is organized as follows. We begin by describing the essential institutional details of employee stock options necessary for our empirical work. We then discuss empirical models of stock option grant and realization decisions. Next, we use these estimates to assess the effect of stock options on compensation per hour. We conclude by addressing some general labor market implications of stock options.

Employee Stock Options

Employee stock options are the right to purchase a given number of shares of company stock at the "strike" price between the vesting date and the expiration date of the options.[5] The vesting period is the interval between when a company grants the option and when the employee can first exercise the option. If the current market price for a vested option exceeds the strike price, the option is "in-the-money." If in-the-money options are exercised (that is, if the employee decides to purchase the underlying shares), the gain to the employee is the difference between the current market price and the strike price multiplied by the number of shares exercised.[6] If the current market price for a vested option is below the strike price, the option is "out-of-the-money." Although out-of-the-money options have no current value if exercised, they still have positive "option value," which reflects the possibility that the future market price of the stock may rise above the strike price prior to the options' expiration date.

Chart 1
Labor Market Tightness and Nominal Compensation per Hour Growth



Source: U.S. Department of Labor, Bureau of Labor Statistics.

Employee stock options can be structured either as incentive stock options or as nonqualified stock options. Incentive stock options must satisfy certain restrictions defined by the Internal Revenue Service that do not apply to nonqualified options.[7] The primary advantages to employees exercising incentive stock options are that the income derived is taxed as a capital gain, rather than as ordinary income, and the tax is levied when the underlying shares are sold, rather than when the option shares are exercised. Offsetting these tax gains to employees, however, is the loss of a tax deduction to the firm. In contrast to incentive stock options, the income gain from nonqualified stock options is treated for tax purposes as ordinary income to the employee as of the exercise date, and the company can deduct this cost as a labor expense. Employers are required to file quarterly reports (ES202s) that list all taxable sources of income paid to their workers, including realized nonqualified stock options. The ES202 reports are used as an input into total compensation. However, these reports do not break out the gain from nonqualified stock options from other sources of compensation. Nonqualified options became the dominant type of employee stock option following the reduction in marginal income tax rates in 1986.

In January 1993, the Securities and Exchange Commission (SEC) began requiring public firms to disclose in their proxy statements both the level of stock option grants to, and the option exercise activity of, their top five executives. The SEC also required companies to report their executive compensation for the two previous years in their annual filings with the agency. Beginning in 1991, then, it is possible to collect detailed information on public company stock option programs for top management. Although firms can value these option grants using any pricing methodology, the dominant method used is the Black-Scholes pricing formula.

Employee stock options differ in many important ways from traded stock options. Most notably, they are

nontradeable. An employee can exercise a vested in-the-money option but cannot sell the option to an investor. An implication of this is that both the employee's valuation of the option and the timing of the exercise decision are affected by the employee's risk tolerance. An employee with a significant amount of wealth tied up in company stock options has a strong interest in diversifying the risk from movements in the value of the company stock. With traded stock options, the employee could simply sell some options in the market to another investor, an action that transfers but does not diminish the options' underlying value. With employee stock options, the employee would have to exercise the options in order to diversify his risk.[8] This creates an incentive for the early exercise of the options, which reduces their overall value because the employee forgoes the remaining option value. Huddart and Lang (1996) show that workers tend to exercise employee stock options soon after their vesting dates, and that this early exercise sacrifices roughly half of the value implied by the Black-Scholes pricing methodology (which is designed to price a traded stock option).

An employee with a significant amount of wealth tied up in company stock options has a strong interest in diversifying the risk from movements in the value of the company stock. . . . This creates an incentive for the early exercise of the options, which reduces their overall value.

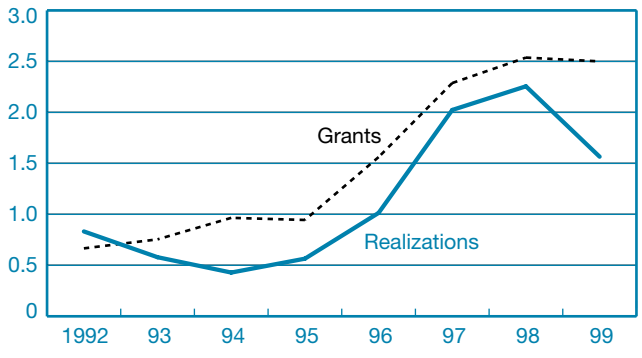
Employee stock options differ from traded stock options in two other key ways. As we observed, employee stock options are subject to vesting requirements and tend to have a significant time period until expiration. A variety of vesting schedules are used in practice, with the majority of plans incorporating vesting over two to five years.[9] In addition, an employee must exercise any vested in-the-money options prior to leaving the firm; any nonvested or out-of-the-money options must be forfeited upon termination of employment. This restriction creates an additional reason for early exercise of these options.[10]

Measuring the Importance of Employee Stock Options

Our primary data source is Standard and Poor's ExecuComp database. ExecuComp includes annual data from proxy statements for the five highest paid executives in three cohorts of firms: the S&P 500, the S&P MidCap 400, and the S&P Small Cap 600.[11] Standard and Poor's makes some adjustments to the firms in the database each year. Our pooled sample, which covers the 1992-99 period, comprises a total of approximately 2,000 companies. We make extensive use of three specific items from the ExecuComp data: the total number of new grants to all employees, the number of grants and their value going to the top five executives, and the value of options exercised by the top five executives. We calculate the total value of all new grants in a year by scaling up the value of the grants to the top five executives by the ratio of the total number of options granted to the number of options granted to the top five executives.[12]

The ExecuComp data are valuable for examining general trends in the use of employee stock options during the 1990s. For example, over the decade, stock options became the dominant component of an executive's compensation package. We illustrate this remarkable change using two measures of the relative importance of executive stock options. The first is the ratio of the grant value of new options in a year divided by the executive's base salary and cash bonus. The second is the ratio of the income gain from stock option realizations in a year divided by the executive's base salary and cash bonus. Chart 2 presents the averages for these two ratios from 1992 to 1999.

Chart 2
Ratios of Stock Option Grants and Realizations to Top Five Executives' Base Salary and Cash Bonus



Source: Standard and Poor's ExecuComp database.

Early in the 1990s, both ratios indicated that stock options typically were smaller than an executive's base salary and cash bonus. By 1996, both ratios equaled or exceeded 1. Two years later, continued rapid growth in the expansion of executive stock option programs had pushed both ratios above 2, with new grants averaging around 250 percent of an executive's base salary and bonus. In 1999, the grant ratio leveled off, while there was a sharp reduction in the realization ratio.[13]

An important related question is whether the use of stock options is also filtering its way down the ranks of company pay structures. The ExecuComp data allow us to track the percentage distribution of total new stock option grants awarded to the top five executives. Although this is a very restrictive view of the diffusion of stock options down the corporate ranks, it has the advantage of providing some sense of recent trends. Chart 3 shows the equally weighted twenty-fifth, fiftieth, and seventy-fifth percentiles of these top five percentages from 1992 to 1999. Despite the dramatic rise in the use of stock options for executives, there has actually been a slight decline in the fraction of new stock option grants directed toward upper management. This indicates that there has also been a commensurate increase over the 1990s in the use of stock options for employees below the top management level.

Given the rapid rise in the use of stock options, it is interesting to speculate on the effect of these options on aggregate compensation growth in the private sector. As noted earlier, aggregate compensation reflects nonqualified stock options when they are realized, rather than when they are granted. Unfortunately, there currently are no collected data that permit the direct measurement of the total size of stock option grants or realizations in the labor market. The alternative is to estimate total stock option grants and nonqualified stock option realizations by year. The growth rate of CPH net of the income from stock option realizations can then be constructed and contrasted with its actual growth rate. In addition, the cash value of new stock option grants can be added into this net-of-realizations CPH measure to arrive at a more accurate measure of current labor market pay conditions. We now turn our attention to implementing this approach.

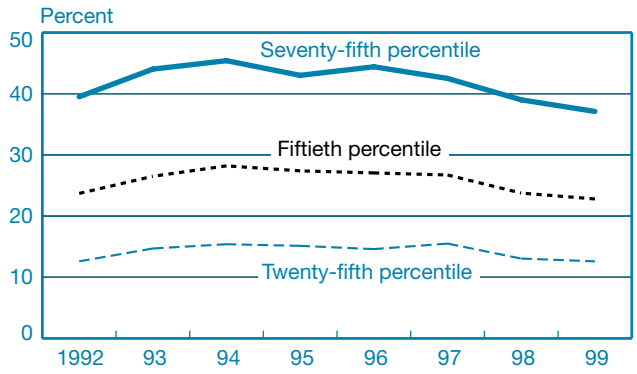
The private, nonfarm sector consists of publicly traded and private firms. Over the past five years, public firms have accounted for between 47 and 50 percent of employment in the private, nonfarm business sector. The ExecuComp data consist entirely of publicly traded firms, and in 1998 the data covered roughly 46 percent of total employment in public firms.[14] Detailed characteristics of publicly traded firms are available from the COMPUSTAT data, and equity returns for these firms are available from the Center for Research in Security Prices (CRSP) data. For private firms, we have no similar data on their characteristics, nor do we have any details of stock option plans from which to draw any inferences. However, a recent Bureau of Labor Statistics study found that the incidence of stock options in privately held firms in 1999 was significantly below that for publicly held firms.[15] Based on this evidence, we focus our analysis exclusively on public firms.

There has actually been a slight decline in the fraction of new stock option grants directed toward upper management. This indicates that there has also been a commensurate increase over the 1990s in the use of stock options for employees below the top management level.

The basic question, then, is how best to use the ExecuComp data to estimate total stock option grants and realizations for publicly held firms. The simplest approach would be to assume for each year that all employees in these firms that are outside the ExecuComp sample are awarded new stock option grants and realize vested stock options at the average rate observed in that year for employees covered in the ExecuComp data. This approach, however, ignores potentially important variations across firms in their use of stock options that relate to firm

Chart 3

Percentage of Stock Option Grants to Top Five Executives



Source: Standard and Poor's ExecuComp database.

characteristics. Taking these variations into account may provide a more accurate estimate of the overall impact of stock options on total compensation.

Determinants of Stock Option Grants

We begin with the problem of estimating stock option grants, since the volume of prior grants is likely to be an important predictor of current realizations. For firms in the ExecuComp sample, we can calculate the Black-Scholes value of the total employee stock option grants made in the year. Although we are interested in understanding the determinants of a firm's decision regarding the total amount of new grants to make in a year, we find it useful to look at the executive compensation literature for guidance on an appropriate empirical specification.

The literature on executive compensation starts with the premise that optimal compensation policies should address agency problems between the firm's managers and its equity and debt holders. The two methods for ameliorating these agency problems are monitoring and incentives.[16] A general prediction is that stock options will be more extensively used when agency costs are high and monitoring is difficult. In addition, the accounting treatment of stock options discussed earlier suggests that firms may also use the options for tax or liquidity reasons.

We include several variables to control for expected agency costs. Monitoring may become difficult when a firm has significant growth opportunities. Information asymmetries may arise from these opportunities, making evaluation of the managers' investment choices more difficult (see, for example, Mehran [1992]; Smith and Watts [1992]; and Bizjak et al. [1993]). Stronger incentives therefore are needed to compensate for the monitoring difficulties. These additional incentives can be provided by increasing the share of stock options in total compensation. We measure a firm's growth opportunities using its market-to-book value. The prediction is that stock option grants will be positively related to this value.

It is also difficult to monitor managers in an environment in which a significant amount of noise is associated with the firm's performance (Lambert and Larcker 1987). In such an environment, a higher pay-performance sensitivity is warranted. Yermack (1995) proxies this sensitivity using the ratio of the relative variability of accounting returns versus stock returns. We focus just on the variability of stock returns over the prior year. The prediction is that higher stock return variability will lead to increased use of stock options. However, higher stock return variability also increases the manager's risk exposure, which should lead to a higher risk premium to compensate the manager for this added risk.[17] This risk premium increases the relative price to the firm of using stock options versus cash compensation, which may induce the firm to substitute away from stock options in its pay structure. The overall effect of stock return variability on the use of stock options therefore is ambiguous.

Capital structure may also exert an important influence on a firm's compensation system. Stock options, by increasing managers' pay-performance sensitivity, may encourage managers to pursue riskier investment strategies that tend to favor equity holders over debt holders. If this shift in investment strategies is anticipated by bondholders, the increased reliance on stock options will give rise to a debt premium that differentially impacts highly leveraged firms (John and John 1993). To reduce this agency cost of debt, highly leveraged firms may choose to scale back their use of stock options. This should lead to an inverse relationship between a firm's leverage and its reliance on stock options.[18]

To help control for any firm life-cycle effects on the use of stock options, we control for a firm's age, which we measure as the number of years over which the firm's stock has been traded. If young firms tend to be more cash-flow constrained, then we would expect them to rely more heavily on stock options. When a firm issues new stock options, it typically incurs no current expense, rather, the expense is shifted to the future, when the stock options are realized. Workers, however, value these new stock options, and are willing to accept lower current cash compensation as a consequence. This should lead to a negative relationship between firm age and the granting of stock options. We also directly proxy for cash-flow constraints using an indicator variable for whether the firm has a net operating loss in the current year.

The use of stock options varies with firm performance and firm size. Firms with a high return on assets tend to grant fewer new stock options. . . . Stock option grants tend to increase with firm size as measured by employment and total assets.

Our remaining firm-specific variables include measures of recent performance and size. We measure firm performance using return on assets. We use the size of the firm's assets and employment to control for possible scale effects. Finally, we include two-digit industry effects and year effects to control for

any remaining differences across industries and time in the pattern of stock option grants.

Table 1 presents our estimation results for stock option grants (summary statistics are provided in Appendix A). For most of our control variables of interest, we divide the range of the variable into quartiles and create indicator variables for the upper three quartiles. The coefficient on an indicator variable should be interpreted as the difference in the use of stock option grants between a firm with a value of the indicated variable in the specified quartile and a similar firm with a value of the indicated variable in the bottom quartile (holding all values for other variables at their sample means).

TABLE 1
Determinants of Stock Option Grants

Variable	Percentage Change	Variable	Percentage Change
Return on assets		Market-to-book value	
Second quartile	-27.7**	Second quartile	43.4**
	(5.1)		(6.0)
Third quartile	-34.4**	Third quartile	104.8**
	(4.7)		(9.3)
Fourth quartile	-39.1**	Fourth quartile	300.3**
	(4.5)		(20.5)
Log employment		Stock return risk	
Second quartile	5.3	Second quartile	-13.5
	(15.6)		(18.0)
Third quartile	3.3	Third quartile	-31.7**
	(15.5)		(10.2)
Fourth quartile	64.7**	Fourth quartile	-23.3**
	(25.2)		(11.2)
Log assets		Net operating loss	24.2**
			(5.0)
Second quartile	89.1	Firm age (ten years)	-8.4**
	(94.4)		(1.5)
Third quartile	343.1	Number of observations	8,182
	(221.8)		
Fourth quartile	1,453.7*	R^2	0.46
	(779.7)		
Leverage			
Second quartile	-5.7		
	(4.5)		
Third quartile	-16.7**		
	(4.0)		
Fourth quartile	-26.6**		
	(3.8)		

Source: Authors' calculations, based on data from Standard and Poor's ExecuComp database and COMPUSTAT.

Notes: Ordinary least squares estimates of the percentage changes in the Black-Scholes grant value are reported with standard errors in parentheses. Two-digit industry and year effects are included in the specification.

** Statistically significant at the 5 percent level.
* Statistically significant at the 10 percent level.

The use of stock options varies with firm performance and firm size. Firms with a high return on assets tend to grant fewer new stock options. For example, grants for firms performing at or above the median in return on assets tend to be around 35 to 40 percent below the poorest performing firms. Stock option grants tend to increase with firm size as measured by employment and total assets. The employment relationship applies only to the top size quartile, while the asset relationship holds throughout the size range and is quite large in magnitude, but is imprecisely estimated. Core and Guay (1999) find that executive stock and option incentives are positively related to firm size as measured by equity value.

Empirical support exists for the agency cost of debt constraint on employee stock options. Controlling for other factors, we find that highly leveraged firms tend to pay out fewer new stock option grants. Firms in the highest quartile of leverage have new grants that are on average 26 percent below the level of firms in the lowest quartile of leverage. These results are in contrast to Yermack's (1995) empirical findings.

Monitoring problems arising from potential market opportunities and noisy environments also play an important role in determining the flow of new stock option grants. Firms with higher market-to-book value tend to have much more aggressive stock option programs, as evidenced by consistently higher flows of new stock option grants. This effect is especially pronounced for firms in the top market-to-book-value quartile that are predicted to have on average a 300 percent larger flow of stock option grants than firms in the bottom quartile. Higher stock return volatility reduces the magnitude of a firm's stock option grants. These findings are consistent with the existing empirical literature (see Core and Guay [1999, 2000]).

We also find support for the prediction that firms facing cash-flow constraints substitute stock options for cash compensation. The data suggest that firms experiencing a net operating loss in a given year have stock option grants that are 24 percent higher than those of similar firms with operating profits.[19] In addition, younger firms tend to rely more heavily on the use of stock options in their compensation structure: a ten-year increase in firm age is associated with an 8 percent decline in stock option grants.

Determinants of Stock Option Realizations

The ExecuComp data report the stock option realizations for each of the top five executives. What is not reported are the total stock option realizations generated by the other employees. To estimate total realizations, we assume that the time pattern of stock option realizations by the top five executives can be used to proxy for the time pattern of realizations by the remaining employees.[20] Specifically, we calculate a firm's total realizations in the year by scaling up the realizations by the top five executives using the ratio of total grants to top five grants from two years earlier.[21]

The empirical specification for a firm's total stock option realizations is motivated in part by the characteristics of employee stock option plans. In any given year, an employee has the right to realize any vested stock options. As previously noted, there is a strong tendency for employees to exercise options close to their vesting dates. While vesting schedules vary across firms, the typical vesting rules imply that it would be important to control for stock option grants from two to five years prior to the current year. Given the short time span covered by the ExecuComp data, we compromise and include only grants from two years prior to the current year.

Vested stock options are exercised only if they are in-the-money. Since the option strike price typically is set equal to the market price on the grant date, the cumulative stock return during the vesting period will determine whether an option is in-the-money on the date it vests. If a firm makes grants to employees over several years and uses a staggered vesting schedule, the appropriate stock return to examine would be a weighted average of different cumulative returns over the various vesting periods. Since we lack the detailed data necessary to calculate this particular stock return, we use as our proxy the firm's cumulative stock return over the prior two years.

A prominent feature of stock option realization data is that in a given year many firms experience no realizations, even if these firms have continuously made grants over the past several years. In our sample of approximately 5,189 firm/year observations for which we have complete data for all of our control variables, 32 percent involve no realizations by the firm in that year. To account for the high frequency of zero realizations in the data, we use a generalized Tobit specification. (Details on the Tobit model are provided in Appendix B.)

The generalized Tobit results are presented in Table 2. For ease of interpretation, we convert the generalized Tobit coefficients into three marginal effects: the implied impact of a variable on 1) the probability that a firm will experience a positive realization in the year, 2) the percentage change in the expected log realizations conditional on a positive realization, and 3) the percentage change in the unconditional expected log realizations.

Table 2
Determinants of Stock Option Realizations

Variable	Probability of a Positive Realization	Expected Realizations Conditional on a Positive Realization (Percent)	Expected Unconditional Realization (Percent)
Grants, lag two years	2.1**	75.1**	75.3**
	(0.6)	(5.3)	(8.5)
Cumulative two-year stock return			
Second quartile	18.0**	4.0	280.7**
	(2.5)	(4.1)	(89.9)
Third quartile	28.2**	89.9**	1,153.0**
	(2.5)	(22.9)	(328.6)
Fourth quartile	32.9**	205.3**	2,541.0**
	(2.5)	(37.3)	(750.3)
Log employment			
Second quartile	20.3**	-38.5	274.4
	(9.1)	(27.7)	(310.1)
Third quartile	23.2**	-25.5	432.7
	(8.9)	(32.9)	(432.5)
Fourth quartile	27.5**	-14.9	715.4
	(8.9)	(37.6)	(666.2)
Leverage			
Second quartile	-0.3	7.4	2.9
	(2.5)	(11.3)	(23.5)
Third quartile	2.3	12.9	31.1
	(2.5)	(11.8)	(29.1)
Fourth quartile	-2.0	2.2	12.7
	(2.7)	(11.9)	(21.4)
Market-to-book value			
Second quartile	11.9**	59.0**	221.5**
	(2.1)	(14.5)	(63.4)
Third quartile	21.7**	118.1**	772.8**
	(2.2)	(21.4)	(204.6)
Fourth quartile	26.5**	223.1**	1,653.2**
	(2.3)	(34.8)	(467.8)
Stock return risk			
Third quartile	5.9**	11.4	77.4**
	(2.1)	(10.4)	(39.3)
Number of observations	5,189[a]	3,508	5,189[a]

Source: Authors' calculations, based on data from Standard and Poor's ExecuComp database and COMPUSTAT.

Notes: Generalized Tobit marginal effects are reported with standard errors in parentheses. Two-digit industry and year effects are included in the specification.

[a]The sample size is smaller than it is in Table 1 because of the inclusion of the lag-grants variable.

** Statistically significant at the 5 percent level.

The level of prior grants and the two-year cumulative stock return both have positive and significant effects on current realizations. Higher prior grants of stock options raise both the probability that a firm has positive realizations in the current year (Table 2, column 1) and the expected magnitude of these realizations conditional on the realizations being positive (Table 2, column 2). Holding constant the level of prior grants, we see that current realizations are sharply increasing in the firm's two-year cumulative stock return. Like prior grants, higher stock returns increase both the incidence and magnitude of current realizations. These findings are consistent with the results of previous case studies (Huddart and Lang 1996).

Although larger firms are more likely to experience positive stock option realizations in a year, firm size as measured by employment has no significant impact on the conditional magnitude of the realizations. Similarly, holding constant our other control variables, we observe that the degree of firm leverage has no significant impact on realizations. Stock option realizations show a strong positive relationship with a firm's market-to-book value, reflecting a positive effect of the value on the incidence and magnitude of realizations. Furthermore, higher stock risk raises the likelihood that a firm will experience positive realizations, but it has no further impact on the magnitude.

The Effect of Stock Options on Compensation per Hour

We now assess the overall impact of stock options on aggregate compensation per hour, using our earlier estimates to predict grants and realizations for all COMPUSTAT firms. We use actual firm data on grants and realizations where reported in the ExecuComp sample. For COMPUSTAT firms not in the ExecuComp sample for which we have a complete set of control variables (where we use predicted instead of actual lag stock option grants), we predict stock option realizations using the estimated model in Table 2. For the remaining COMPUSTAT firms for which we have missing data for one or more control variables, we impute their stock option realizations.[22] We aggregate these actual and estimated grants and realizations across all publicly traded firms, and then multiply by the assumed percentage of employee stock options that represent nonqualified stock options.[23] This calculation provides our estimate of the total income generated from nonqualified stock options in that year.

Table 3 shows total compensation for the private, nonfarm business sector, our estimates of total nonqualified stock option grants and realizations, and the growth rates of all three for 1995 through 1999. The findings are presented both on an aggregate and a per-worker basis. The data indicate that in the mid-1990s, stock option grants and realizations amounted to less than 1 percent of total compensation. However, the growth rates of both have significantly exceeded the growth rate of compensation. For example, stock option grants and realizations in 1998 grew by 56 percent and 53 percent, respectively, whereas total compensation grew by 8 percent. Over the five years from 1995 to 1999, stock option realizations per worker more than doubled, from $395 to $1,068.[24]

The rapid rate of increase in the magnitude of employee stock options raises the possibility that they had a significant impact on CPH growth in recent years. This growth can be expressed as a weighted average of the growth in stock option realizations per hour and the growth in other compensation per hour. The weight on the growth in stock option realizations per hour is the share of realizations in that year to total compensation. Despite the small weight given to stock option realizations per hour, their fast growth rate, as seen in Table 3, may imply a significant contribution to compensation growth.

Stock options may be changing the traditional relationship between unemployment rates and pay measures.

Our estimates of the effect of stock options on CPH growth are provided in Table 4. For reference, we also include the annual growth in CPH (column 2). We start by recomputing the growth rate in each year and removing from total compensation an estimate of overall nonqualified stock option realizations in public companies. We do this using two different approaches. First, we perform a simple extrapolation from the ExecuComp sample, which requires no estimation (column 3). For each year, we calculate the average stock option realizations per employee based on all firms in the ExecuComp sample. We then gross this figure up to cover all public firms by assuming that all workers in public firms not in the ExecuComp sample realized this average value of stock options. Our second (and preferred) approach is to use our estimates from Table 2 to predict stock option realizations for COMPUSTAT firms not in the ExecuComp sample (column 4). In both cases, we subtract the implied income derived from

Table 3

Trends in Compensation, Stock Option Grants, and Stock Option Realizations

Year	Compensation (Billions of Dollars)[a]	Stock Option Realizations (Billions of Dollars)[b]	Realizations as a Percentage of Compensation	Stock Option Grants (Billions of Dollars)[c]	Grants as a Percentage of Compensation
			Panel A: Aggregate		
1995	3,488.1	38.6	1.1	26.5	0.8
	(4.6)	(84.2)		(7.3)	
1996	3,656.9	49.8	1.4	39.6	1.1
	(4.8)	(28.8)		(49.6)	
1997	3,911.1	71.6	1.8	55.6	1.4
	(7.0)	(43.8)		(40.3)	
1998	4,214.7	109.3	2.6	86.7	2.1
	(7.8)	(52.7)		(55.9)	
1999	4,489.1	116.0	2.6	110.5	2.5
	(6.5)	(6.1)		(27.5)	
			Panel B: Per Worker[d]		
1995	35,631	395	1.1	271	0.8
	(1.5)	(78.8)		(4.2)	
1996	36,498	497	1.4	395	1.1
	(2.4)	(25.9)		(46.2)	
1997	37,925	694	1.8	539	1.4
	(3.9)	(39.7)		(36.3)	
1998	39,749	1,032	2.6	817	2.1
	(4.8)	(48.6)		(51.7)	
1999	41,333	1,068	2.6	1,018	2.5
	(4.0)	(3.6)		(24.5)	

Source: Authors' calculations, based on data from Standard and Poor's ExecuComp database and COMPUSTAT.

Notes: Stock option realizations and grants are estimates based on ExecuComp and COMPUSTAT data.
Percentage changes from the prior year are in parentheses.

[a] Private, nonfarm business sector.
[b] Public companies only—scaled by 82 percent to reflect nonqualified stock options (estimated).
[c] Public companies only—scaled by 50 percent to reflect effective cash value (estimated).
[d] We use the same sample and scaling as we do in the aggregate panel.

nonqualified stock option realizations from total compensation in that year, and we divide by total hours to recompute CPH net of the effect of stock option realizations.[25]

Our calculations reveal that the actual growth in nominal CPH accelerated from around 2 percent in 1995 to 5 percent in 1998, consistent with the labor market tightening that occurred during this period. Notice, however, that if we had removed the contribution of stock option realizations from public companies using our second approach, CPH growth in 1998 would have been 4.3 percent. Thus, stock option realizations appear to have contributed around 0.7 percentage point to CPH growth in 1998. This finding illustrates the sizable impact that a fast-growing segment of compensation can have on overall CPH growth rates, even when that segment still accounts for a small fraction of overall compensation.

Having removed the influence of current stock option realizations from CPH, we now recalculate CPH growth by including the estimated cash value of new employee stock option grants (column 5). This last adjustment yields a CPH measure that should reflect current labor market conditions more accurately. To recalculate CPH, we add the cash value of new employee stock option grants to total compensation less stock option realizations in that year and divide by total hours.

It is now reasonable to ask whether the peculiar way in which stock options enter CPH offers an explanation for the second pay puzzle of the 1990s. To answer this question, we

Table 4

Effect of Employee Stock Options on Compensation per Hour Growth

Year	Actual Growth	Public Companies: Growth less Realizations[a]	Public Companies: Growth less Realizations[b]	Public Companies: Growth less Realizations plus Grants[b]
1995	2.09	1.41	1.61	1.63
			(0.07)	(0.07)
1996	3.07	2.78	2.82	3.14
			(0.07)	(0.07)
1997	3.52	3.12	3.05	3.39
			(0.09)	(0.09)
1998	5.08	3.79	4.30	4.95
			(0.09)	(0.09)
1999	4.64	3.31	4.65	5.05
			(0.09)	(0.08)

Source: Authors' calculations, based on data from Standard and Poor's ExecuComp database and COMPUSTAT.

Notes: Private, nonfarm compensation per hour growth. Monte Carlo standard errors based on 1,000 simulations are in parentheses.

[a] Simple extrapolations based on ExecuComp data.
[b] Based on estimated models presented in Tables 2 and 3.

examine the implied growth rate of CPH in 1998 and 1999 in which we have removed stock option realizations and included new grants. Despite continued labor market tightening in 1999, actual CPH decelerated from its 1998 growth rate, from 5.08 percent in 1998 to 4.64 percent in 1999. However, when we look at our adjusted CPH measure, we find that it continued to accelerate through 1999, from 4.95 percent in 1998 to 5.05 percent in 1999.[26] The drop-off in the pace of actual CPH in 1999 can therefore potentially be explained by the rapid increase in new stock option grants in that year relative to current realizations from prior-year grants.

An implication of this finding is that stock options may be changing the traditional relationship between unemployment rates and pay measures. If firms increasingly use stock options as a substitute for wage and salary increases to attract and retain workers in a tight labor market, the impact of tight labor markets will either be muted in the data (for pay measures such as the employment cost index, which do not reflect stock options), or it will show up with a several-year lag (for pay measures such as CPH, which reflect realizations) because of the vesting requirements for stock options.

The most comparable effort to assess the impact of stock options on aggregate pay measures was made by Lebow et al. (1999). They construct a sample of employee stock option plans for 125 S&P 500 firms from 1994 to 1998. Using the details of the option grants, they calculate modified Black-Scholes values for the new grants in each year. They find that over their sample period, the average stock option grant value per employee grew at a 31 percent annual rate. This result accords well with our data, which indicate an average annual 33 percent growth rate over this period. Assuming that all workers at public companies experienced the same growth rate in stock option grants, the authors calculate that the treatment of stock option grants as compensation on the grant date would have added roughly a quarter percentage point to growth in the employment cost index.

Additional Implications

Our analysis reveals that although employee stock options still represent a small fraction of total compensation in the United States, they have grown rapidly over the past few years. Accordingly, the recent growth in CPH has been significantly affected by the behavior of stock option grants and realizations (Table 4). These findings have several important implications.

If the trend in stock option use continues, CPH growth is likely to be more variable in the future than it has been. As we observed, current stock option realizations depend to a great extent on a firm's recent stock performance. Swings in the equity markets will generate swings in stock option realizations that are likely to exceed the underlying movements in base wage and salary income. This increased volatility suggests that it will be more difficult to discern trend changes in CPH growth. Therefore, an understanding of the effect of stock options on CPH is critical for one to make the correct inference on the underlying pay trends. As such, more accurate and timely data on stock options are clearly needed.

A greater reliance on stock options may also increase overall pay flexibility in the U.S. labor market. Various arguments have been put forward as to why employers are reluctant to impose nominal wage cuts on workers during adverse times (see Lebow et al. [1995]; Groshen and Schweitzer [1996]; Card and Hyslop [1997]; and McLaughlin [1999]). A corollary is that some inflation is good for labor market efficiency because it allows for real wage reductions, even in the absence of nominal wage reductions. Stock options by design build in downward pay

flexibility. As noted earlier, the typical nonqualified stock option is issued with a strike price equal to the market price. If the firm does not produce equity gains during the vesting period, the options will remain out-of-the-money and will not be exercised by employees.[27] This added pay flexibility may help to relax any constraints imposed by nominal wage rigidities that exist in the base wage and salary components of pay. Consequently, the labor market may be able to operate efficiently at a lower steady-state rate of inflation.

Furthermore, stock options may strengthen the link between pay and performance. Hall and Liebman (1998) argue that the rising importance of stock options in executive pay has been the primary determinant of the increased sensitivity of executive compensation to firm performance. As stock options filter down the salary ranks, an increasing segment of a firm's salary liability will become linked to firm performance. This restructuring of the wage contract between a firm and its workers therefore may be contributing to the upturn in labor productivity (see Black and Lynch [2000]).

Conclusion

Between 1995 and 1998, actual growth in nominal compensation per hour accelerated from approximately 2 percent to 5 percent. Yet as labor markets continued to tighten in 1999, CPH growth paradoxically slowed. In this article, we have attempted to solve this aggregate wage puzzle by exploring whether changes in pay structure—specifically, the increased use of employee stock options—can account for the behavior of CPH in the late 1990s.

We conclude that the behavior of CPH can be explained largely by the point in time when employee stock options are captured in this measure. When we recalculate CPH growth to reflect the value of current stock options when they are granted—rather than their value when they are realized—we find that our adjusted CPH measure accelerated in each year from 1995 to 1999. This finding suggests that in 1999 there was likely no downturn in CPH growth.

Appendix A: Data Definitions and Descriptive Statistics

Description	Source	Method of Calculation	Mean	Standard Deviation	Minimum	Maximum
		Panel A: Grants Regression				
Total grant value (thousands of dollars)	ExecuComp	Grants to top 5 * (100/% of grants to top 5)	31,378	356,183	15	14,200,000
Log total grant value	ExecuComp		8.78	1.59	2.74	16.47
Return on assets, one-year lag	COMPUSTAT	(Operating income before depreciation [13] + interest expense [15]) / (total assets [6])	0.16	0.11	-1.55	0.97
Employment (thousands)	COMPUSTAT	[29]	17.99	49.83	0.01	825.00
Log employment	COMPUSTAT	*ln*([29])	1.49	1.70	-4.96	6.72
Total assets (millions of dollars)	COMPUSTAT	[6]	5,109	21,675	14	668,641
Log total assets	COMPUSTAT	*ln*([6])	6.96	1.63	2.62	13.41
Leverage ratio	COMPUSTAT	Total long-term debt [9]/total assets [6]	0.19	0.16	0.00	1.75
Market value/book value, one-year lag	COMPUSTAT	(Price-close calendar year [24] * shares outstanding [25] + total assets [6] - common equity [60])/ (total assets [6])	2.20	2.08	0.48	45.33
Standard deviation of stock returns, one-year lag	CRSP or Campbell and Lettau	Firm-level (CRSP) data, if available, otherwise industry-level (Campbell and Lettau, *Journal of Finance*, forthcoming) data used	0.02	0.01	0.00	0.09
Number of years since stock first traded publicly	CRSP	Data year minus year stock first traded publicly	13.60	9.85	0.00	30.00
Net operating loss	COMPUSTAT	1 if [52] > 0; 0 if [52] = 0	0.31	0.39	0.00	1.00
		Panel B: Probit—Positive Realizations				
Total realized option value (thousands of dollars)	ExecuComp	Realized value for top 5 * (100/% of grants to top 5), two-year lag	6,492	12,693	-2	72,047
Log total realized option value	ExecuComp		5.37	4.02	0.00	11.185
Employment (thousands)	COMPUSTAT	[29]	16.79	45.34	0.005	756.30
Log employment	COMPUSTAT	*ln*([29])	1.53	1.60	-5.30	6.63
Leverage ratio	COMPUSTAT	Total long-term debt [9]/total assets [6]	0.19	0.16	-0.04	1.72
Market value/book value	COMPUSTAT	(Price-close calendar year [24] * shares outstanding [25] + total assets [6] - common equity [60])/(total assets [6])	1.98	1.49	0.49	15.77
Standard deviation of stock returns	CRSP or Campbell and Lettau	Firm-level (CRSP) data, if available, otherwise industry-level (Campbell and Lettau, *Journal of Finance*, forthcoming) data used	0.02	0.01	0.01	0.20
Percentage increase of stock returns over previous two years	CRSP		0.47	1.08	-0.99	18.95
Log total grants, two-year lag	ExecuComp or forecast	ExecuComp data, if available, otherwise forecast used	8.41	1.40	2.74	13.51

Note: COMPUSTAT item numbers are in brackets.

Description	Source	Method of Calculation	Mean	Standard Deviation	Minimum	Maximum
		Panel C: Realized Truncated Regression				
Total realized option value (thousands of dollars)	ExecuComp	Realized value for top 5 * (100/% of grants to top 5), two-year lag	9,602	14,439	0	72,047
Log total realized option value	ExecuComp		7.94	1.86	0.34	11.19
Employment (thousands)	COMPUSTAT	[29]	18.49	47.95	0.04	756.30
Log employment	COMPUSTAT	*ln*([29])	1.63	1.60	-3.30	6.63
Leverage ratio	COMPUSTAT	Total long-term debt [9]/total assets [6]	0.18	0.15	-0.04	1.72
Market value/book value	COMPUSTAT	(Price-close calendar year [24] * shares outstanding [25] + total assets [6] - common equity [60])/ (total assets [6])	2.13	1.62	0.56	15.77
Standard deviation of stock returns	CRSP or Campbell and Lettau	Firm-level (CRSP) data, if available, otherwise industry-level (Campbell and Lettau, *Journal of Finance*, forthcoming) data used	0.02	0.01	0.01	0.12
Percentage increase of stock returns over previous two years	CRSP		0.60	1.18	-0.95	18.95
Log total grants, two-year lag	ExecuComp or forecast	ExecuComp data, if available, otherwise forecast used	8.50	1.38	2.74	13.51
Mills ratio	Probit model	ϕ (*Xb* from probit) / Φ (*Xb* from probit)	0.46	0.24	0.06	1.91

Appendix B: Estimating the Level of Stock Option Realizations

We use a generalized Tobit framework to estimate a firm's stock option realizations. Let I^* denote a latent index for the propensity of a firm's workers to realize their vested options in a given year. Let R^* denote desired realizations and R denote actual realizations. We assume that I^* and lnR^* have a continuous distribution, while lnR has a censored distribution.

$$I_{it}^* = Z_{it}\gamma + \varepsilon_{1it},$$

$$lnR_{it}^* = X_{it}\beta + \varepsilon_{2it},$$

$$\begin{bmatrix}\varepsilon_1 \\ \varepsilon_2\end{bmatrix} \tilde{\square} N(0, \Sigma), \ \Sigma = \begin{bmatrix}1 & \sigma_{12} \\ \cdot & \sigma_2^2\end{bmatrix},$$

$$lnR_{it} = lnR_{it}^* \quad \text{if} \quad I_{it}^* > 0$$
$$0 \text{ otherwise.}$$

The probability of a firm having positive stock option realizations in a year is given by $\Phi(Z_{it}\gamma)$. Given the assumed normality of the two error terms, the observed stock option realizations have the following conditional mean:

$$E(lnR_{it} \mid lnR_{it}^* > 0) = X_{it}\beta + \sigma_{12}\frac{\phi(Z_{it}\gamma)}{\Phi(Z_{it}\gamma)},$$

where ϕ and Φ are the standard normal density function and cumulative density functions, respectively. The expected unconditional stock option realizations are given by the probability of observing positive realizations in a year multiplied by the expected conditional magnitude of the realizations.

$$E(lnR_{it} \mid Z_{it}, X_{it}) = \Phi(Z_{it})\left[X_{it}\beta + \sigma_{12}\frac{\phi(Z_{it}\gamma)}{\Phi(Z_{it}\gamma)}\right].$$

We estimate this model in two steps. First, we estimate the γ parameters using a probit model. Using these estimates, we calculate the variable ϕ/Φ for each observation with a positive realization. We then estimate the β parameters by regressing the log positive realizations on our X variables and ϕ/Φ.

Endnotes

1. CPH is the most comprehensive U.S. pay measure. It captures wage and salary income, tips and overtime, paid leave and severance pay, payments in-kind, benefits, bonus and profit-sharing payments, and realizations of stock options.

2. See Farber (1997) and Manski and Straub (2000).

3. See Bell and Neumark (1993), Bell and Kruse (1995), Cohn (1999), Duca (1998), Epstein (1999), and Lebow et al. (1999).

4. We stress, however, that although our conclusion represents an educated assessment of the impact of stock options on the dynamics of CPH, there is a clear need for greater availability of data.

5. See Murphy (1999) for a discussion of the structure of employee stock option plans.

6. A common practice is for a cashless transaction to occur using the services of a third party. The third party makes a short-term loan to the employee to cover the cost of purchasing the exercised options at the strike price. The shares are then immediately sold back to the market and the loan is paid off, with a fee going to the third party.

7. The restrictions are defined in Internal Revenue Code Section 422.

8. For incentive stock options, there is a minimum holding period for the underlying stock that compounds the diversification problem. No similar restriction applies to nonqualified stock options.

9. A Hewitt Associates study of seventy-four plans in 1998 found that 35 percent of the plans used cliff vesting (where all shares vest at the same specified time), with one and three years being the most frequent vesting times; 45 percent used uniform vesting (where shares vest at a uniform rate over the vesting period), with three and four years being the most frequent vesting times; and the remaining 20 percent used either mixed vesting or provided no information (Hewitt Associates LLC 1998). The most common expiration date is ten years after the grant date.

10. This feature of employee stock options makes them a useful tool for reducing employee turnover. Mehran and Yermack (1999) document that the probability of a voluntary departure by a CEO is inversely related to the length of the stock option vesting schedule. They also document that the higher the ratio of deferred compensation to current pay, the less likely a CEO is to leave voluntarily.

11. The median real market value is $8.3 billion for the S&P 500 firms, $1.7 billion for the S&P MidCap firms, and $0.4 billion for the S&P Small Cap firms.

12. In 1994, ExecuComp began recalculating the grant value of a company's new options using a consistent set of assumptions on the interest rate, the implied stock return volatility, and the expected duration of the option. Company handbooks on employee stock option plans typically do not make any distinction between executive and nonexecutive stock option plans. Therefore, we assume that the Black-Scholes value of an option granted to an executive and to a nonexecutive is the same.

13. There is no general agreement as to what caused the popularity of stock options in the 1990s. Murphy (1999) presents a behavioral discussion. Hall and Liebman (2000) examine the role of taxes whereby under Internal Revenue Code Section 162(m), compensation above $1 million is not deductible unless it is performance-based. Of the 1,672 ExecuComp firms in 1998, 1,566 reported paying less than a $1 million salary to their CEOs.

14. This is based on the comparison of COMPUSTAT employment for ExecuComp firms in 1998 with total employment of COMPUSTAT firms in the same year.

15. See U.S. Department of Labor (2000).

16. Our discussion borrows heavily from Yermack (1995).

17. Although volatility always raises the option value of traded stock options, Lambert, Larcker, and Verrecchia (1991) and Kulatilaka and Marcus (1994) show that increased volatility can lower the value of employee stock options, especially for more risk-averse employees.

18. More specifically, the prediction pertains to the relative portion of an executive's compensation that is stock-based. Our dependent variable is the total amount of stock options granted, rather than the ratio of total stock option grants to total compensation.

19. As a robustness check, we also used the firm's "before financing" marginal tax rate (see Graham [1996, 2001]). We found that both net operating loss and marginal tax rates generated the predicted sign and were statistically significant. However, because marginal tax rates were missing for roughly 15 percent of our COMPUSTAT sample, we proceeded using only the net operating loss.

20. The time pattern of exercise for executives may differ from that of other employees for two reasons. First, executives have private information about their firm's prospects that can alter the timing of their exercise decision. Second, footnotes in company proxy statements typically reveal that top executives may exercise their options sooner than the normal vesting schedules permit if certain financial conditions are met. Huddart and Lang (1996) find that the exercise decisions of top management compared with those of other employees are less sensitive to recent stock returns and return volatility.

21. Ideally, we would like to use a weighted average of these ratios based on the typical vesting pattern for employee stock options. However, this is precluded by the short time period covered by the ExecuComp sample.

22. For firms with one or two values missing from our control variables, we impute these values by regressing the variables in question on all other control variables using the estimation sample that has no missing values. We then predict their grants and realizations using these estimated values for the missing right-hand-side variables and actual data for the remaining control variables. For firms with chronic missing data, we leave their grant and realization values missing. We then scale up to a one-digit industry level our estimates to cover all public firms by taking our in-sample average grants and realizations per employee and multiplying the figure by the ratio of total public firm employment in that industry to our in-sample public firm employment in that industry.

23. We assume that 82 percent of employee stock options represent nonqualified stock options, and that this share is constant over our sample period (see Hewitt Associates LLC [1998]). When reporting the value of new nonqualified stock option grants, we scale down first by the 82 percent and then by an additional 50 percent to reflect the likely overestimate of the value by the Black-Scholes methodology (see Huddard and Lang [1996]).

24. Our estimates of the value of stock options per employee are likely to be conservative, given our assumption of no stock option use by privately held firms.

25. To assess the reliability of our estimates, we also report Monte Carlo standard errors. These are computed by simulating draws of new coefficient estimates from the stock option grant and realization estimations, recalculating all results, and repeating this process 1,000 times. The reported standard errors are the standard deviations of the sample distribution of results for each statistic reported in the table.

26. The adjusted CPH growth rate is sensitive to the assumptions we made along the way. For example, if we assume that the cash value of new grants is 60 percent (40 percent) of the Black-Scholes value, the adjusted CPH growth rate in 1999 is 5.13 percent (4.97 percent).

27. However, firms may reprice their employee stock options and/or issue new grants in order to restore incentives. See Carter and Lynch (2000) for Financial Accounting Standards Board reporting of employee stock option repricings.

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