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Repricing and executive turnover

Narayanan Subramanian, *Cornerstone Research*
Atreya Chakraborty, *University of Massachusetts Boston*
Shahbaz A Sheikh, *The University of Western Ontario*

EFA Eastern Finance Association

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Narayanan Subramanian*

Cornerstone Research

Atreya Chakraborty

University of Massachusetts

Shahbaz Sheikh

The University of Western Ontario

Abstract

We examine whether the threat of executive turnover faced by a firm affects its decision to reprice stock options held by its executives. We estimate a model of voluntary turnover among top executives and show that the predicted turnover from this model is positively related to the probability of repricing. The relationship is robust to the inclusion of several known determinants of repricing. Our results are consistent with a model in which a tight labor market makes executives hard to replace, forcing firms to reprice stock options when they go underwater.

Keywords: option repricing, executive compensation, incentive compensation, management turnover, CEO turnover

JEL Classifications: G34, J33, M52

**Corresponding author:* Cornerstone Research, 699 Boylston Street, 5th Floor, Boston, MA 02116; Phone: (617) 927-3000; Fax: (617) 927-3100; E-mail: nsubra1@gmail.com

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1. Introduction

During the 1990s, many firms repriced outstanding executive stock options. In the typical case, a sharp decline in a firm's stock price left executives holding options that were deeply out of the money. In response, the firm lowered the exercise price of the options to the market price. Repricing firms often justified the practice as necessary to retain key employees.[1] In this paper, we provide evidence on the validity of this argument.

We examine 281 instances of option repricing between 1992 and 1998. For these and a control sample of nonrepricers, we estimate the probability of executive turnover prior to repricing. We test whether the threat of turnover significantly explains the repricing decision, after controlling for other potential determinants, such as the restoration of lost incentives and lost value of executive option holdings. We find that the primary determinant of the repricing decision is the threat of executive turnover.

Previous research in this area has focused on the *ex post* effect of repricing on executive turnover. However, many firms restart vesting or impose blackout periods on exercise at the time of a repricing. These accompanying changes could explain why executive turnover decreases following a repricing event. Thus, a finding that repricing is followed by lower turnover does not, by itself, validate the claim by firms that repricing is intended to help avoid high turnover. Such a claim could only be justified if the anticipated turnover of repricing firms, based on various factors including the moneyness of options outstanding, was significantly higher than that of comparable firms that did not reprice. Hence, in this paper, we focus on the anticipated turnover prior to repricing.

First, we estimate a negative binomial model (probit model) of voluntary turnover for the five highest paid executives (chief executive officer, CEO) of a firm. We control for known determinants of turnover, such as firm size, performance, management ownership, tenure, and industry. The results show turnover to be positively related to firm size, and negatively related to performance, management ownership, and executive tenure. We define anticipated turnover for a firm as the predicted value of turnover from the estimated model. Next, we estimate a two-equation probit model of repricing, in which a selection equation and a repricing equation are jointly estimated. In the estimation, we control for various firm characteristics including size, age, performance, industry, board size, and management ownership, and executive compensation characteristics including the value and incentive effects of repricing underwater options. We find that repricing is positively related to anticipated turnover.

[1] For example: "Given the variety of alternative employment opportunities from both established high-technology companies and high-technology startup companies, the Board of Directors concluded that repricing out-of-the-money options would greatly assist the Company in retaining its employees and the members of the Company's management team." (*Auspex Systems Inc., Proxy Statement, October 14, 1997).*

Our results are robust to alternative measures of incentives and stock return volatility, and alternative specifications for the turnover equation. Including the "moneyness" of outstanding options as a variable in the sample selection equation (stage 1 of the repricing model) does not affect the results. To further demonstrate robustness to sample selection, we repeat the repricing estimations with a control sample of firms that do not reprice options despite a stock price decline of more than 40% in the previous year, and show that repricing remains positively related to anticipated turnover.

2. Prior research

The early literature on option repricing focuses on the characteristics of repricing firms (see Gilson and Vetsuypens, 1993; Saly, 1994; Brenner, Sundaram, and Yermack, 2000; Chance, Kumar, and Todd, 2000; Carter and Lynch, 2001). These studies find that repricings typically follow poor firm-specific performance, and that repricing firms are smaller and appear to have greater agency problems than nonrepricing firms. On the theoretical side, Acharya, John, and Sundaram (2000) develop a model of repricing and show that permitting stock options to be reset may be optimal for firms *ex ante* despite the negative effect on incentives.

Previous work on repricing and turnover focuses on the *ex post* effect of repricing on executive turnover. Carter and Lynch (2004) examine whether repricing stock options reduces both executive and overall employee turnover using a sample of 136 firms that reprice underwater stock options in 1998 and a control sample of firms with underwater stock options that do not reprice. They find that while repricing does not affect executive turnover, it does reduce overall employee turnover. Callaghan, Subramaniam, and Youngblood (2003) report that executive and CEO retention is higher at repricing firms in the three years following the repricing date as compared to nonrepricers. Both papers focus on comparing the turnover rates before and after repricing.

Chen (2004) studies the issue of *ex ante* restrictions imposed by firms on the management's ability to reprice stock options. He reports that relative to firms with a flexible repricing policy, firms with restrictions on repricing face higher levels of executive turnover in response to stock price declines, particularly among non-CEO executives. This implies that in the absence of repricing, many firms whose stock prices declines over a relatively short period would face difficulties in retaining top executives.

Chidambaran and Prabhala (2003) study 213 repricing instances between 1992 and 1997 and conclude that repricing is not primarily a manifestation of agency problems or poor corporate governance. They find that CEO turnover among repricing firms is lower when the CEO is included in the repricing, which suggests a retention role for the repricing.

3. Sample

We identify repricing firms in 1992–2000 using Standard and Poor's 2000 ExecuComp database. We studied news items and proxy statements surrounding the reported event. We exclude repricing events that coincide with mergers and acquisitions, pertain only to warrants or involve scheduled annual repricing according to a preset formula. For the remaining firms, we examine the proxy statements (from edgar.sec.gov) that report the repricing. Each proxy statement includes the Ten-Year Option Repricing table giving details on the pre- and post-repricing strike prices, maturities, and numbers of executive stock options. As per SEC rules in effect since 1992, such a table is mandatory if a company lowers the exercise price of options granted to the CEO or the four highest paid non-CEO executives. We are able to obtain full details of the repricing for 304 (firm-year) instances of option repricing between 1992 and 2000, covering 1,557 executive-year observations and 3,989 tranches. Among these, for our primary analysis, we drop 23 repricings that occur after November 30, 1998, due to a Financial and Accounting Standards Board (FASB) rule change regarding accounting for repricing effective December 15, 1998.[2]

Our final repricing sample contains 281 (firm-year) instances of option repricing between 1992 and November 30, 1998, covering 1,291 executive-year observations and 3,652 tranches. The sample is larger than those of the studies cited above. Of the 197 repricing firms in our sample, 126 firms repriced once during the period, 60 firms twice, nine firms three times, and two firms repriced in four separate fiscal years. Table 1 reports the number of repricings by year and by broad industry grouping. Repricing increases over the years, peaking in 1998.[3] We use the same industry categories as Chidambaran and Prabhala (2003), who classify firms as belonging to technology, manufacturing, trade, services, and other industries. As the table shows, technology firms constitute over half of the repricing sample, and the incidence of repricing is also higher among technology firms than other firms in all years except 1995.

The majority of repricings in the sample involve a decrease in strike price to the market price prevailing on the date of the repricing, with no change in the number or maturity of options. The mean reduction in the weighted average strike price (where the weights reflect the number of options repriced) is 44.2% and the median is 46%. Brenner, Sundaram, and Yermack (2000), who also use ExecuComp data, obtain similar estimates for 1992–1995, as do Chance, Kumar, and Todd (2000) for 1985–1994. About 10% of the tranches have their maturities extended. The mean extension is about 29.3 months in our sample and the median extension is 21 months. These figures are similar to those reported by Chance, Kumar, and Todd and Brenner, Sundaram, and Yermack.

[2] All results are unchanged when these 23 instances are included.

[3] Repricing has been far less frequent since 1998 due to the FASB ruling.

Table 1

Repricing sample

The sample contains 281 firm-year instances of stock option repricing (covering 3,652 tranches) between January 1, 1992 and November 30, 1998. The number of repricers as a percentage of firms in the industry is in paranthesis. Data source: ExecuComp, 1992–2000; SEC's EDGAR database.

	1992	1993	1994	1995	1996	1997	1998	Total
Technology	14 (3.5%)	13 (5%)	12 (4.4%)	10 (3.2%)	33 (9.1%)	29 (6.9%)	34 (8.1%)	145
Manufacturing	3 (0.7%)	6 (1.4%)	4 (0.9%)	8 (1.7%)	10 (2.1%)	9 (1.9%)	12 (2.6%)	52
Services	1 (0.9%)	5 (3.9%)	5 (3.5%)	5 (3.3%)	2 (1.2%)	6 (3.4%)	6 (3.4%)	30
Trade	2 (1.3%)	1 (0.6%)	5 (3.0%)	7 (3.8%)	5 (2.5%)	2 (1.0%)	5 (2.7%)	27
Other industries	2 (0.3%)	4 (0.6%)	4 (0.6%)	1 (0.2%)	3 (0.4%)	4 (0.6%)	9 (1.3%)	27
Total	22 (1.5%)	29 (1.8%)	30 (1.8%)	31 (1.7%)	53 (2.8%)	50 (2.5%)	66 (3.4%)	281

4. Anticipated turnover

Our approach differs from other studies in that we focus on the anticipated turnover prior to repricing. We estimate a model that predicts the fraction of executives quitting a firm in the following year, based on year-end variables.

We follow the turnover literature in identifying voluntary turnovers. Carter and Lynch (2004) measure the turnover rate as the fraction of executives in a company's proxy statement for one year who are absent from the next year's proxy statement, implicitly assuming that all these executives quit voluntarily. Chen (2004) makes a similar assumption after confirming each departure with Standard and Poor's *Register of Corporations, Directors and Executives*. Studies of CEO turnovers, such as Parrino (1997), Huson, Malatesta, and Parrino (2004), and Huson, Parrino, and Starks (2001), uniformly report that voluntary turnovers constitute over 80% of all turnovers. Following these studies, we identify a turnover at year-end t as the event of the executive having a date of departure in ExecuComp beyond t, but before $t + 1$.

We identify as potential turnovers instances where an executive appears in a certain firm-year in ExecuComp and is absent in the following firm-year. Not all these executives actually leave the firm. For example, some may not be among the top five highest paid executives in the following year and hence are not reported in the firm's proxy statement for that year. We examine the date of each executive's departure and include the event in the turnover sample only if the departure occurs after the current fiscal year end and before the following fiscal year-end. In a few cases, executives continue to appear as employees more than a year beyond the specified date of departure, or rejoin the firm at a later date. We drop these instances from the sample. If the reason for departure is available in ExecuComp and is retirement or death, we drop the event from the sample.

Our final estimation sample has 1,267 instances of turnover, for a turnover rate of 4.04%, which is lower than the rate in other studies on turnover such as Weisbach (1988), Denis and Denis (1995), Parrino (1997), Fee and Hadlock (2004), and Chen (2004). These studies report turnover rates ranging from 8% to 13%. The reason for the lower rate in our study is that we require the date of departure of the executive to be available in ExecuComp. Without the restriction, our turnover rate increases to 9.71%, which is in line with the rest of the turnover literature.

As a robustness check, for CEOs only, we search news reports to obtain the exact reasons for departure and thereby precisely identify voluntary turnovers. We obtain similar results when we estimate the turnover equation using only voluntary CEO turnovers.

4.1. Turnover determinants

As argued in Section 1, the weakening of incentives and the loss of wealth on executive option portfolios caused by a decline in share price may increase the threat of turnover. Weak incentives may induce the more capable employees to self-select

out of the firm and into other firms to better exploit their abilities. Similarly, the loss of value on their option portfolios has the effect of creating a wedge between the employee's current wage and reservation wage, thus making outside opportunities more attractive. Therefore, we include incentive realignment (IR) and value gains (VG) as two determinants of turnover.

We use the Black–Scholes (1973) model to calculate the value and the delta of options held by executives. Our primary measure of incentives is *Dollar Sensitivity*, the change in executive portfolio wealth for a $1,000 change in firm value (see Jensen and Murphy, 1990). The calculation of this measure is similar to that of Core and Guay (1999); details are available from the authors.[4]

We measure IR as follows.

I^0_{t+1} = pre-repricing incentive level at the lowest stock price in fiscal year $(t + 1)$.

I^1_{t+1} = post-repricing incentive level assuming that options are repriced to be at the money.

IR_t = potential incentive realignment at the end of fiscal year t
$= I^1_{t+1} - I^0_{t+1}$.

The potential value gain from a repricing, VG_t, is correspondingly measured. We calculate IR_t and VG_t for each executive and then find the firm-level average. We use the average rather than the sum over all the executives of the firm, since firms differ in the number of executives whose portfolio details are reported in ExecuComp.

We include other determinants of turnover similar to those in such papers as Weisbach (1988), Denis, Denis, and Sarin (1997), Fee and Hadlock (2004), Carter and Lynch (2004), and Chen (2004). While the studies differ in the exact variables used to explain turnover, most include measures of past firm performance, firm size, executive age and tenure, management share ownership, and corporate governance. We include the following variables in addition to IR and VG.

(1) One- and three-year stock returns relative to the industry median. Stock returns reflect firm performance, which could be correlated with employee morale and satisfaction. Lower employee morale is likely to be associated with higher turnover level.
(2) The difference in the cash compensation (salary and bonus) between the firm and the industry median. Firms with higher cash compensation are potentially less prone to turnover caused by portfolio losses on employee stock options.
(3) Management ownership. Greater ownership may imply a greater vested interest in the firm and lower chances of turnover. Higher ownership may also

[4]We also re-estimate all regressions using two other incentive measures (not reported in a table): the change in portfolio wealth for a $1 change in the share price and for a 1% change in the share price. The main results are robust to the choice of incentive measure.

imply greater control over compensation decisions—in this case, executives may be able to recoup lost portfolio wealth (following poor stock price performance) through changes in the compensation package. This would imply a weaker VG effect on turnover.

(4) Firm size, measured by log of sales. Executives at larger firms may be able to find alternative employment opportunities more easily than their counterparts at small firms.

Finally, while many of the turnover determinants could also affect repricing independently, executive tenure is likely to primarily affect turnover, rather than repricing. Older executives are less likely to quit a firm (as they accumulate firm-specific human capital), until they approach retirement, around which time, they are more likely to quit than the average executive. While executive tenure could affect repricing also, it is reasonable to assume that this effect works primarily through turnover rather than independently. Based on this reasoning, we use executive tenure in linear and quadratic form as the identifying variable in the turnover equation.

In Table 2, we present the summary statistics for these variables, for observations with one turnover or less in a given year, and those with more than one turnover. Since we omit turnovers within three years after a repricing, the average firm-level IR and VG are negative, implying that the options of these firms are in-the-money on average. Firms with high turnover have significantly higher levels of IR and lower levels of ownership and tenure, and are worse performers than firms with low turnover. While VG is also higher for high turnover firms, the difference in mean VG between the two groups is not significant.

4.2. Turnover prediction model

Since the dependent variable (the number of executives who quit) is a count, one potentially could use either a negative binomial or a Poisson model for the turnover equation. A general specification that includes both is

$$q_{it}^{F} = \frac{n_{it}}{N_{it}} = \exp\left(Z_{it}^{F}\gamma + u_{it}\right)$$
$$\exp(u_{it}) \sim \text{Gamma}(1/\alpha, 1/\alpha), \tag{1}$$

where q_{it}^{F} is the turnover rate, n_{it} is the number of executives of firm i at the end of fiscal year t who quit the firm in the following year, and N_{it} is the total number of executives of firm i at fiscal year-end t. Z_{it}^{F} is a set of firm-level variables at fiscal year-end t. u_{it} is an unobserved error term. In estimating this model, we drop firm-year observations that have less than three executives. We also drop all firm-year instances within three years of a repricing, since the turnover in these cases may have been affected by the repricing. The results are similar when we restrict our turnover sample to firms that never reprice executive stock options during the sample period.

Table 2

Turnover prediction variables

The sample includes 5,097 firm-years between fiscal years 1995 and 1998. Firms with zero or one turnover are classified as "Low turnover" and the rest are classified as "High turnover." IR is the change in incentives caused by option repricing; for nonrepricing firms, it is the change in incentives that would be caused by a hypothetical repricing in the following fiscal year, in which all outstanding options are repriced to be in-the-money at the lowest stock price. Incentives are measured by the change in portfolio value caused by a $1,000 change in firm value. VG is the average change in the value of executive option portfolios caused by the same repricing event. Cash compensation and stock returns are measured relative to the industry median. Management ownership is the total fractional ownership of common stock by a firm's executives in the ExecuComp database. Industry categories are as per Chidambaran and Prabhala (2003). *p*-values are for tests of equality across the two subsamples.

	Mean			Median		
	Low turnover	High turnover	*p*-value	Low turnover	High turnover	*p*-value
Incentive realignment per ($1000)	−12.324	−4.615	0.038*	−0.383	−0.070	0.000**
Value gain ($ mn)	−0.735	−0.340	0.646	−0.205	−0.063	0.001**
Relative cash compensation ($ 000)	224.995	155.247	0.112	77.157	57.648	0.552
Relative one-year return (%)	8.121	−7.732	0.000**	1.914	−8.319	0.000**
Relative three-year return (%)	4.3611	−4.127	0.000**	1.5340	−4.2185	0.001**
Ownership (%)	4.5251	2.6392	0.005**	0.9312	0.6405	0.011*
Tenure (years)	8.385	6.761	0.029*	3.500	2.500	0.053
Sales ($ mn)	3,791.22	3,678.09	0.870	1070.29	1255.91	0.134
Fraction of firms in technology	0.166	0.194	0.330			
Fraction of firms in manufacturing	0.279	0.280	0.981			
Fraction of firms in services	0.0753	0.0860	0.589			
Fraction of firms in trade	0.0996	0.1290	0.190			

* and **denote significance at the 5% and 1% levels, respectively.

α is a parameter that measures overdispersion and can be used to distinguish between the negative binomial and Poisson specifications. For the Poisson model, α equals zero. We estimate the generalized model (1) and a restricted model with $\alpha = 0$, and conduct a likelihood-ratio test to determine which model is appropriate. The test, reported in Table 3, rejects the null of zero overdispersion, thereby invalidating the use of a Poisson specification. Therefore, we use the negative binomial specification.

The negative binomial regression results are in Table 3. Column 1 presents the baseline model. Incentive weakening (proxied by IR) has a positive and significant coefficient, but the wealth loss on options (proxied by VG) is not significant. As expected, the turnover rate is higher at firms with lower stock returns. The relative cash compensation level has no significant effect. The identifying variable executive tenure is strongly significant and has the expected convex relationship: turnover decreases with tenure until a tenure level of about 17 years, beyond which turnover increases with tenure. Firm size has the expected positive relationship to turnover. Finally, the industry dummies indicate that turnover is higher in the technology, manufacturing, and trade sectors relative to services and other industries.

In estimating the baseline model, we include all firm-years with data on at least three executives. The discrete turnover variable implies that the same number of turnovers in a particular year can lead to different turnover rates depending on the number of executives. This could be a cause for concern in firms with fewer than five executives. To ensure that our main results are not driven by this problem, we estimate the model using a restricted sample of firm-year observations with five executives. Column 2 presents these results. The sample size is less than one-third of that for the baseline model. Incentive weakening continues to have a positive and significant effect on turnover. The performance, ownership and tenure variables retain their signs, but lose significance.

One potential problem with the baseline estimation is that we do not have a verified reason for the turnover of executives other than the CEO. Hence, some involuntary turnovers may be misclassified as being voluntary. To check the robustness of the main results, we estimate a probit model of voluntary CEO turnover, the results of which are in column 3. Incentive weakening continues to have a positive and significant effect on turnover. CEO tenure also has the same effect as in the baseline model.

Finally, the inclusion of IR and VG in both the turnover and the repricing equations may lead to some concerns regarding simultaneity. Therefore, we test the robustness of our results by estimating the baseline model excluding IR and VG from the explanatory variables. We note that these estimates, presented in column 4, are very close to the baseline estimates in size, sign, and significance. (Columns 4–6 of Table 5 contain the repricing estimates corresponding to the alternative models for the turnover equation given in columns 2–4 of Table 3.)

The estimates for each model in Table 3 are used to predict the turnover rate that a firm anticipates over the following year based on year-end variables. Specifically,

Table 3

Turnover prediction regressions

Columns 1, 2, and 4 present the results of a negative binomial estimation of the determinants of firm-level turnover. The dependent variable is the number of executives at a fiscal year-end who quit the firm over the following year. In column 2, the sample is restricted to firm-years with five executives. Column 3 gives estimates from a probit regression of voluntary CEO turnover. See Table 2 for variable definitions. *z*-statistics are in parentheses (for the overdispersion parameter, *z* is derived from a likelihood ratio test).

	(1)	(2)	(3)	(4)
Value gains	0.0013	0.0020	0.0007	
	(0.843)	(0.645)	(0.233)	
Incentive realignment	0.0283	0.1108*	0.0258*	
	(1.720)	(2.034)	(0.022)	
Relative cash compensation (×0.001)	−0.0079	0.0744	−0.0472	−0.0401
	(0.069)	(0.502)	(0.409)	(0.330)
Relative 1-year stock return (×0.001)	−3.1626**	−1.9540	−1.1048	−3.2166**
	(2.699)	(0.982)	(0.262)	(2.720)
Relative 3-year stock return (×0.001)	−4.7011*	−2.4106	0.0557	−5.4429**
	(2.442)	(0.639)	(0.981)	(2.830)
Management ownership (×0.01)	−1.1986**	−0.7443	−1.2696	−1.2192**
	(2.764)	(0.944)	(0.122)	(2.790)
Tenure (×0.01)	−5.4891**	−3.7252	−3.3236**	−5.4594**
	(4.692)	(1.177)	(0.001)	(4.680)
Tenure sq. (×0.0001)	15.5821**	7.8676	9.7801**	15.6364**
	(4.392)	(0.772)	0.000	(4.420)
Log sales	0.0661*	0.0576	0.0411	0.0654*
	(2.098)	(0.834)	(0.239)	(1.960)
Technology	0.2195*	0.5155*	0.2184	0.2104*
	(2.093)	(2.241)	(0.083)	(2.000)
Manufacturing	0.2060**	0.2761	0.2021	0.2046**
	(2.654)	(1.363)	(0.065)	(2.640)
Services	0.1779	0.0736	0.2068	0.1701
	(1.467)	(0.237)	(0.189)	(1.400)
Trade	0.2985**	0.4537*	0.1588	0.2976**
	(2.826)	(1.799)	(0.264)	(2.810)
Constant	−3.5777**	−4.0767**	−1.8215**	−3.5899**
	(16.457)	(8.840)	0.000	(15.810)
Overdispersion parameter (α)	0.360**	1.2521**		0.3620**
	(3.804)	(3.606)		(3.813)
N	5097	1643	2545	5097

* and **denote significance at the 5% and 1% levels, respectively.

we predict the turnover rate, $\hat{q}_{it}^{F}$, as follows:

$$\hat{q}_{it}^{F} = \frac{\hat{n}_{it}}{N_{it}} = \exp\left(Z_{it}^{F}\hat{\gamma}^{F}\right), \tag{2}$$

where $\hat{q}_{it}^{F}$ represents the turnover threat facing firm i at fiscal year-end t.

5. Repricing model

5.1. Specification

In addition to the anticipated executive turnover rate $\hat{q}$, two other potential motives for repricing are IR and VG. Firms may reprice stock options to restore the lost portfolio incentives of executives, not just to stem turnover, but also to encourage better performance. On the other hand, critics of repricing charge that top managers reprice stock options to recoup the wealth losses incurred on their option portfolios following a company's stock price decline, even if they bear responsibility for the decline. To test these arguments, we include IR and VG as explanatory variables in our repricing equation in addition to $\hat{q}$:

$$\text{Prob (repricing)} = F(\hat{q}, \text{IR, VG, turnover control factors}). \tag{3}$$

While this model could be estimated for the entire sample, it could be argued that many firms do not even consider repricing and therefore should not be included in the regression. These are firms where stock prices have not declined much, leaving options in-the-money. The issue of choosing an appropriate control sample has been dealt with in different ways in the literature. We follow the approach of Chidambaran and Prabhala (2003). They estimate a partial observability probit model similar to Abowd and Farber (1982). This method assigns weights to firms according to the likelihood of their being in the control sample. The weights are chosen endogenously as part of the likelihood maximization routine. This enables one to use the entire data rather than arbitrarily delete firms from the control sample.

Our primary specification, in which the sample selection equation and the repricing equation are jointly estimated, is

$$\text{Prob (repricing)} = \Phi(\boldsymbol{X}_{1i}\beta_1)\Phi(\boldsymbol{X}_{2i}\beta_2), \tag{4}$$

where $\Phi(\cdot)$ stands for the standard normal distribution function. The likelihood of repricing is the product of the probability that observation i is in the control sample, $\Phi(\boldsymbol{X}_{1i}\ \beta_1)$, and the probability that a control sample observation reprices in the next year, $\Phi(\boldsymbol{X}_{2i}\ \beta_2)$. Equation (4) is estimated by maximum likelihood.

5.2. Variable selection

In Equation (4), $\boldsymbol{X}_1$ and $\boldsymbol{X}_2$ are the covariate vectors in the sample selection and repricing equations, respectively. $\boldsymbol{X}_1$ consists of the one- and three-year stock returns prior to the repricing year. These two variables are natural candidates for the selection equation. The negative relationship between the repricing tendency and a firm's stock price performance is well established; moreover, Chidambaran and Prabhala (2003) show that the typical repricing firm enjoys high growth and profitability up to two years before the event and subsequently suffers a sharp drop in growth and profitability. The one- and three-year returns are intended to capture this reversal of fortune. We also repeat all regressions with the stock return in the fiscal year of repricing as an

additional variable in the sample selection equation. This is to capture Chidambaran and Prabhala's observation that many repricing firms suffer a sharp decline in share price in the previous six months.

In the repricing equation, the three main variables are: (1) the anticipated turnover ($\hat{q}$), (2) IR, and (3) VG. In addition, following Brenner, Sundaram, and Yermack (2000) and Chidambaran and Prabhala (2003), we include control variables (4) firm size, (5) firm age, (6) management share ownership, (7) board size, and (8) industry dummies. Firm size is measured by the natural log of sales and firm age by the number of years since the firm's stock price details are first available. The literature reports that repricing is concentrated among the smaller firms and that younger firms are more likely to reprice. Management ownership, measured by the total percentage holdings of executive officers who appear in ExecuComp, is a proxy for the level of managerial control over the repricing decision. Board size is reported in the literature to influence the repricing decision. Technology firms may be more likely to reprice as they tend to use option-based compensation to a greater extent.

Table 4 reports descriptive statistics of the key variables for repricers, the full sample of nonrepricers, and a selected control sample of nonrepricers that is discussed below. The nonrepricers differ significantly from repricers in general. Repricers have a median return of −21.93% in the fiscal year prior to repricing, compared to a median return of 16.75% for nonrepricing firms. Repricers also have significantly lower median three-year stock returns than nonrepricers, though the difference in means between the two groups is not significant. The mean and median of IR and VG are substantially higher for repricing firms than that for nonrepricers, with the difference in medians being significant at the 1% level. The difference in mean IR is also significant at the 1% level. Repricing firms are significantly smaller and younger than nonrepricers, and have a slightly higher level of management ownership. Among technology firms, the fraction of repricers is significantly higher than nonrepricers while the relationship is reversed for manufacturing firms.

5.3. Results

Table 5 presents the repricing regression results. Columns 1 and 2 contain the results of our baseline regressions. The *t*-statistics use standard errors corrected for two-equation estimation.[5] Column 1 presents the estimates with, and column 2 without, the contemporaneous stock return included in the sample selection equation. In both specifications, the selection equation (upper panel) has the expected positive sign on the one-year stock return and negative sign on the three-year stock returns.

[5]The raw standard errors need to be corrected to account for the fact that the anticipated turnover propensity is not directly observed. The regressor used as its proxy, namely, the predicted turnover rate, is measured with sampling error. Consequently, the estimates of the asymptotic covariance matrix are biased and need to be corrected. Murphy and Topel (1985) provide a method for correcting the standard errors. We apply their method here.

Table 4

Repricing prediction variables

Comparison of repricing firms with nonrepricing firms, with tests for equality of means and medians between repricers and nonrepricers. The sample includes 154 firm-year instances of repricing between 1992 and November 30, 1998, and 2,871 nonrepricing firm years. The selected nonrepricers sample consists of 233 firms where the stock price declines by over 40% during one fiscal year. Value gain, for repricing firms, is the average change in the value of executive option portfolios caused by the repricing. For nonrepricing firms, it is the change in value that would be caused by a hypothetical repricing in the following fiscal year, in which all outstanding options are repriced to be in-the-money at the lowest stock price. Incentive realignment is the corresponding change in incentives caused by the same repricing event. Options values are calculated using the Black–Scholes formula. Management ownership is the total fractional ownership of common stock by a firm's executives appearing in the ExecuComp database.

	Mean			Median		
	Repricers	All nonrepricers	Selected nonrepricers	Repricers	All nonrepricers	Selected nonrepricers
One-year return (%)	−2.104	23.6993**	30.0028**	−21.931	16.75**	12.431**
Three-year return (%)	17.177	18.645	18.435	10.725	15.201*	14.535
Return in repricing year (%)	−1.467	18.8873**	−29.8007**	−21.914	10.09**	−39.839**
Turnover probability (%)	5.268	4.4416**	4.7100**	5.321	4.3461**	4.6800**
Value gain ($ mn)	0.1225	−16.620	0.1825	0.0684	−0.406**	0.0971*
Incentive realignment ($ per $1000)	0.4320	−0.7318**	0.3252	0.1398	−0.1926**	0.2027
Firm age (years)	12.390	28.7029**	23.1717**	9.000	26.000**	16.000**
Sales ($ mn)	1,018.20	4,322.76**	2,153.06**	402.97	1,197.19**	609.384**
Management ownership (%)	5.280	4.735	2.5817**	1.918	0.9467**	0.8175**
Board size	7.701	9.6876**	8.8197**	8.000	9.000**	9.000**
Fraction of firms in technology	0.4675	0.2104**	0.2661**			
Fraction of firms in manufacturing	0.2078	0.3615**	0.3047*			
Fraction of firms in services	0.1039	0.0839	0.0730			
Fraction of firms in trade	0.1234	0.1292	0.1073			

* and **denote significance at the 5% and 1% levels, respectively.

Table 5

Regressions to explain repricing

Columns 1–8 present two-equation probit estimates of the determinants of option repricing, where $P(\text{repricing}) = \Phi\,(X_1\beta_1)\;\Phi\,(X_2\beta_2)$. The first equation is for sample selection and the second is the repricing equation controlling for sample selection. The sample includes 154 firm-year instances of repricing between 1992 and November 30, 1998. In column 3, stock return volatility is measured over the previous 120 trading days. The turnover propensity is estimated using firm-years with five executives in column 4, using CEO turnovers in column 5, and excluding IR and VG in column 6. Column 9 presents probit estimates with a control sample of 233 nonrepricing firms where the stock price declines by over 40% during the year. See Table 4 for variable definitions. Two-equation corrected z-statistics are in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
One-year stock return (×0.001)	−4.0037*	−4.0934*	−4.5036*	−3.9356	−7.9510**	−4.06398*	−3.9997*	−4.3361**	−3.4663
	(2.154)	(2.291)	(1.993)	(1.197)	(0.001)	(2.234)	(2.159)	(3.243)	(0.931)
Three-year stock return (×0.001)	14.7553**	15.8637**	16.160**	13.7668**	14.0544**	15.0257**	14.6619**	22.590**	9.9352**
	(4.164)	(4.403)	(3.687)	(3.224)	(0.000)	(4.311)	(4.155)	(5.830)	(3.345)
Return in repricing year (×0.001)	−0.3474		−0.4933	−0.3815	−0.3754	−0.3385	−0.3464	0.0978	4.1315**
	(0.345)		(0.411)	(0.371)	(0.703)	(0.337)	(0.344)	(0.111)	(3.350)
Moneyness of options								−0.3328	
								(1.443)	
Constant	−0.7707**	−0.8026**	−0.6366*	−0.7524**	−0.8619**	−0.7749**	−0.7720**	−0.7387**	
	(7.485)	(7.895)	(2.317)	(6.134)	(0.000)	(7.602)	(7.618)	(5.872)	
Turnover probability	35.539**	36.1869**	35.430**	71.428*	18.5739*	34.6387**	34.9767**	22.581**	24.5544*
	(4.688)	(4.668)	(3.101)	(2.144)	(0.045)	(4.910)	(4.837)	(2.666)	(2.285)
Value gains (×0.001)	4.9456*	4.8367*	0.1973	4.8052	4.2518**	5.0006*	4.9716*	4.1246	−0.5899
	(2.331)	(2.328)	(0.218)	(1.624)	(0.002)	(2.417)	(2.408)	(1.547)	(0.852)

(*continued*)

Table 5 (*continued*)

Regressions to explain repricing

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Incentive realignment	0.3052	0.2837	1.2008	0.0937	0.1885	0.3539	0.2981	0.2520	0.1118
	(0.832)	(0.727)	(1.063)	(0.203)	(0.653)	(0.966)	(0.819)	(0.554)	(0.539)
Firm age	−0.0437	−0.0433	−0.0379*	−0.0393	−0.0349**	−0.0444	−0.0439	−0.0476	−0.0303**
	(1.555)	(1.583)	(2.190)	(0.891)	(0.004)	(1.615)	(1.571)	(1.822)	(6.393)
Log sales	−0.1417	−0.1378	−0.162	−0.1957	−0.1765	−0.128	−0.1412	−0.2222	0.0388
	(0.832)	(0.831)	(1.228)	(0.772)	(0.220)	(0.778)	(0.833)	(1.215)	(0.246)
Management ownership	0.2745	0.2933	0.5053	0.0169	−0.5816	0.2327		−0.1689	3.1885
	(0.268)	(0.283)	(0.627)	(0.014)	(0.554)	(0.230)		(0.165)	(0.997)
Board size	−0.0617	−0.0616	−0.0097	−0.0664	−0.0284	−0.0613	−0.0635	−0.0821	−0.0180
	(1.129)	(1.142)	(0.082)	(1.102)	(0.577)	(1.130)	(1.157)	(1.237)	(0.542)
Technology	1.1307	1.1321	0.6586	0.3153	0.4883	1.1796	1.1342	1.5364**	0.5393*
	(1.818)	(1.824)	(1.116)	(0.294)	(0.312)	(1.953)	(1.846)	(2.756)	(2.378)
Manufacturing	0.3377	0.3567	0.0096	0.1062	0.0158	0.3613	0.3441	0.4500	0.3943
	(0.557)	(0.592)	(0.016)	(0.122)	(0.973)	(0.609)	(0.585)	(0.862)	(1.293)
Services	0.7261	0.7423	0.237	0.7499	0.5074	0.7681	0.7341	0.7098	0.4607
	(1.027)	(1.065)	(0.371)	(0.823)	(0.363)	(1.115)	(1.072)	(1.031)	(1.717)
Trade	0.6008	0.6454	0.1278	0.1074	0.6888	0.6374	0.6132	0.8958	0.0500
	(0.830)	(0.897)	(0.172)	(0.095)	(0.179)	(0.909)	(0.876)	(1.293)	(0.105)
Constant	−0.5282	−0.6243	−0.7939	−0.3753	−0.2006	−0.5581	−0.4707	0.9861	−1.5303
	(0.643)	(0.766)	(1.065)	(0.307)	(0.824)	(0.689)	(0.598)	(1.238)	(1.380)
N	3025	3098	3018	3025	2997	3025	3025	3025	386

* and **denote significance at the 5% and 1% levels, respectively.

Both variables are significant at the 5% level. Thus, firms that experience a sharp reversal of fortune are more likely to consider repricing. The contemporaneous stock return is not significant in the first specification. In the repricing equation (lower panel), anticipated turnover and VG have positive and significant coefficients, while IR has no significant effect. Among the control variables, firm size, firm age, and board size have the expected negative signs, though none of the variables is significant. As expected, technology firms are more likely to reprice than firms in other industries.

The significant and positive coefficient on turnover lends support to the claim by firms that repricing is necessary to prevent potential turnover. The finding of Callaghan, Subramaniam, and Youngblood (2003) that CEO turnover is significantly higher at repricing firms from the beginning of the repricing year until the repricing date, while it is significantly lower from the repricing date until the end of the repricing year, lends further support to the claim.

6. Robustness

6.1. Volatility measures

Differences in volatility across executive portfolios is one of the sources of the differences in convexity that we exploit to disentangle the two effects of an option repricing, namely, the change in value and the change in slope or incentives. Given this, it is important to examine whether our results depend on a particular definition of volatility. To do this, following Core and Guay (1999), we recalculate IR and VG using the (annualized) SD of daily stock returns over the 120 trading days prior to each fiscal year-end as the volatility measure. We then re-estimate the turnover and repricing regressions. Column 3 of Table 5 presents the repricing equation results using the new volatility measure. Two main results emerge: (1) the anticipated turnover remains positive and significant at the 1% level throughout and (2) VG are no longer significant.

6.2. Turnover measures

Columns 4–6 of Table 5 contain the repricing estimates corresponding to columns 2–4 of Table 3, each of which uses a different model for the turnover equation. In column 4, the anticipated turnover is estimated using a restricted sample of firms with five executives, while in column 5, it is estimated using a probit model of CEO turnover. In column 6, the model for turnover excludes IR and VG. The results are largely similar across the different columns. Anticipated turnover is always positive and significant, while VG is always positive, but significant only for one model (column 6). IR is not significant in any of the models.

6.3. Control sample selection

In Table 5, column 8, we add a more direct measure of the moneyness of options outstanding to the sample selection equation. This measure is the percentage difference between the fiscal year-end stock price and the weighted average exercise price of options granted in the previous three years. The results are similar to our baseline results. The anticipated turnover is significant at the 1% level, while IR and VG are not significant. Younger firms and technology firms are more likely to reprice than other firms.

The specification in Equation (4), which estimates the sample selection and repricing equations jointly, includes all nonrepricing firm-year observations in the control sample. It weights the observations according to the firm's stock returns in the previous three years. It could be argued that this method compares firms in widely different situations from the repricing perspective. An alternative approach is to choose control sample observations explicitly, matching either on the firm's stock returns in the recent past or based on the moneyness of options outstanding. This approach has the advantage that it focuses on the key determinants of repricing. The disadvantage is that the cutoff for selection of firms to be included in the control sample is arbitrary. We present the results for a control sample that is restricted to those nonrepricing firm-year observations for which there is at least a 40% decline in stock price from that fiscal year-end to the minimum price in the following year. This restriction gives us a control sample of 233 firm-year observations compared to the 154 repricing firm-year observations (with no missing data for any of the required variables).

Table 4 presents univariate comparisons of the repricing and control samples for the key variables. Repricers have significantly lower stock returns in the previous year. However, nonrepricers have significantly lower contemporaneous returns (compared to returns in the repricing year). This is due to the selection criterion that the control sample consists only of firms with large negative contemporaneous returns. Differences in IR and VG between the two samples are not significant, which suggests that the two samples are similar in the moneyness of options outstanding. The anticipated turnover is significantly higher for repricers. Management ownership is significantly lower in the restricted sample of nonrepricers, in contrast to the unrestricted sample.

In column 9 of Table 5, we present the results of a probit regression of the repricing decision using the restricted control sample.[6] The contemporaneous stock return coefficient is positive and significant. Apart from the sample selection criterion discussed above, another reason for this is that the stock prices of repricing firms recover quite quickly following the repricing, as noted by Chance, Kumar, and Todd (2000). Our primary result, however, remains unchanged: only the anticipated turnover is significant among the three main motives for repricing. In line with the

[6]Since the control sample is explicitly matched, we do not use a selection equation.

rest of the literature, younger firms and technology firms are more likely to reprice than other firms.

We also try a control sample restricted to nonrepricing firm-year observations for which the stock price at the fiscal year-end is lower than the weighted average exercise price of options granted to executives in the previous three years. Results for this control sample (not reported) are similar to those in column 9.

6.4. Other robustness checks

Management ownership is a right-hand side variable that is a potential source of collinearity since it also enters the incentive measure. We therefore repeat the estimation without management ownership in the repricing equation. The main results are not affected, as shown in column 7 of Table 5. Alternative measures of incentives including the change in portfolio value for a dollar change in share price and the change in the portfolio value for a 1% change in firm value yield results similar to the baseline results in Table 5. We also find qualitatively similar results when the variables are winsorized at the 1% level or when we include post-December-1998 repricers in the sample.

7. Conclusion

We study instances of option repricing between 1992 and 1998 reported in Standard and Poor's ExecuComp database, and examine whether the threat of turnover faced by a firm affects its propensity to reprice stock options held by its executives. Unlike other studies of the relationship between turnover and repricing, we focus on the anticipated turnover prior to a repricing. We estimate a model of executive turnover and test whether the predicted turnover measure affects the repricing decision. We find that the threat of executive turnover is the primary factor inducing repricing.

Some suggest that the phenomenon of repricing is an example of managerial entrenchment arising from weak corporate governance (e.g., Bebchuk, Fried, and Walker, 2002). Our findings suggest a different explanation: the source of managerial power, to the extent that it explains the repricing phenomenon, was the tight labor market for executives during the stock market boom of the 1990s. This may be understood on the basis of the employee's participation constraint. When the employee's current compensation is indexed to firm performance, while his outside labor market opportunities are not perfectly correlated with firm performance, it is possible for the employee's reservation wage to be higher than the current compensation during periods when the firm performs poorly. When this occurs, the threat of employee turnover is heightened. Repricing and other renegotiation mechanisms enable the firm to meet the employee's participation constraint ex post, thereby preventing potential turnover. Repricing works in reducing turnover in two ways. First, it raises the probability that the options will be in the money at the time of vesting. This increases the employee's incentives to exert effort sufficiently so that the worker is better off staying at the

firm and exploiting his already invested firm-specific human capital than leaving the firm and receiving the same incentives elsewhere. Second, repricing provides the employee with VG that raise compensation to the reservation level. Indexing the employee's compensation to outside offers would achieve a similar result, but as Oyer (2004) argues, this may not be feasible for reasons including the downward rigidity of employee compensation, the adverse effects on employee morale and the difficulty of identifying a suitable index for outside offers.

During and after the sample period, the labor market for executives was tight, due to the fast pace of economic growth and the rise of the dot coms and other technology companies. Several articles in the popular press in the late 1990s discuss this phenomenon. (See, e.g., "For Top Talent, How Green Is the Valley—E-commerce sparks a bidding war for CEOs," BusinessWeek, August 9, 1999; "Tight Labor Market Creates Talent Squeeze at the Top, Executives Find," Fort Worth Star-Telegram, May 9, 2000; "As Labor Market Tightens, Executive Recruiters Become More Valuable," The Sacramento Bee, August 2, 1998.) The abundance of alternative employment opportunities with attractive compensation packages would have raised the reservation wage of executives. At poorly performing firms, this might have pushed the reservation wage above current compensation, raising the threat of turnover. Technology firms and younger firms, whose performance was relatively more volatile and thus susceptible to sudden downturns, would have been particularly susceptible. Many firms resorted to repricing stock options during this period to retain employees.

References

Abowd, J. and H. Farber, 1982. Job queues and union status of workers, *Industrial and Labor Relations Review* 35, 354–367.

Acharya, V., K. John, and R. Sundaram, 2000. On the optimality of resetting executive stock options. *Journal of Financial Economics* 57, 65–101.

Bebchuk, L.A., J. Fried, and D. Walker, 2002. Managerial power and rent extraction in the design of executive compensation, *University of Chicago Law Review* 69, 751–846.

Black, F. and M. Scholes, 1973. The pricing of options and corporate liabilities, *Journal of Political Economy* 81, 637–654.

Brenner, M., R. Sundaram, and D. Yermack, 2000. Altering the terms of executive stock options, *Journal of Financial Economics* 57, 103–128.

Callaghan, S., C. Subramaniam, and S. Youngblood, 2003. Does option repricing retain executives and improve future performance? *Working paper*, Texas Christian University.

Carter, M.E. and L. Lynch, 2001. An examination of executive stock option repricing, *Journal of Financial Economics* 61, 207–225.

Carter, M.E. and L. Lynch, 2004. The effect of stock option repricing on employee turnover, *Journal of Accounting and Economics* 37, 91–112.

Chance, D.M., R. Kumar, and R. Todd, 2000. The "repricing" of executive stock options, *Journal of Financial Economics* 57, 129–154.

Chen, M., 2004. Executive option repricing, incentives and retention, *Journal of Finance* 59, 1167–1200.

Chidambaran, N.K. and N. Prabhala, 2003. Executive stock option repricing, internal governance mechanisms and management turnover, *Journal of Financial Economics* 69(1), 153–189.

Core, J. and W. Guay, 1999. The use of equity grants to manage optimal equity incentive levels, *Journal of Accounting and Economics* 28, 151–184.

Denis, D.J. and D.K. Denis, 1995. Performance changes following top management dismissals, *Journal of Finance* 50, 1029–1057.

Denis, D.J., D.K. Denis, and A. Sarin, 1997. Ownership structure and top executive turnover, *Journal of Financial Economics* 45, 193–221.

Fee, E.C. and C. Hadlock, 2004. Management turnover across the corporate hierarchy, *Journal of Accounting and Economics* 37, 3–38.

Gilson, S.C. and M. R. Vetsuypens, 1993. CEO compensation in financially distressed firms: An empirical analysis, *Journal of Finance* 48, 425–458.

Huson, M.R., P. Malatesta, and R. Parrino, 2004. Managerial succession and firm performance, *Journal of Financial Economics* 74, 237–275.

Huson, M.R., R. Parrino, and L. Starks, 2001. Internal monitoring mechanisms and CEO turnover: A long term perspective, *Journal of Finance* 56, 2265–2297.

Jensen, M. and K.J. Murphy, 1990. Performance pay and top-management incentives, *Journal of Political Economy* 98(2), 225–264.

Murphy, K.J. and R. Topel, 1985. Estimation and inference in "two-step" econometric models, *Journal of Business and Economic Statistics* 3(4), 370–380.

Oyer, P., 2004. Why do firms use incentives that have no incentive effects? *Journal of Finance* 59, 1619–1649.

Parrino, R., 1997. CEO turnover and outside succession: A cross-sectional analysis, *Journal of Financial Economics* 46, 165–197.

Saly, P.J., 1994. Repricing of executive stock options in a down market, *Journal of Accounting and Economics* 18, 325–356.

Weisbach, M., 1988. Outside directors and CEO turnover, *Journal of Financial Economics* 20(1–2), 431–460.