Internet Appendix for "Stock Options and Managerial Incentives for Risk-Taking: Evidence from FAS 123R"

Rachel M. Hayes[*]
rachel.hayes@business.utah.edu

Michael Lemmon
michael.lemmon@business.utah.edu

Mingming Qiu[a]
mingming.qiu@business.utah.edu

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[*]All three authors are affiliated with the David Eccles School of Business at the University of Utah.
[a] Corresponding author. Tel.: +1801 860 0968; fax: +1801 581 3956. E-mail address: mingming.qiu@utah.edu

In this internet appendix, we provide all supplemental analysis indicated in Hayes Lemmon and Qiu (2011) “Stock Options and Managerial Incentives for Risk-Taking: Evidence from FAS 123R”.

1. Analysis with a Control Group

As a robustness check, we would like to do a standard difference-in-difference test of firms’ investment/financing policies and firm risk to evaluate the effect of FAS 123R. Ideally, we would select a control group with zero total outstanding stock options in both the pre- and post-FAS 123R time periods. However, we have only 16 firms that satisfy this requirement in our sample. If we go beyond our sample and select firms from the whole Compustat database, we end up with 109 firms, but these firms are thinly traded and do not have stock return data in the CRSP database. Although we can get stock return data for these firms from Compustat, the low trading volume makes the volatility estimates for these stocks unreliable. Given these data limitations, for this analysis we select a subsample of firms that have zero current stock option grants throughout the pre-FAS 123R time period from the sample used in the paper. We view these firms as a control group that is relatively unaffected by FAS 123R, in the sense that they would have zero option expense from current stock option grants, if they were required to expense stock options over the pre-FAS 123R period. One weakness of this test is that these firms are quite different from the option granting firms across a number of observable dimensions. We also acknowledge the fact that these firms have some outstanding stock options and are thus not quite the ideal control sample. Nevertheless, the results are consistent with those reported in the paper and show little evidence that changes in the investment/financing policies and firm risk of the treated group are any different from those of the control group.

A subsample of 114 firms satisfies this requirement and is selected as our control group. This subsample includes 278 firm year observations in the pre-123R period and 380 observations in the post-123R period. The remaining firms from the sample in the paper comprise the treated group. We provide some summary statistics for both the control and treated group in Table 1.

As expected, the control firms have zero pre-123R Vega_c. Compared to the treated firms, the control firms are smaller in size, and have smaller R&D expense, higher cash holdings, and lower leverage. We note that the volatility levels of the control and treated groups are very close in magnitude, and are not significantly different from each other at 5%. The control group is similar in magnitude to the treated group in other documented dimensions.

Using this control group, we perform a difference-in-difference test of firm policies and firm risk. Referring to the coefficient on the interaction term (post*treated) in Table 2, we conclude that there are no significant differences in the responses of the treated and control firms' investment and financing policies/firm risk to FAS 123R.

This analysis supplements the discussion on page 15 of HLQ (2011).

2. Analysis with Alternative Measures of Delta and Vega

First, we repeat all of our regressions in Table 4 of HLQ (2011) using measures of Delta and Vega scaled by total assets (a.k.a. Delta_c_at, Delta_t_at, Vega_c_at, and Vega_t_at) in Table 3. Second, we repeat our analysis using a definition of Delta based on 0.01 dollar (as opposed to a 1%) change in stock price (a.k.a. Delta_c_dollar, Delta_t_dollar) and with a definition of Vega based on a 1% (as opposed to a 0.01) change in volatility (a.k.a. Vega _c_percent, Vega _t_ percent).

This analysis supplements the discussion on page 22 of HLQ (2011).

3. Subsample Analysis for Vega_c

In Table 4 of this internet appendix, we present the results of subsample tests analogous to those in Table 3 of the paper, but using Vega_c as the dependent variable in place of the fraction of options in current compensation. Our findings are similar to those in Table 3 and suggest that reductions in convexity are related to financial reporting costs. All of the coefficient estimates on the post-123R indicator in the high Accounting Impact subsample are significantly negative. The subsamples with high Accounting Impact universally show a larger decline in Vega_c in the post-123R period than their low Accounting Impact counterparts, and the difference is statistically significant for the high MTB, non-zero R&D, and non-new economy subsamples. Within each subsample of Accounting Impact, we find no evidence that the decrease in Vega_c is less in firms with a higher demand for risk-taking and some evidence to the contrary: high MTB firms reduce Vega_c more than low MTB firms. These results further confirm that the reduction in the use of options (and consequently convexity) appears to vary based on differences in perceived financial reporting costs but much less so based on differences in incentives for risk-taking. We focus on Vega_c, as current grants are directly under the control of the board of directors.

This analysis supplements the discussion on page 22 of HLQ (2011).

4. Analysis with Total Proportion of Option and LTIA

To explore the possibility that firms replace the convexity from options with convexity in other sources of compensation, we replace the changes in Vega_t and Delta_t in Table 5 of HLQ (2011) with changes in the fraction of total compensation coming from the sum of options and LTIA. These results are presented in Table 5 of this internet appendix.

This analysis supplements the discussion on page 26 of HLQ (2011).

5. An Approximate Way to Calculate the Convexity Introduced by LTIA

To preface our analysis, a typical LTIA award has a three year vesting period that is based on some type of performance hurdles. The amount to be paid under LTIA can be specified in number of shares of stock or in dollars (in this case, the award still might be settled in shares). The award generally specifies a threshold, target, and maximum number of shares to be received based on attainment of various performance measures. The performance measures are generally based on accounting variables (e.g., earnings, sales growth, etc) or stock returns and often use multiple metrics to assess performance.[1] Unfortunately firms seldom disclose the formulas they use to determine the payouts to the executives. Nevertheless, we attempt to assess how the switch to LTIA might affect our conclusions by approximating the amount of convexity in the LTIA awards in our sample.

[1] We conjecture that the reason that firms use accounting metrics rather than stock-price metrics is also driven by FAS 123R. In particular, 123R requires firms to explicitly model vesting conditions that are based on stock price when computing the fair value of awards for expensing purposes. In contrast, with accounting-based vesting firms are allowed to "estimate" the expected payoff for expensing purposes at the time of the grant and are allowed to "true up" the expense later based on actual outcomes. The differing treatment of market and accounting based vesting conditions gives firms additional discretion when using accounting-based performance vesting.

As noted above, most LTIA are based on accounting variables or stock price variables. In order to compute the convexity of an LTIA, however, we need to map the payoff directly into stock prices only (i.e., similar to a stock option). To do so, we approach the problem as follows: Assume that the accounting variable used to determine the LTIA payout is earnings. If we assume the firm has a constant P/E multiple, then we can map earnings into stock prices using the P/E ratio. We assume a three year vesting period and that the stock price follows a lognormal distribution. In addition, the CEO is awarded the target number of shares if the firm's stock price is above the current price compounded forward for three years; and the CEO is awarded the maximum/threshold number of shares if the firm's stock price is surpassing one standard deviation (based on the firm's stock price volatility) above/below the current price compounded forward for three years. For stock prices more than one standard deviation below the current price compounded forward for three years, the CEO receives no shares. We compute the expected payoff of the LTIA award and then increase volatility by 0.01 and recompute the expected payoff. The difference between the two expected values is defined as the vega or convexity of the LTIA award.[2] This approach is similar to Hall and Murphy (2002). We provide details in an Appendix and summarize the findings below.

In summary, under our assumptions, the vega of an LTIA grant can be positive or negative. The negative vega is driven by the discontinuities in the payoff function, the comparative magnitude of the grants for threshold, target and maximum, and the volatility level that determines the distribution of stock price. For a total of 1,552 firm-year observation with non-zero current LTIA grants, the mean of LTIA convexity is

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[2] Note that we checked our procedure to ensure that it replicates the vega for a Black-Scholes option when an option payoff is used rather than the LTIA.

$1560. For the whole sample adding the vega of the current grants of LTIA to the vega_c calculated in the paper results in an increase of vega_c from $29264 (presented in Table 1 in the paper) to $29610 (presented in Panel A of Table 2 in this response). Specifically, in the pre-123R period, this results in an increase of vega_c from $30320 (presented in Table 1 in the paper) to $30560 (presented in Panel A of Table 2 in this response). In the post-123R period, this results in an increase of vega_c from $28438 (presented in Table 1 in the paper) to $28870 (presented in Panel A of Table 2 in this response). Further, when we include the convexity of current LTIA grants in our calculation of vega_c, vega_c still shows a significant drop in the post-123R period. In sum, only 1,552 of the 6,983 firm year observations in our sample have non-zero current LTIA grants. More importantly, under our assumptions, the convexity embedded in LTIA grants does not seem to offset the decline in convexity arising from the reduction in option grants. Given the number of assumptions we needed to make we are hesitant to draw strong conclusions from these calculations.

This analysis supplements the discussion on page 26 of HLQ (2011).

Table 1. Summary Statistics for Incentive Measures and Policy/Firm Risk Measures
Panel A contains summary statistics for the control/treated firms over the entire sample period. Panel B/C contains summary statistics for the control/treated firms pre- and post-FAS 123R. The control group consists of 658 firm-year observations over fiscal years 2002 through 2008 surrounding the adoption of FAS 123R.

Panel A

	Control Firms			Treated Firms		
	N	Mean	Median	N	Mean	Median
Vega ($000)						
Vega_c	658	6.90	0.00	6325	31.59*	12.10*
Vega_t	658	84.92	8.76	6325	156.17*	69.44*
Policy/Firm Risk Measures						
R&D	658	0.02	0.00	6325	0.04*	0.01*
CAPEX	656	0.05	0.03	6319	0.05	0.03
Cash	658	0.19	0.14	6323	0.17*	0.10*
Leverage	658	0.17	0.12	6325	0.21*	0.19*
MTB	658	1.94	1.57	6325	1.99	1.63*
Volatility	658	0.42	0.37	6325	0.43	0.36
Total Book Assets (in millions)	658	2939.28	764.94	6325	4973.84*	1397.30*
Log (Total Book Assets)	658	6.87	6.64	6325	7.33*	7.24*

* indicates that means/medians of variables in the control and treated groups are significantly different at 5%.

Table 1 Panel B

	Pre			Post		
	N	Mean	Median	N	Mean	Median
Vega ($000)						
Vega_c	278	0.00	0.00	380	11.94*	0.00*
Vega_t	278	104.00	11.74	380	70.95	8.40
Policy/Firm Risk Measures						
R&D	278	0.02	0.00	380	0.02	0.00
CAPEX	276	0.05	0.03	380	0.06*	0.04*
Cash	278	0.21	0.16	380	0.17*	0.12*
Leverage	278	0.17	0.10	380	0.18	0.13
MTB	278	2.00	1.66	380	1.89	1.50*
Volatility	278	0.48	0.41	380	0.37*	0.34*
Total Book Assets (in millions)	278	2721.14	660.67	380	3098.86	854.38*
Log (Total Book Assets)	278	6.74	6.49	380	6.97*	6.75*

* indicates that means/medians of variables from pre- to post-123R period are significantly different at 5%.

Table 1 Continued. Panel C

	Pre			Post		
	N	Mean	Median	N	Mean	Median
Vega ($000)						
Vega_c	2787	33.34	14.16	3538	30.21*	10.38*
Vega_t	2787	160.00	72.90	3538	153.15	66.54*
Policy/Firm Risk Measures						
R&D	2787	0.04	0.01	3538	0.04	0.01
CAPEX	2787	0.05	0.03	3532	0.05*	0.04*
Cash	2787	0.18	0.11	3536	0.16*	0.10*
Leverage	2787	0.21	0.20	3538	0.21	0.19
MTB	2787	2.04	1.63	3538	1.94*	1.63*
Volatility	2787	0.52	0.45	3538	0.35*	0.32*
Total Book Assets (in millions)	2787	4289.86	1103.79	3538	5512.63*	1613.35*
Log (Total Book Assets)	2787	7.17	7.01	3538	7.46*	7.39*

* indicates that means/medians of variables from pre- to post-123R period are significantly different at 5%.

Table 2. Firm Fixed-Effect Regressions Describing Difference-in-Difference Tests of Firm Policies/Firm Risk Using a Control Group.

The table contains results from firm fixed-effects regressions describing difference-in-difference tests of firms' investment/financing policies using a control group. In Panel A we report the results from regressions that include a post-123R indicator and an interaction between post-123R and a treated indicator to capture the difference between the two groups' responses to FAS 123R. Note that the main effect of treatment is subsumed by the firm fixed effects. The independent variables in Panel B follow Coles, Daniel and Naveen (2006) and Chava and Purnanandam (2010). We do not report most of the control variables in Panel B for brevity. The sample consists of 6,983 firm-year observations over fiscal years 2002 to 2008 surrounding the adoption of FAS 123R. The table reports t-statistics based on robust standard errors clustered at the firm level in parentheses. Asterisks denote statistical significance. *** = significant at 1%, ** = significant at 5%, * = significant at 10%.

		Panel A			
Independent Variable	R&D	CAPEX	Leverage	Cash	Log (Volatility)
Post-123R	0.00671***	0.00662**	0.0102	-0.0157*	-0.268***
	(3.05)	(1.97)	(0.99)	(-1.72)	(-7.79)
Post * Treated	0.000912	-0.00281	-0.0109	0.0119	-0.0536
	(0.45)	(-0.77)	(-1.00)	(1.24)	(-1.51)
Log (Total Book Assets)	-0.0253***	-0.00280	0.0139	-0.0379***	-0.0820***
	(-4.03)	(-1.31)	(0.86)	(-5.16)	(-4.48)
N	6983	6975	6983	6981	6983
Adjusted R2	0.787	0.714	0.721	0.811	0.743
		Panel B			
Independent Variable	R&D	CAPEX	Leverage	Cash	Log (Volatility)
Post-123R	0.00368	0.00501*	0.00183	-0.0192**	-0.273***
	(1.63)	(1.70)	(0.16)	(-2.25)	(-7.76)
Post * Treated	0.000391	-0.00443	-0.00200	0.0131	-0.0487
	(0.19)	(-1.41)	(-0.20)	(1.47)	(-1.35)

Table 3. Firm Fixed-Effect Regressions Describing Changes in CEO Incentive Measures (Alternative Measures of Delta and Vega Scaled by Total Assets) Around the Adoption of FAS 123R.

The table contains results from firm fixed-effects regressions describing changes in the CEO incentive measures (alternative measures of Delta and Vega) around FAS 123R. The sample consists of 6,983 firm-year observations over fiscal year 2002 to 2008 surrounding the adoption of FAS 123R. In Panel A, the dependent variables in the regressions are various incentive measures scaled by total assets. In Panel B, the dependent variables in the regressions use a definition of Delta based on 0.01 dollar (as opposed to a 1%) change in stock price and a definition of Vega based on a 1% (as opposed to a 0.01) change in volatility. The independent variables mainly follow Guay (1999). The table reports t-statistics based on robust standard errors clustered at the firm level in parentheses. Asterisks denote statistical significance. *** = significant at 1%, ** = significant at 5%, * = significant at 10%.

Panel A

Independent Variable	Delta_c_at	Delta_t_at	Vega_c_at	Vega_t_at
Post-123R	-0.0000252	-0.0624***	-0.00301***	-0.00974***
	(-0.03)	(-5.66)	(-6.24)	(-5.45)
Log (Total Book Assets)	-0.0116***	-0.177***	-0.00593***	-0.0281***
	(-7.23)	(-8.86)	(-6.39)	(-8.43)
Cash Compensation	0.000000434	0.00000742	3.92e-08	0.000000835
	(1.14)	(1.30)	(0.13)	(0.83)
Tenure	-0.000494***	0.0263***	-0.000325***	0.000702**
	(-5.99)	(10.23)	(-6.04)	(2.57)
N	6983	6983	6983	6983
Adjusted R^2	0.355	0.747	0.399	0.707

Panel B

Independent Variable	Delta_c_dollar	Delta_t_dollar	Vega_c_percent	Vega_t_percent
Post-123R	0.175***	-2.512***	-3.656***	-19.01***
	(2.91)	(-4.41)	(-12.00)	(-13.85)
Log (Total Book Assets)	-0.0120	1.606*	2.024***	10.94***
	(-0.11)	(1.69)	(4.33)	(5.16)
Cash Compensation	0.0000334	0.000458	-0.000202	0.000684
	(1.36)	(1.36)	(-0.86)	(0.88)
Tenure	-0.0275***	1.434***	-0.123***	0.858***
	(-3.47)	(11.97)	(-3.57)	(3.93)
N	6983	6983	6983	6983
Adjusted R^2	0.447	0.794	0.496	0.721

Table 4. Firm Fixed-Effect Regressions Describing Changes In Vega_c of CEO Compensation Around the Adoption of FAS 123R In Subsamples.

The table contains results from firm fixed-effects regressions describing changes in Vega_c of CEO compensation around FAS 123R in subsamples. The sample consists of 6,983 firm-year observations over fiscal year 2002 to 2008 surrounding the adoption of FAS 123R. The dependent variables are Vega_c of CEO compensation. We divide the whole sample into subsamples on the basis of two types of variables: Accounting Impact and a proxy for the firm's demand for risk-taking. Then we run separate regressions in each subsample. Low / High Accounting Impact refers to below and above median of average Accounting Impact for the pre-FAS 123R period, which is fiscal year 2002 to 2004. The proxies for the demand for risk-taking include the Market-to-Book ratio (market value of assets to book value of assets) in Panel A (low and high Market-to-Book refers to below and above median of Market-to-Book ratio for pre-FAS 123R period, which is fiscal year 2002 to 2004), the ratio of R&D spending to total book assets in Panel B (zero and non-zero refers to average zero and non-zero R&D ratio for pre-FAS 123R period, which is fiscal year 2002 to 2004), and subsamples of new and non-new economy firms as defined by Ittner, Lambert and Larcker (2003) in Panel C. The independent variables in the regressions include an indicator (Post-123R) equal to one for the post-FAS 123R period (which is defined as fiscal years 2005 through 2008) and zero otherwise, and other control variables that include size of the firm (Natural log of total book assets), cash compensation and CEO tenure. We report only the coefficient loaded on the post-FAS 123R indicator and provide p-values for tests that coefficients on the Post-123R indicators are equal. Variables are defined in appendix B. The table reports t-statistics based on robust standard errors clustered at the firm level in parentheses. Asterisks denote statistical significance. *** = significant at 1%, ** = significant at 5%, * = significant at 10%.

Panel A

	Low Accounting Impact	High Accounting Impact	p-value for test that coefficients on the Post-123R indicators for subsamples of different Accounting Impacts are equal
Low Market-to-Book	-0.877	-2.871*	0.3432
	(-0.69)	(-1.72)	
High Market-to-Book	-2.284	-9.478***	0.0024
	(-1.36)	(-5.69)	
p-value for test that coefficients on the Post-123R indicators for subsamples of different risk-taking measures are equal	0.5057	0.0051	

Panel B

	Low Accounting Impact	High Accounting Impact	p-value for test that coefficients on the Post-123R indicators for subsamples of different Accounting Impacts are equal
Zero R&D	-2.704*	-5.556**	0.2996
	(-1.94)	(-2.35)	
Non-Zero R&D	0.201	-7.496***	0.0000
	(0.15)	(-5.73)	
p-value for test that coefficients on the Post-123R indicators for subsamples of different risk-taking measures are equal	0.1337	0.4733	

Table 4 Continued. Panel C

	Low Accounting Impact	High Accounting Impact	p-value for test that coefficients on the Post-123R indicators for subsamples of different Accounting Impacts are equal
Non-New Economy	-1.548	-6.176***	0.0087
	(-1.54)	(-4.26)	
New Economy	-0.248	-7.444***	0.1131
	(-0.06)	(-3.59)	
p-value for test that coefficients on the Post-123R indicators for subsamples of different risk-taking measures are equal	0.7548	0.6158	

Table 5. Cross-Sectional Regressions Describing Changes in Investment And Financing Policies Around the Adoption of FAS 123R.

The table contains results from cross-sectional regressions describing changes in investment and financing policies around FAS 123R. We take the average of each variable for each firm pre- and post-FAS 123R and use the difference in the regression. The sample consists of 1,150 firm observations surrounding the adoption of FAS 123R. The dependent variables in the regressions are various investment and financing policies measures. The independent variables in the regressions mainly follow Coles, Daniel and Naveen (2006) and Chava and Purnanandam (2010). The table reports t-statistics based on robust standard errors clustered at the firm level in parentheses. Asterisks denote statistical significance. *** = significant at 1%, ** = significant at 5%, * = significant at 10%.

Independent Variable	Change in R&D	Change in CAPEX	Change in Leverage	Change in Cash
Change in P_OptLTIA	-0.00615	0.00614	-0.0530***	-0.0160
	(-1.55)	(1.37)	(-2.92)	(-1.32)
Change in Cash Compensation	0.000000645**	0.00000122		
	(2.10)	(1.18)		
Change in Log (Sale)	-0.00501	0.00224	-0.00369	
	(-1.26)	(0.67)	(-0.26)	
Change in MTB	0.00588**	0.00701***		0.0212***
	(2.13)	(4.29)		(3.63)
Change in Surplus Cash	-0.0326	0.0384**		
	(-0.72)	(2.09)		
Change in Sales Growth	-0.0404***	0.00279		
	(-3.94)	(0.37)		
Change in Last Year's Stock Return	0.00537*	-0.0128***		
	(1.77)	(-4.38)		
Change in Leverage	-0.0135	-0.0205**		-0.163***
	(-0.99)	(-2.37)		(-5.08)
Change in ROA			0.279**	
			(2.38)	

Change in Modzq			-0.0779***	
			(-6.97)	
Change in RDS			0.0395*	0.0158
			(1.87)	(0.86)
Change in PPE			0.112	
			(1.43)	
Change in Rated			0.101***	
			(4.32)	
Change in Log (Total Book Assets)				-0.0250***
				(-3.12)
Change in Cflow				0.0392
				(0.83)
Change in Net Working Capital				-0.244***
				(-5.17)
Change in Acquisition				-0.163**
				(-2.37)
Change in CAPEX				-0.366***
				(-4.01)
Change in Dividend Payer Indicator				-0.00408
				(-0.42)
Change in Tenure				
Change in R&D				
N	1129	1129	1150	1133
Adjusted R^2	0.117	0.068	0.135	0.157

Appendix: An Approximate Method for Calculating Convexity of Long Term Incentive Awards (LTIA)

Convexity (Vega) of LTIA is defined as the change in LTIA value for a 0.01 change in stock return volatility.

We make the following assumptions about the LTIA:

1) Payments under the LTIA are settled in shares of stock. Under this assumption, we convert any dollar payments to be made under LTIA into a number of shares by dividing the dollar value by fiscal year end stock price. Consequently, we will have a threshold/target/maximum number of shares ($n_{Threshold}, n_{Target}, n_{Threshold}$) to be paid for each firm that has a LTIA plan. Further, if the threshold number is missing, we set it to zero. If the maximum number is missing, we set it to be the target number.
2) Let P^0 be the stock price at $T=0$. Define σ as stock return volatility, where we calculate σ^2 as the yearly variance of the stock calculated using the past 3 years' monthly return as of $T=0$. The stock price after T years P^T is lognormally distributed with mean of $(r_f - \frac{\sigma^2}{2})T$ and variance of $T \times \sigma^2$; i.e.,
$$P^T = P^0 \exp\left[(r_f - \frac{\sigma^2}{2})T + u\sqrt{T}\sigma \right] \qquad (1)$$
Where u is a standard normal random variable with zero mean and variance of 1, with probability density function $f(u) = \frac{1}{\sqrt{2\pi}} \exp\left(-\frac{u^2}{2} \right)$.
3) LTIA payout is determined solely by stock price. For each LTIA grant, we set three prices $P_{Threshold}, P_{Target}, P_{Max}$ (see assumption 7 for details about how these prices are determined), and the LTIA payout schedule is defined as follows. If $P_{Target} > P^T \geq P_{Threshold}$, the threshold number of shares will be paid. If $P_{Max} > P^T \geq P_{Target}$, the target number of shares will be paid. If $P^T \geq P_{Max}$, the maximum number of shares in the LTIA will be paid.
4) T=0 is defined as the end of the fiscal year when LTIA is granted.
5) Performance in the LTIA will be evaluated after 3 years; i.e., at T=3.
6) Risk free rate $r_f = 10\%$.
7) For firm A with price P_A^0 at time 0 and volatility σ_A, let $P_{Threshold}, P_{Target}, P_{Max}$ be the following: $P_{Threshold}^A = P_A^0 \exp\left[(r_f - \frac{\sigma_A^2}{2})T - \sqrt{T}\sigma_A \right]$; $P_{Target}^A = P_A^0 \exp\left[(r_f - \frac{\sigma_A^2}{2})T \right]$. $P_{Max}^A = P_A^0 \exp\left[(r_f - \frac{\sigma_A^2}{2})T + \sqrt{T}\sigma_A \right]$. Note that these three prices do not change for a given firm.

Next, we calculate the value of LTIA for volatility σ_A and volatility $\sigma_A^1 = \sigma_A + 0.01$ under the above assumptions. We use the calculated values of LTIA to compute the convexity.

1) Calculate the value of LTIA when firm A's volatility is σ_A. In order to get the expected payoff when stock volatility is σ_A, we plug each value of $P_{Threshold}^A, P_{Target}^A, P_{Max}^A$ from assumption 7 above into equation (1), and set $\sigma = \sigma_A$ in order to solve for $u_{Threshold}$, u_{Target}, and u_{Max}. The value of LTIA for volatility σ_A is represented by:
$$Value_{\sigma_A}^{LTIA} = e^{-r_f T} \left(\int_{u_{Threshold}}^{u_{Target}} n_{Threshold} P_{\sigma_A}^T f(u) du + \int_{u_{Target}}^{u_{Max}} n_{Target} P_{\sigma_A}^T f(u) du + \int_{u_{Max}}^{\infty} n_{Max} P_{\sigma_A}^T f(u) du \right)$$

2) Calculate the value of LTIA when firm A's volatility increases by 0.01, i.e. at $\sigma_A^1 = \sigma_A + 0.01$. As before, we plug each value of $P_{Threshold}^A, P_{Target}^A, P_{Max}^A$ from assumption 7 above into equation (1) and set $\sigma = \sigma_A^1$ in order to solve for $u_{Threshold}^1$, u_{Target}^1, and u_{Max}^1. The value of LTIA for volatility σ_A^1 is represented by:

$$Value_{\sigma_A^1}^{LTIA} = e^{-r_f T}\left(\int_{u_{Threshold}^1}^{u_{Target}^1} n_{Threshold} P_{\sigma_A^1}^T f(u)du + \int_{u_{Target}^1}^{u_{Max}^1} n_{Target} P_{\sigma_A^1}^T f(u)du + \int_{u_{Max}^1}^{\infty} n_{Max} P_{\sigma_A^1}^T f(u)du \right)$$

3) Convexity of LTIA $= Value_{\sigma_A^1}^{LTIA} - Value_{\sigma_A}^{LTIA}$

We use Maple to do the numerical calculations. Tables 1 and 2 present the summary statistics. Table 3 presents firm fixed-effects regressions describing changes in Vega_c (including calculated convexity from LTIA) around FAS 123R.

Table 1 Summary statistics for the subsample of 1,552 non-zero current LTIA firms

	N	Mean	Std	Min	P10	P25	P50	P75	P90	Max
Convexity of LTIA ($000)										
Entire Period	1552	1.56	22.10	-626.11	-4.43	-0.88	0.00	3.79	14.98	61.27
Pre Period	379	1.92	19.40	-319.66	-3.24	-1.33	0.43	4.03	14.85	47.33
Post Period	1173	1.45	22.91	-626.11	-5.24	-0.81	0.00	3.49	15.14	61.27

Table 2 Summary Statistics for Vega_c Including Calculated Convexity from LTIA
Panel A contains summary statistics over the entire sample period. Panel B contains summary statistics pre- and post-FAS 123R. The sample consists of 6,983 firm-year observations over fiscal years 2002 through 2008 surrounding the adoption of FAS 123R.

Panel A

	N	Mean	Std	P25	P50	P75
Vega ($000)						
Vega_c	6983	29.61	50.64	0.00	10.13	35.99

Panel B

		Pre			Post	
	N	Mean	Median	N	Mean	Median
Vega ($000)						
Vega_c	3065	30.56	11.45	3918	28.87	9.08*

* indicates that means/medians of variables in the pre- and post-periods are significantly different at 5%.

Table 3 Firm Fixed-Effect Regressions Describing Changes in Vega_c Including Calculated Convexity from LTIA

The table contains results from firm fixed-effects regressions describing changes in Vega_c (including calculated convexity from LTIA) around FAS 123R. The sample consists of 6,983 firm-year observations over fiscal year 2002 to 2008 surrounding the adoption of FAS 123R. The dependent variable in the regression is Vega_c, which includes convexity calculated from LTIA in this appendix. The independent variables mainly follow Guay (1999). The table reports t-statistics based on robust standard errors clustered at the firm level in parentheses. Asterisks denote statistical significance. *** = significant at 1%, ** = significant at 5%, * = significant at 10%.

Independent Variable	Vega_c
Post-123R	-4.312***
	(-3.44)
Log (Total Book Assets)	10.57***
	(4.87)
Cash Compensation	-0.00108
	(-0.67)
Tenure	-0.360**
	(-2.25)
N	6983
Adjusted R^2	0.526