# Performance-Vesting Provisions in Executive Compensation

by

J. Carr Bettis[a], John Bizjak[b], Jeffrey Coles[c,*], and Swaminathan Kalpathy[d]

This draft: September 12, 2016


## Abstract

The usage of performance vesting (p-v) equity awards to top executives in large US companies has grown from 20 to 70 percent from 1998 to 2012. We assess the implications of these increasingly complex awards by examining the accuracy of and biases in disclosure and the connection between the structure of executive pay, risk-taking incentives, and firm risk. To do so, we develop and implement new methods that empirically quantify the significant effects of p-v provisions on the value, delta, and vega of equity-based compensation. We find large biases in the value of executive compensation reported in company disclosures. The elasticity of reported value in economic value is far less than one, with additional bias downward (upward) for large institutional ownership (when the firm uses a high-market-share compensation consultant). Our analysis empirically reaffirms the presence of a causal relation in both the time series and cross section between compensation convexity and firm risk.


*JEL Classifications: M52, M55, J33, G34; G32, G13, M41.*
*Keywords: Performance-vesting provisions, executive compensation, stock awards, option awards, time-vesting, performance measures, CEO pay, corporate governance.*

---

[a] *Research Professor of Finance, W.P. Carey School of Business, Arizona State University, Tempe, AZ, 85287, USA; carr@asu.edu*
[b] *Robert and Maria Lowden Chair of Finance, Neeley School of Business, Texas Christian University, Fort Worth, TX, 76129, USA; j.bizjak@tcu.edu*
[c] *Samuel S. Stewart, Jr. Presidential Chair in Business, David Eccles School of Business, University of Utah, Salt Lake City, UT, 84112, USA; jeff.coles@eccles.utah.edu*
[d] *Assistant Professor of Finance, Neeley School of Business, Texas Christian University, Fort Worth, TX, 76129, USA; s.kalpathy@tcu.edu*
[*] *Corresponding author.*

We thank discussants Shane Johnson (2012 Lone Star Finance Conference), Stuart Gillan (9th Annual Conference on Corporate Finance, Washington University in St. Louis, 2012), David Erkens (23rd Annual Conference on Financial Economics and Accounting, USC, 2012), Lixiong Guo (2013 FIRS Conference), Dalida Kadyrzhanova (2013 SFS Cavalcade), John Core (2014 Annual Georgia State University CEAR/Finance Symposium), Mireia Gine (2014 European Finance Association Annual Meeting), Kristina Minnick (2014 EFMA Annual Conference), Shinya Tsujimoto (2014 FMA Asian Conference), Abudy Meni (2014 EUROFIDAI Conference), Rik Sen (2015 HKUST Finance Symposium), Florian Peters (2016 Erasmus Workshop on Corporate Governance and Executive Compensation), seminar participants at those conferences and at the University of Utah, Arizona State University, Chinese University of Hong Kong, Erasmus University of Rotterdam, Texas Christian University, Temple University, University of Amsterdam, University of Tennessee, and the University of Louisville for helpful comments. The authors are grateful to Incentive Lab, a Scottsdale, Arizona compensation data and science firm (now a unit of ISS), for generously supporting collection of data on vesting provisions and for providing additional data. The analysis and conclusions in this paper are those of the authors and have been formulated independently of the views of Incentive Lab. Bettis and Coles formerly served as consultants to ISS Incentive Lab.

## 1. Introduction

In contrast to traditional time-based vesting (t-v), performance-vesting (p-v) provisions either accelerate or trigger vesting of stock, option and cash grants to executives. The criteria for number of units vested or accelerated are commonly based on one or more accounting, stock-price, or other metrics, such as market share, sales growth, or customer satisfaction. A recent illustrative form of a *simple* conditional p-v grant conveys stock, with the number of shares granted equal to zero up to some performance threshold, a discrete jump in shares granted at that minimum performance level, and a ceiling number of shares granted beyond a maximal performance level. Between the threshold and ceiling is an "incentive zone," a range which contains a "target" number of shares granted at a corresponding "target" performance level. In this zone, the number of shares granted is specified by a schedule that is a function of performance, potentially with both discrete steps and continuous sections over the performance domain. Figure 1 depicts two such piecewise-linear p-v grant schedules. L3 Communications (Amgen) granted stock to CEO Michael Strianese (Kevin Sharer) in 2008 contingent on and largely concave (convex) in diluted EPS growth rate (annualized total stock return, TSR) in the incentive zone over a three-year performance period.

To our knowledge, initial usage of this innovation in compensation contracts appeared in the early to mid-1990s in FTSE-100 firms.[1] Large U.S.-listed firms followed soon after. Gerakos, Ittner, and Larcker (GIL, 2007) study 128 U.S. firms that between 1993 and 2002 either issued premium options (exercise price above the issue-date stock price) or made a first p-v option grant to their CEOs. Bettis, Bizjak, Coles, and Kalpathy (2010, BBCK) identify 983 p-v grants of stock or options among

[1] In FTSE-100 firms, Camara and Henderson (2009) examine the "real earnings performance based stock option," or the "REPBSO." Carter, Ittner, and Zechman (2009) stress that "the vast majority of long term incentive plans in large UK companies link the vesting of stock options to performance targets, [and one of the] most common performance targets is earnings per share (EPS)". Likewise, Kuang (2008) notes that by 2003, 90 % of the FTSE top 250 non-financial firms had stock options with performance criteria, and that the most widely adopted target was the growth rate of EPS. Conyon et al (2000) find 72% of firms in their 1997 sample of UK firms use performance criteria, typically a hurdle based on earnings per share.

approximately 2,000 large U.S. firms over the period 1995-2001. As we build on this prior literature, it is important to note that, relative to the data and analysis in GIL (2007) and BBCK (2010), the nature of equity-based compensation has changed significantly in practice in two respects. First, early U.S. versions of p-v grants were quite simple, all-or-none in nature, with zero vesting of shares or options up to some threshold level of performance and full vesting of the shares or options if that threshold were met or surpassed. In stark contrast, among large U.S. firms over the last decade p-v awards of stock, options, and cash to executives have become considerably more complex. Second, even in the largest of the early samples (BBCK, 2010), p-v provisions represented only about 7% of stock and option grants, while traditional time-vesting grants then were the dominant vesting model. Current practice is substantially different. In our sample of U.S. firms, p-v grants are approaching and potentially will overtake t-v provisions in usage.[2] As a consequence of these two trends, measurement of the value and incentive properties of stock and option awards is confounded considerably, as traditional time-based vesting has been displaced by complex performance-vesting provisions.

The trend toward p-v provisions is placed in the context of recent, broad-based, visible debate over corporate governance and regulation in general,[3] and over the level, structure, and incentive properties of executive compensation, in particular.[4] Of particular importance is FASB ASC Section

[2] Institutional Shareholder Services, Inc., the largest proxy advisor, asserts that this already has occurred. In reference to p-v awards, ISS (2013) states that "2012 marked a seminal year in executive compensation: the first year where the majority of CEO grant-date pay was performance based."

[3] Various rules arising from the Sarbanes-Oxley Act of 2002 (SOX), the Emergency Economic Stabilization Act of 2008 (EESA), the American Recovery and Reinvestment Act of 2009 (ARRA), and the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 ("Dodd-Frank") regulate executive compensation. Moreover, the Special Master for TARP Executive Pay was provided significant latitude in regulating internal incentives at individual financial firms receiving U.S. government assistance.

[4] The recent academic literature focuses significant attention on a wide variety of questions related to executive compensation, questions that also are of interest to regulators and investors. Examples include usage and form of clawback provisions (Babenko, Bennett, Bizjak, and Coles, 2015; Chen, Greene, and Owers, 2015), the effects of incentive alignment on performance (e.g., Coles, Lemmon, and Meschke, 2012), the relation between firm size and pay (Edmans, Gabaix, and Landier, 2009), the relation between pay and domicile (Fernandez, Ferreira, Matos, and Murphy, 2013), whether executives undo pay-related incentives through hedging (Bettis, Bizjak, and Kalpathy, 2015), peer-group formation (Bizjak, Lemmon, and Nguyen, 2011), the effects of compensation structure on risk-taking (Coles, Daniel, and Naveen, 2006), and whether executive pay caused the financial crisis (Murphy and Jensen, 2011).

718 (formerly FAS 123R), which went into effect in 2005 for most firms. ASC 718 specifies revised reporting conventions that eliminate prior special treatment for option grants. One result has been a significant shift away from option awards towards stock grants (Carter, Lynch, and Tuna, 2007; Brown and Lee, 2011) and a purported (by Hayes, Lemmon, and Qiu, 2012, HLQ) corresponding reduction in executive risk-taking incentives. Moreover, ASC 718 promulgates reporting standards that are relatively flexible, should the award depend on accounting performance. A consequence, as our data indicate, appears to be that accounting metrics are displacing stock-price metrics in the performance conditions of p-v awards.

The changing accounting and disclosure standards, decline in option usage, increased usage of p-v awards, and the increasing complexity and reliance on accounting metrics (and associated measurement intricacies) of p-v awards raise at least two unexamined issues. We extend the prior literature, which focused on the determinants and implications of usage for early rudimentary p-v awards,[5] by addressing: (i) the accuracy of and biases in disclosure; and (ii) the connection between the structure of executive pay, risk-taking incentives, and firm risk.

These two questions are bound together by both the need for detailed data on compensation contracts and, given data, the need to measure the value and incentive properties of complex p-v awards. Based on hand-collected data from proxy statements on all grants of stock and options to named executive officers (NEOs) in 1,833 large U.S. firms over the period 1998-2012, we provide a comprehensive characterization of the incidence and form of both p-v and traditional t-v provisions in large U.S.-listed companies. As it turns out, the GIL (2007) and BBCK (2010) samples were only the tip of the growing iceberg. As depicted in Figure 3, usage has increased from 20% in 1998 to the point

[5] BBCK (2010), like GIL (2007), examined the determinants and implications of usage for early rudimentary p-v awards. For example, BBCK (2010) find that the propensity to use p-v provisions is positively related to the arrival of a new CEO and the proportion of outsiders on the board of directors and negatively related to prior stock performance. Performance-vesting firms have significantly better subsequent operating performance than control firms.

that in 2012 just under 70% of large U.S. firms utilize in a given year a p-v award to one or more top executives.

With these data, we confront the intricacies of the measurement of value and incentive properties of now ubiquitous complex p-v awards. To clarify, by value we mean the expected value of the grants of stock and options, which we label estimated or simulated *economic value*. By incentive characteristics, we mean: "delta," the sensitivity of expected executive wealth to stock price, arising from the stock and option portfolio of the executive; and "vega," the sensitivity of expected executive wealth to a change in the volatility of stock return. It is not particularly difficult to value simple time-vested stock and options, or even primitive p-v grants (BBCK, 2010), and to calculate their delta and vega. On the other hand, as will become apparent, value, delta, and vega are significantly more problematic to measure when the grant relies on a more complex vesting provisions based on one or more accounting (e.g., earnings, income, sales, ROA, ROE, EBITDA margin), stock-price, market-share, or other non-stock-price, non-accounting metric. A simple benchmark value, essentially as if the option or stock grant were unencumbered by the p-v provision, would be "target value," the product of the target number of shares or options expected to vest times the grant date value per share or option.[6] Accommodating correlation between the accounting performance metric and stock price and the relation between the grant schedule and the value of the back-end instrument, the average grant date economic value is on average 42% lower than unencumbered target value.

When a p-v grant depends on accounting performance and stock and accounting performance are related, conventional delta and vega are incomplete because they neglect the effects of performance and volatility on grant value through the accounting-metric channel. Of course, an immediate question is whether the accounting channel is empirically meaningful relative to the stock-price channel. We

[6] This is one version of a variety of calculations falling under the label of "realizable pay." See Equilar (2014).

develop new measures of delta and vega that isolate the marginal effects of accounting performance and volatility and also construct aggregate delta and vega that combine the performance and volatility effects through both the stock price and accounting channels.

We find that p-v provisions have significant implications for managerial incentives. Scaling the size of the p-v grant to be equal in value to the grant of stock or options had there been no p-v provision, the median marginal stock price delta of a value-neutral stock price p-v stock grant is about 160 % larger than without the performance-contingent grant schedule. For p-v stock grants based on a single accounting metric, the accounting channel supplements marginal stock price delta to enhance executive delta incentives by approximately 72 %. We also find that p-v awards contingent on stock and/or accounting performance on average convey the incentive to increase performance volatility. For example, for a stock-price-based p-v option award, the p-v schedule on average approximately doubles vega, holding value constant. In the subsample of p-v option and stock awards based on a single accounting metric, the average aggregate vega with the p-v schedule is more than 12 times the vega absent the p-v provision.

In terms of our two primary contributions, we first examine disclosure practices, specifically the extent to which the disclosed value of p-v awards is driven by various measures of award value. Corporate disclosure is seen to be necessary for price discovery in capital markets, the efficiency of which then is a means to effectively allocate scarce human and financial capital to promising investment opportunities (Healy and Palepu, 2001; Bushman and Smith, 2003). Estimated economic value differs from what is disclosed as grant date fair value (GDFV). The mean (median) p-v grant value disclosed in proxy statements is 30% (79%) higher than the simulated economic value. Moreover, if economic value drives disclosed GDFV we would expect unit elasticity of the latter in the former. Our estimates are much smaller. The elasticity of GDFV in economic value is 0.449

(0.667) for p-v awards based on an accounting (stock-price) metric. Such biases are particularly surprising for stock-price-based p-v awards, as FASB endorses the risk-neutral simulation methods that we deploy herein to measure economic value. For p-v accounting awards, however, the FASB allows more latitude in reporting, so various other approaches to estimating value appear to be acceptable.[7] Indeed, the elasticity of disclosed GDFV in benchmark or target value is quite close to one (0.964) for p-v accounting awards, though we also document the puzzling result that target value has significant explanatory power for the GDFV of stock-price-based grants as well.

ASC 718 was implemented to improve disclosure of the cost of compensation.[8] We find instead that the connection between GDFV and economic value declines after ASC 718 went into effect. This likely is a combination of three factors: a shift to reliance on accounting metrics after 2005; accounting awards have a lower elasticity of GDFV in economic value than p-v stock-price awards; and the elasticity of the GDFV of accounting awards in economic value declined from 0.84 pre-2005 to about 0.45 after 2005. Overall, we find significant biases in reporting in the full sample (1998-2012) and that the quality of disclosure actually decreased after ASC 718 went into effect.

Second, we examine the connection between p-v awards and firm risk. The structure of managerial compensation is seen to be an important aspect of corporate governance and incentive alignment, by which shareholders can induce managers to work hard, take appropriate risks, and generally select and implement firm policies that advance the interests of shareholders (Holmstrom, 1979; Jensen and Meckling, 1976). Empirically, for example, Guay (1999) and Coles, Daniel, and Naveen (2006) provide evidence of a strong causal relation between managerial compensation and

---

[7] The reason appears to be that it is uncertain as to whether the risk-neutral valuation methods, the FASB-sanctioned standard for stock-price-based awards, are appropriate for accounting-metric-based awards. We discuss further below.

[8] For example, in a summary statement (http://www.fasb.org/summary/stsum123r.shtml), FAS 123R is consistent with FASB Concepts Statement No. 2, *Qualitative Characteristics of Accounting Information*, in "…providing more relevant and reliable information about the costs incurred by the employer to obtain employee services in the marketplace."

firm risk, investment policy, and financial policy. Since stock awards have displaced option grants, however, Hayes, Lemmon, and Qiu (2012) assert that the compensation-related incentive to take risk (convexity) has declined significantly since ASC 718. Moreover, because firm risk has not declined since 2005, HLQ (2012) conclude that the evidence is inconsistent with the view that that the convexity in executive compensation, such as that arising from option awards, can be used to reduce risk-related agency problems between managers and shareholders. Our empirical evidence contradicts these conclusions. When the convexity in pay arising from p-v provisions is included in measurement, with the exception of 2008 pay convexity has not declined since ASC 718. Furthermore, based on comprehensive measurement of pay convexity, we find that compensation convexity has been and still is related to firm risk in both the time series and cross section. Our results appear to restore and reaffirm the causal connection between convexity in compensation and firm risk. In summary, our analysis indicates that p-v provisions can significantly amplify the managerial incentive to take risk and that firm risk is positively related to CEO risk incentives and firm risk.

## 2. Sample, Definitions, and Examples

We obtain from ISS Incentive Lab detailed data from proxy statements (DEF 14A) on the various aspects of all short-term and long-term (vesting term and/or performance period exceeding one year) stock, option, and cash awards to named executive officers (NEOs) over the period 1998-2012. We focus on all equity-based awards (stock and options as the backend securities), leaving analysis of cash awards to a concurrent paper (Li and Wang, 2016) and our own later study.

The sample of firms is based on the largest 750 firms, measured by market capitalization of the stock, in each of the years 1998-2012. The set of 750 largest firms changes from year to year. Back- and forward-filling yields 1,833 firms during the period between 1998 and 2012, though data will not be available for some firms in a given year for the usual reasons (e.g., merger, not listed). Of these 1,833 firms, 1,268 (69%) tie vesting of stock or stock options to stock price, accounting, or other non-financial performance metrics ("performance-based awards") one or more times in the sample period, while almost all firms (1,793) grant t-v stock or options once or more.

The data contain all the information provided in the proxy statements on the back-end security and on the functional form of the vesting provision. For t-v awards this includes the time horizon of the vesting schedule and whether the shares or options vest uniformly (also known as "ratable") or all at once ("cliff" vesting). For p-v awards, the data contain all reported information on absolute and relative performance metrics, hurdles, and other characteristics of grant schedules. We obtain stock price and dividend data from CRSP and accounting and other information from Compustat.

*Contingent*-vesting awards specify the number of units of stock or options that vest contingent on performance. *Accelerated*-vesting provisions specify that if certain performance conditions are satisfied then the award vests early. Otherwise, the award still vests but on a time-based schedule that represents the default. A very simple, all-or-none example would be a grant of N shares of stock to an executive that would vest only if (or early if) if annualized total stock return (TSR, stock market return plus dividends) exceeded Y% per year over a performance-measurement period of $\tau$ years.[9]

Such simple one-step grant schedules were the predominant form when US firms began to use p-v provisions in the mid-1990s (BBCK, 2010), but no longer are the norm. As Figure 1 indicates, both L3 Communications and Amgen recently used more complex contingent vesting provisions. Per the Grants of Plan-Based Awards (GPBA) table, at the threshold (target, ceiling) performance of 0% (8%, 18%) three-year annualized TSR, Mr. Kevin Sharer, the CEO of Amgen, would earn 36,500 (73,000, 146,000) common shares. The description of the award specifies interpolation between

[9] Per BBCK (2010, p. 3851), both the 1998 conditional option grant by Conoco to CEO Archie Dunham and the 1997 accelerated option award by Amgen to CEO Gordon Binder are examples of this sort of single-step grant schedule.

threshold, target, and ceiling and zero shares for TSR performance below 0% per year. Such details in the Amgen disclosure allow full characterization of the functional form of the grant schedule and ex post value for the stock award (Figure 2).

The p-v awards used by Amgen and L3 are based on single metrics, TSR or EPS. Some firms employ multiple metrics in their grants of p-v awards. Absolute performance evaluation (APE), under which the p-v provision is based on an absolute performance metric, is employed in both the Amgen and L3 awards and many other awards. In some instances, however, the p-v metric is defined relative to industry or peer-firm performance (relative performance evaluation, or RPE). See Appendix 1 for an example (Brunswick Corp.) of an award that employs both multiple performance metrics and RPE.

## 3. The Nature and Evolution of P-V Award Characteristics

### *3.1. P-V provisions are Displacing Time-Based Vesting Provisions*

Per Figure 3 and Table 1, the proportion of firms issuing one or more p-v awards to one or more NEOs in a given year has more than tripled over the sample period, from 21% in 1998 to nearly 70% (767 of 1,128) in 2012. Based on values reported by the firms themselves in proxy statements, the value of p-v grants as a proportion of the value of all equity-based (stock and options) grants has more than tripled over the same period from 12% to 41%.[10]

Table 1 contains summary statistics on the propensity of sample firms to make the various types of grants in a given year to one or more NEOs. The frequency counts identify stock versus options (as the back-end instrument) and t-v versus p-v for vesting. Our data indicate that stock is

[10] While our focus is on p-v grants, the Incentive Lab dataset also contains information on the types of awards that these grants are coming to displace. Several broad conclusions arise from examination of those data. Among t-v grants, the relative use of cliff vesting versus uniform vesting is declining for both option and stock awards. Ratable option and stock awards predominantly vest uniformly over either four, three, or five year periods (in declining order of frequency). For cliff vesting grants of stock or options, companies have moved away from immediate vesting to a longer horizon, most frequently with cliff vesting at three years from the grant date.

displacing options as the back-end security for both t-v and p-v grants and that, likewise, so are p-v awards displacing t-v awards. In Table 1 these trends appear to be most pronounced around ASC 718, which for 2006 and thereafter removed the preferential treatment in reporting and expensing given to options over restricted stock.[11]

### *3.2. Conditional vesting provisions have become the norm*

The number of firms that granted restricted stock with a contingent vesting provision has risen from 185 in 1998 to 739 in 2012 (Panel A, Table 2). The proportion of p-v provisions that are conditional (or "contingent") (versus accelerated) has risen from 72.8% to 98.8% over 1998-2012. Panel B indicates that p-v awards most frequently are based on absolute performance evaluation (APE) metrics rather than relative performance evaluation (RPE).[12] Hereafter, including Panels C-F, we focus on the bulk of the data, specifically *conditional* p-v *APE* awards.

### *3.3. P-V provisions increasingly are based on accounting performance metrics*

Panel C indicates that accounting performance metrics have displaced to some extent stock price metrics.[13] Among p-v grants, since 2003 more than four in five use an accounting hurdle alone or in conjunction with one or more other performance measure(s). Note that the figures in Panel C add up to more than 100% because some awards use multiple performance metrics. Accounting metrics are most common for grants of stock (Panel D). Panel E shows the wide spectrum of

---

[11] For a formal test of these two trends combined, we regress the change in proportion of the value of yearly executive pay arising from conditional APE *p-v stock* grants on the change in proportion of yearly pay arising from *t-v options*, the same change in proportion interacted with an indicator for post 2005, and controls. The value calculations for this regression are based on simulated economic value, as developed below in Section 4. The estimated coefficients are negative and highly significant for both the linear ($t = -8.18$, $p < 0.01$) and interaction ($t = -3.07$, $p < 0.01$) terms. Summing the two coefficients yields an offsetting contemporaneous response to a $1 reduction in t-v option grant value of an increase in p-v stock award value of $0.32 post-2005.

[12] Though absolute awards make up the majority of our sample, explicit relative performance evaluation appears to have been a nontrivial and persistent aspect of executive compensation. Bettis, Bizjak, Coles, and Young (2013) treat relative awards in detail.

[13] When a stock price or stock return metric is employed, typically the award specifies that the performance measure includes dividends paid over the performance period. Total stock return (TSR) includes dividends.

accounting metrics employed. Some measure of earnings is used in about two-thirds of instances in which an accounting-based p-v provision is employed, while some accounting rate of return is used in about one-quarter of cases. A cash-flow metric appears 13.1% of the time in the sample period.

As a matter of further description, consider the transition out of t-v equity-based grants towards p-v stock and option awards based on accounting performance. Given the relative flexibility accorded by ASC 718 (starting in 2006) in reporting of GDFV for p-v awards contingent on accounting performance, we expect that recent p-v awards are more likely to have been conditioned on accounting performance.[14] While the transition from options to stock around ASC 718 is well-documented (Carter, Lynch and Tuna, 2007; HLQ, 2012), our concern here is the transition to stock awards that are based on accounting performance directly, the mechanism being a performance-vesting schedule.

We control for other forces that should affect usage of accounting metrics versus TSR. First, per the Informativeness Principle (Holmstrom, 1979), to the extent that accounting metrics contain information in addition to that contained in stock return, executive pay should depend on accounting performance. Arguing likewise, Paul (1992) shows that it can be optimal to base compensation not just on stock price but also on accounting performance when the agent is engaged in multiple projects. In that model accounting performance aggregates project value differently than does the stock market and, thereby, contains information orthogonal to that in stock returns alone. Thus, because we expect p-v awards based on accounting performance to be more prevalent among firms with significant sales across multiple business segments, we control for firm focus. Second, in terms of the tension between incentive alignment and risk bearing, Sloan (1993) argues that if earnings are used to insulate executives from market-wide fluctuations in equity values then executive compensation should be more sensitive to earnings performance relative to stock-price performance the greater is the noise in

[14] See Hayes, Lemmon, and Qiu (2012) and BBCK (2010) for discussion of ASC 718 (FAS 123R).

stock returns versus earnings and the less positive (more negative) is the correlation between the noise in stock returns and the noise in earnings. Finally, just as p-v usage is relatively new, so especially are p-v grant schedules based on accounting performance. As contractual innovation diffuses through learning by doing or by way of organization responses to competitors, firm usage is likely to be positively related to industry usage.

Table 3 (models 1-3) reports results consistent with the expectation that accounting metrics will have displaced stock price metrics and hurdles after 2005. The sign on the Post-2005 indicator for use of an accounting metric in the p-v provision is positive and highly significant. The coefficient on the number of reported business segments is always positive and highly significant ($p < 0.01$), which supports the adaptation of Holmstrom (1979) in Paul (1992). While the estimated coefficient on the ratio of inverse signal-to-noise ratios essentially is zero, accounting metric usage is strongly negatively associated with the correlation of earnings with stock returns and with volatility of stock returns, which, like Sloan (1993), supports the notion that use of an earnings metric is meant in part to reduce exposure of the executive to market risk. Finally, accounting metric usage is positively related to industry usage, regardless of whether that industry norm arises from a Nash equilibrium in the structure of executive compensation, innovation in contracting facilitated by compensation consultants, pressure from proxy advisor ISS and Glass Lewis, or other forces.

## 4. A Framework for Measuring the Value of P-V Grants

While ASC 718 removed the preferential treatment in reporting and expensing given to options over restricted stock, it also allows additional flexibility in reporting and expensing for p-v grants that use any hurdle not based on stock price. For equity awards with stock price vesting conditions, firms must use standard proven methods to produce a valuation that incorporates the characteristics of both the back-end instrument and the grant schedule.[15] This value would be reported as the Grant Date Fair Value (GDFV) in the proxy statement and would not be adjusted in future accounting statements.

In contrast, no "formal" valuation need be conducted if the vesting condition is based on at least one metric other than stock price. For these types of awards, firms report a grant date fair value that need not incorporate the specific features of the vesting provision. For example, for a restricted stock (option) award with an accounting-based vesting condition, at least some firms report GDFV as the stock price (value based on Black and Scholes (1973)) on the grant date times the target number of units of that back-end instrument.[16] On the other hand, the value of a p-v accounting metric award is to be re-evaluated each quarter by management. If the likelihood of achieving the performance level assumed at grant date has changed, then the company adjusts the value of the award. Any revisions in expected payout affect value, expense, and taxes paid.

### *4.1. The grant date (ex ante) discounted expected value of ex post realized value*

Consider a p-v APE award that employs two performance metrics, where $A_t$ represents the level of an accounting metric that is the basis for a performance measure (e.g., some measure of earnings, EPS, ROA, ROE, ROI, etc.) and $P_t$ is stock price of the firm. The subscript indicates time $t \geq 0$ for the initial grant date ($t = 0$) and thereafter. The performance metrics have initial values at the grant date, $t = 0$, $A_0$ and $P_0$. Performance is evaluated over the "performance period," from $t = 0$ to $t = \tau$. While this example and associated notation focus on a mix of one accounting and one stock price metric, both $A$ and $P$ can be accounting metrics or both can be stock price metrics. In addition, in some instances p-v awards employ more than two performance metrics.

[15] Firms can use different methodologies as long as they are based on sound economic theory and practice. In the case of a stock or option award based on a stock price vesting condition, acceptable approaches can include Black-Scholes, binomial lattice models, Monte Carlo simulations, or a closed-form solution.

[16] One reason behind the discrepancy in reporting based on the vesting characteristic appears to be due to the fact that there are acceptable and "well-established" valuation techniques for valuing equity awards with stock price vesting conditions (e.g., a barrier option), but that the analogous techniques for equity awards with other types of performance metrics (e.g., sales growth) heretofore have not been available.

Let $N(A_\tau, P_\tau)$ denote the grant schedule. Figures 1 and 2 provide examples for simple grant schedules. For an award with stock as the back-end payout, $N(A_\tau, P_\tau)$ represents the number of shares of stock that vest at the end of the performance period $t = \tau$. Let $V(A_\tau, P_\tau)$ denote the value of the back-end instrument at the end of the performance period. For both options and stock awards $V(A_\tau, P_\tau)$ depends directly on $P_\tau$ only, so $V(A_\tau, P_\tau) = V(P_\tau)$. Ex post value of the conditional p-v grant, at the end of the performance period, is the product of the number of units earned through the performance-vesting provision and the value at time $t = \tau$ per unit of the back-end instrument, $N(A_\tau, P_\tau)V(P_\tau)$.

Let $\rho$ be the discount *rate* applied to $N(A_\tau, P_\tau)V(P_\tau)$. One approach to valuation and estimation of delta and vega is to rely on risk-neutral methods. For the case where the back end instrument is either stock or an option and the vesting barrier is a function of stock price only, then risk-neutral methods are appropriate. In contrast, valuing awards with accounting vesting conditions is more complicated.[17] When the accounting metric is not perfectly correlated with stock price, accounting risk is less easily hedged. For purposes of producing valuations with accounting vesting conditions, we assume accounting risk can also be hedged and thereby calculate value and incentive properties under a risk-neutral framework (e.g., Cox and Ross, 1976).[18] To the degree firms can hedge stock and accounting risk, our measure represents the cost of these awards to the firm. To the degree that accounting risk cannot be hedged by the firm (or any counter party), the values we produce will be upper bounds on the costs of these instruments to the firm.[19] Likewise, our calculations will also

---

[17] Johnson and Tian (2000) and Kuang and Suijs (2006) provide closed form solutions to stock options with a stock price barrier but do not consider valuation of awards with accounting vesting provisions. Bettis, Bizjak, Coles and Kalpathy (2010) use a risk-neutral framework to calculate the incentive properties (i.e., delta and vega) of awards with stock-price vesting conditions, but also do not treat accounting p-v awards.

[18] Holden and Kim (2014) and Bizjak, Kalpathy, and Thompson (2016) provide an analytical, risk-neutral value for some classes of p-v awards. We use risk-neutral, simulation methods to calculate value for a broader spectrum of p-v provisions.

[19] The valuation problem faced when it is not possible to hedge away the underlying risk is similar to producing the value of a stock option (or any derivative award) to an executive who cannot hedge away the risk of the particular instrument. Since executives hold undiversified portfolios and cannot hedge away the risk associated with the derivative award the value to the executive then depends on the risk preferences of the executive and the level of diversification of the

produce upper bounds from the firm's perspective on the incentives of these awards to increase stock price (i.e., delta) and to increase risk (i.e., vega), since both deltas and vegas are lower when the underlying risk of the derivative security cannot be hedged.[20] An additional benefit to valuing p-v equity awards under a risk-neutral framework is that it allows comparison of the value and incentive properties of p-v awards to other types of equity based pay granted to executives (i.e., t-v stock options and restricted stock) using methodology consistent with prior empirical work.[21]

### *4.2. Evolution of the state variables,* $A_t$, $P_t$ **and** *estimating the associated parameters*

Estimating *economic value* of a grant requires a probabilistic model of how the performance (state) variables $A_t$ and $P_t$ evolve from initial values $A_0$ and $P_0$ over the performance period, $t = 0$ to $t = \tau$, and beyond to any other $t > \tau$ of interest. We assume that rate of change in $(A_t, P_t)$, has a stationary multivariate cumulative distribution, $\vec{r} = (r_A, r_P) \sim \mathrm{F}(\vec{\mu}, \Sigma)$, with vector of expected drift rates given by $\vec{\mu}$ and the covariance (among drift rates) matrix by $\Sigma$. Both $A_t$ and $P_t$ can enter directly into ex post value of the grant and, thus will affect discounted, expected, *economic value* through the variation of each and covariation with each other.

When the grant schedule employs a performance metric based only on stock price, we use three years of weekly data up to the week just prior to the grant date ($t = 0$), or the valuation date $0 < t \leq \tau$ if it follows the grant date, to estimate the parameters of $(\vec{\mu}, \Sigma)$. Thus, for example, estimates of volatility rely on up to 156 (+1) months of data to calculate returns on $P$. When the grant schedule employs one or more accounting metrics, however, for some parameter estimates we employ five years of quarterly

executive's outside wealth. This value is lower than for a tradeable option. For further discussion see Hall and Murphy (2002) and Ingersoll (2006).

[20] See Hall and Murphy (2002) and Ingersoll (2006) for examples of how pricing options outside a risk-neutral framework lowers option deltas. Bettis, Bizjak, and Lemmon (2005) illustrate how vegas are affected when the risk of an option cannot be hedged. Bettis et al. (2005) not only demonstrate that in general vegas are lower outside a risk-neutral world but that for high levels of volatility vegas can be negative.

[21] The standard empirical methodology for valuing and measuring the incentive effects of time-vested stock options in executive compensation has been under a risk-neutral framework. For time vested-stock options see Murphy (1999), Core and Guay (2002), Hall and Murphy (2002), Coles, Daniel, and Naveen (2006).

data up to the most recent quarter prior to the valuation date.[22] Because the data are noisy and the observations few (20), for the granting firm we estimate $(\vec{\mu}, \Sigma)$ as the average across all firms, including the granting firm, in the same two-digit SIC.[23] Thus, for example, estimates of $\sigma_{AP} = cov(r_A, r_P)$ rely on 20 (+1) quarters of data to calculate returns on $A$ and $P$ for all firms in the same two-digit industry. Given $F(\vec{\mu}, \Sigma)$, for a given grant we simulate one million paths from initial values of the vector of state variables to the end of the performance period. All stock return measures include dividends. The risk-free rate is the rate at the time on the newest ten-year Treasury note.

## 5. Measuring the Incentive Properties of P-V Grants

### *5.1. Marginal and aggregate sensitivity of grant value to stock price*

One conventional way to calculate the pay-performance sensitivity of a stock or option grant (delta) is to calculate the change in value of that grant arising from a 1% change in stock price.[24] Likewise, for a p-v grant of stock or options, we perturb initial $P_0$ (or $P_t$ with $0 < t < \tau$) by 1%, simulate ex ante value based on the different initial condition $(A_0, (1.01)P_0)$, and take the difference between the simulated values based on different initial starting points ($(A_0, (1.01)P_0)$ versus $(A_0, P_0)$). This difference indicates the effect on the ex ante expected discounted value of the p-v grant of changing the stock price by 1%. We call this the *marginal stock delta* and denote it as $\delta_P$.

[22] A standard technical problem arises because earnings drift is not well defined for companies with either zero or negative lagged earnings. If lagged earnings is positive, then we define drift in earnings as change in earnings divided by lagged earnings. If lagged earnings is less than zero then we use the absolute value in the denominator.

[23] We use an industry-level approach for the large-sample analysis in this paper. The benefit, absent large differences across companies, is additional precision in the estimates. The cost is that this assumes that all firms in the same industry have the same process generating the state variables. If drift rates and the covariance matrix vary significantly across firms in the same industry, customized parameter estimates can better reflect the characteristics of the specific company. For example, to generate firm-specific forecasts of $(\vec{\mu}, \Sigma)$, one can use a mix of industry and firm parameters, characteristics of prior grants (including threshold, target, ceiling, and type of metric), and whether the firm achieved critical performance levels specified in prior grants.

[24] For example, see Coles, Daniel, and Naveen (2006) for usage of the semi-elasticity form of pay-performance sensitivity (delta) in the absence of vesting provisions.

Many APE p-v grants are based on one or more accounting metrics, so we extend the above approach to accounting performance. We perturb initial $A_0$ by 1%, simulate ex ante value based on the different initial condition $((1.01)A_0, P_0)$, and take the difference between the simulated values based on the different initial starting points. The difference indicates the effect of changing accounting performance by 1% on the ex ante expected discounted value of the p-v grant. We call this the *marginal accounting delta*, denoted as $\delta_A$.

Stock performance and other performance metrics often are related. For example, managerial actions that enhance firm performance often increase both accounting and stock returns. While the calculation herein is focused on stock return, we think of the information in accounting performance, via price discovery in the stock market, as an important driver of stock returns, as opposed to stock returns causing accounting performance. Or, if accounting numbers are not the mechanism for information flow to the capital market, some common factors drive both together. Empirically, the parameters, estimated using historical data, used to construct $\mathrm{F}(\vec{\mu}, \Sigma)$, represent the relation between stock and accounting metric drift. For each 1% change in stock price, on average there will have been some antecedent or associated change in accounting performance which can be estimated as the (statistical) elasticity of $A$ in $P$, $\beta_{AP} \equiv cov(r_A, r_P)/cov(r_P, r_P)$. Thus, the marginal delta in stock price is an incomplete measure of the sensitivity of the ex ante value of the p-v grant to stock price. Accordingly, we perturb initial $P_0$ by 1%, $A_0$ by $\beta_{AP}$%, simulate ex ante value based on the different initial condition$((1 + 0.01\beta_{AP})A_0, (1.01)P_0)$, and take the difference between the simulated values based on the different starting points, $((1 + 0.01\beta_{AP})A_0, (1.01)P_0)$ versus $(A_0, P_0)$. The difference indicates the effect of changing stock performance by 1%, while also including the normal associated change in the other performance metric, to measure the full effect of the 1% change in stock price on the ex ante expected discounted value of the p-v grant. We call this the *aggregate delta*, $\delta_{Agg}$.[25] To our knowledge, the marginal delta in accounting performance and aggregate delta in stock performance are new constructs for measuring incentive alignment.

### *5.2. Marginal and aggregate sensitivity of p-v grant value to stock return volatility*

The sensitivity of expected value of an award to the volatility of stock performance, vega, is seen as a measure of the incentive conveyed by the award to the executive to take risk on behalf of shareholders. One standard measure of vega is the change in expected value of the award associated with a 1% proportional change in the annualized standard deviation of stock return (e.g., Anderson and Core, 2015). In the absence of vesting provisions, in general the convexity in payoff arising from options is large relative to any convexity arising from shares (Core and Guay, 2002), so historically almost all of vega in an executive's portfolio arose from the accumulation of options net of dispositions.[26] We address the increasing usage of p-v awards by adapting the existing approach to include in measured vega the effects of nonlinearities in the grant schedule.

Again consider, $\vec{r} = (r_A, r_P) \sim \mathrm{F}(\vec{\mu}, \Sigma)$, based on estimated parameters. For a given p-v grant of stock or options, we proportionally increase, $\sqrt{\sigma_{PP}} \equiv \sqrt{cov(r_P, r_P)}$, by 1%. We then simulate ex ante value based on the different initial condition based on $(1.01)\sqrt{\sigma_{PP}}$ and take the difference between the simulated expected values based on different drift parameters [$(1.01)\sqrt{\sigma_{PP}}$ versus $\sqrt{\sigma_{PP}}$, holding all other parameters constant]. This difference indicates the effect of changing the stock return volatility proportionally by 1% on the ex ante expected discounted value of the p-v grant. We call this the *marginal stock vega*, denoted $\nu_P$, which is analogous to the vega defined in Core and Guay (2002).

[25] $\delta_{Agg}$ to a first order can be approximated by $\delta_{Agg} \approx \delta_P + \beta_{AP}\delta_A$. The expression is approximate because $\delta_A$ need not be linear in the size of the perturbation in $A_0$.
[26] See Anderson and Core (2015) for a recent reassessment of this conventional wisdom.

Likewise, we calculate the effect of a change in volatility of the accounting (or other) performance metric. We proportionally increase $\sqrt{\sigma_{AA}} \equiv \sqrt{cov(r_A, r_A)}$ by 1%. We then simulate ex ante value based on the different initial condition, $(1.01)\sqrt{\sigma_{AA}}$ and take the difference between the simulated *expected values*, based on $(1.01)\sqrt{\sigma_{AA}}$ versus $\sqrt{\sigma_{AA}}$, holding all other parameters constant. This difference indicates the effect of changing the volatility of drift in the accounting metric proportionally by 1% on the ex ante expected discounted value of the p-v grant. We call this the *marginal accounting vega* and denote it as $v_A$. The notion, as yet untested, is that $v_A$ shapes executive incentives either to smooth accounting performance or, instead, to increase accounting volatility.

The marginal vegas ignore the off-diagonal elements of the covariance matrix. To account for the changes in the covariation in performance metrics concurrent with changes in the own covariances, we apply the analogous procedure to all elements of Σ. In other words, we perturb the variance-covariance matrix of stock and accounting drift rates by $1.01^2$. This procedure both acknowledges the covariation of the accounting and stock performance metrics and also maintains the elements in Σ in the same proportions.[27] We simulate ex ante grant value based on the different parameters using the difference between the simulated *expected values* based on different initial starting points, holding $\vec{\mu}$ constant. We call this *aggregate vega* and denote it as $v_{Agg}$.

While $v_P$ is well-known, to our knowledge the marginal vega in accounting performance and aggregate vega are new measures of the incentives of executives to implement risky firm policy.

[27] Another common measure of vega is the change in expected value of the award associated with an absolute 0.01 change in the annualized standard deviation of stock return (see Guay, 1999, and Coles, Daniel, and Naveen, 2006, for example). This approach seems natural when applied to one element of the covariance matrix in isolation of the other elements. Adding 0.01 to multiple elements of the matrix of square roots of the return covariances, however, changes the covariances (and their square roots) relative to one another. Thus, instead we apply proportional changes to measures of covariation.

Below, in Section 8, we empirically assess the economic significance of $v_{Agg}$ and $v_A$ versus the conventional measure, $v_P$, as well as $\delta_{Agg}$ and $\delta_A$ versus the conventional measure, $\delta_P$.[28]

## 6. Preliminaries: Value, Disclosure, Incentives, and Firm Risk

One possibility is that p-v provisions are inconsequential and, instead, simply are window-dressing to appease critics who complain that t-v is merely "pay-for-pulse." If so, then the implications of p-v provisions for grant value to executives and as disclosed, alignment of executive with shareholder interests (delta), and incentives for executives to select and implement risky financial and investment policy (vega) of the award are likely to be negligible. An alternative is that p-v provisions have meaningful economic effects on economic and disclosed value and on the incentive properties of executive compensation. We examine the magnitude of these effects in Sections 7 and 8.

While our valuation approach is applicable to highly complex awards, in the following sections, for simplicity, we set aside the most complex p-v awards. That is, hereafter we restrict our analysis to p-v awards with at most a moderately complex grant schedule that depends either on stock performance only or on one or more accounting performance metrics only.

## 7. The Implications of P-V Provisions for the Economic and Disclosed Values of Executive Compensation

### *7.1. Performance-Vesting provisions are consequential: vesting probabilities and economic value*

Recall the example of the 2008 Amgen award, which specifies the performance metric (TSR) and the number of shares granted at a threshold, target and ceiling (maximum). Not all p-v grants

[28] Note the above approach for measuring executive incentives focuses on a single grant at a single award date. Executives often receive a sequence of p-v and t-v stock, option, and cash awards that are accumulated into a portfolio, net of dispositions. The same methods for measuring value (Section 4) and executive incentives (Section 5) extend to such a portfolio of accumulated grants.

contain all three milestones, but all grants specify at least one of the three. For our sample of 9,214 conditional p-v awards based on a stock price measure or on one or more accounting metric(s), with complete disclosure of the grant schedule, Table 4 reports results on simulated and actual hit rates for these hurdles. The mean annualized threshold, target, and ceiling hurdles require that stock or accounting performance improve by 9.5%, 13.0%, and 17.0% per year, respectively, over an average performance horizon of 2.15 years. As an imperfect basis for comparison, these annual performance hurdles exceed the average matched expected return on the stock (per the CAPM) of 7.23%. Per Table 4, the mean simulated (actual) probabilities of vesting at threshold, target, and ceiling are 0.54 (0.54), 0.49 (0.47), and 0.43 (0.42),[29] respectively, which suggests that the hurdles for single-metric grants are nontrivial and material for value. The simulated hurdle hit rates are very close to actual hit rates for the subclasses of grants. The simulated stochastic inputs to the valuation model seem reasonable.

Consider the implications of the p-v grant schedule for award value. One simple benchmark is target pay, which is the product of the target number of shares or options expected to vest times the grant-date value per share or option. Assuming "target" is a meaningful point of reference, target pay is value calculated as if the option or stock grant were unencumbered by the p-v provision.[30]

For Table 5 we deploy the simulation methodology from Section 4 to provide ex ante estimated (simulated) *economic value* of the awards for the subset of single-metric p-v grants. This calculation includes consequences for value arising from the correlation between the performance measure(s) on which the p-v provision is based with, the determinants of value of the stock or options, specifically stock price, and for convexities and concavities in the grant schedule. Initially, for comparability

[29] BBCK (2010) report 47.50% as the cumulative hit rate, based on an assumed three-year horizon (rather than the actual performance period), for the simple one-step vesting schedules typical of the occasional p-v award given over 1995-2001. The actual hit rate in our sample of 46.6% for target over the actual performance period is similar. Both their figure and ours are lower than the 73.55% cumulative vesting percentage at three years for t-v awards (per BBCK, 2010, Table 5).

[30] Another simple approach would be to apply a "haircut," based on the likelihood of meeting target performance, to the value of the stock or options at target (realizable pay). Doing so with the simulated (actual) average at target would suggest an average reduction in value of the p-v award of 51.3% (53.4%) versus target value.

across the 9,214 single-metric-type grants, we normalize the back-end instrument and p-v grant schedule by assuming a grant date stock price of $1, an option exercise price of $1, and a benchmark of 1.0 units (stock or options) granted at target. Thus, the benchmark value of a stock grant absent the p-v provision is $1, while the average Black-Scholes value of the benchmark at-the-money option is $0.53. In comparison, the average p-v stock (option) award is worth $0.58 ($0.35). Aggregating the awards, the average value without the p-v provision is $0.96 versus $0.57 when the p-v provision is included. Thus, the haircut to target on average is about 41% [($0.964-$0.565)/$0.964].[31]

The results in Tables 4 and 5 indicate that the milestones and functional form embedded in p-v grant schedules are consequential for economic value and material for disclosure.[32]

### *7.2. The relation between disclosed GDFV, estimated economic value, and target value*

What adjustments to target value, if any, do firms, auditors, and compensation consultants apply in formulating public disclosures? Following the change in the reporting requirements adopted by the SEC in 2006, companies are now required to disclose the grant date fair value (GDFV) for all awards. Of the 9,214 single-metric-type awards that we are able to value in Table 4, firms disclose GDFV for 7,308 of those awards. Though prior to the enhancement of disclosure requirements some companies did report GDFV, only after ASC 718 is GDFV regularly reported. Of awards that are based on accounting metrics alone, a majority of the awards employ more than one accounting metric. For simplicity, we focus on the subsample of awards that rely either on a single stock-price or accounting metric. For the 2,350 fully-described, single-metric, conditional awards, made in 2006 or after, with disclosed GDFV, we now compare reported GDFV and the *economic value* of the grant.[33]

[31] This is smaller than the haircut that might be suggested by the hit rate for target performance of 53.4% (1-0.466, per Table 4), the reason likely being that the haircut based on target hit rate ignores the portion of the grant schedule above target, as well as the structure of the grant schedule below target.
[32] Under the principles underlying FASB ASC 718, all material elements of a company's executive compensation program must be disclosed.
[33] Under our valuation methodology we apply the standard risk-neutral methods broadly permitted and accepted and sanctioned by the FASB. We deploy the framework in Section 4 and drift the performance metric at the risk-free rate and

Table 6 provides the comparison aggregated and in subsamples depending on the type of performance metric and by the back-end security. Table 6 indicates that for the full sample both the mean and median of the reported GDFV are significantly different from estimated economic value. In the full sample of single-metric grants, for example, based on medians the disclosed GDFV *overstates* economic value by 79%. Restated, median estimated economic value represents a haircut of 44.1% relative to disclosed GDFV. In the subsamples, except for option grants (9.6% of the sample), median disclosed GDFV depends, at least in part, on considerations other than economic value.

Interpreting the reporting standards arising from ASC 718, Ernst and Young (2014) asserts that stock or options with an accounting-based p-v provision attached can be valued as the GDFV of the stock or option adjusted for the number of units of that back-end instrument *expected* to vest at the end of the performance period under the p-v grant schedule. While the reporting firm is allowed some discretion in specifying the number of units expected to vest, one obvious candidate is the "target" number of back-end units, as designated in the disclosure of the functional form of the grant schedule. Per the example in Appendix 1, Walmart reported the GDFV of the p-v shares as the product of the closing price on the grant date and the target number of shares granted.[34]

Median disclosed GDFV is $543,362, which differs only slightly from median target grant value of $580,668. The similarity between target value and disclosed value is driven by the largest segments of the sample, specifically awards of stock and p-v grants contingent on an accounting

---

discount all *ex post* realizations at the risk-free rate, to generate simulated "risk-neutral value." Precisely this approach is encouraged for awards with performance conditions based on stock price (Ernst and Young, 2014).

[34] As it turns out, this target number times the GDFV of the stock or option is one version of "realizable pay," a pay measure that receives explicit attention from proxy advisors ISS and Glass Lewis (Prakash, 2014). Moreover, firms themselves have begun to report realizable or target pay, typically as a supplemental disclosure to the Summary Compensation Table, in the annual proxy statement.

metric. Roughly speaking, firms apply a haircut to target pay, but not one that is large enough so as to reduce GDFV all of the way to simulated, risk-neutral, economic value.[35]

To assess the degree to which disclosed grant value is influenced by the differing approaches to value, we regress disclosed GDFV of the award on target value and estimated economic value. If economic value is the driver of disclosed GDFV, assuming our model to estimate economic value is well-specified, the elasticity of reported GDFV in estimated economic value should be one. We expect the same for target value if it is the primary determinant of disclosed value. Table 7 reports results separately for p-v awards based on a stock price metric (models 1-2) and those contingent on an accounting metric (models 3-4) because the latter awards are allowed more flexibility in reporting.

The logarithm of economic value and target value both have very significant explanatory power for the logarithm of disclosed grant value. For stock-price p-v awards, the estimated elasticity of GDFV in economic value (0.677, $p < 0.001$) is less than the elasticity in target value (0.884, $p < 0.001$), and both are significantly less than 1. Fit is not dissimilar, though it is not quite as good for economic value as target value (adj. R-squared of 0.778 versus 0.878). The differences are larger for accounting-metric awards. The estimated elasticity (0.964, $p < 0.001$) for the subsample of 1,969 single-metric accounting-based awards is only slightly less than 1, simulated economic value has a much smaller estimated elasticity that is about half (0.449), and the *gap* in fit is much larger (adj. R-squared = 0.557 versus 0.932). These results for accounting metric versus stock-price metric p-v awards are precisely what one would expect if stock-price metric awards are to be valued using

[35] One possibility is that we create bias upward in disclosed GDFV by focusing on single-metric awards. If firms using simpler single-metric awards are more "honest" than firms that obfuscate with multiple-metric p-v awards, then we would observe an apparent upward bias in GDFV, as suggested in Table 6. While we do not have a way to measure honesty, we do assess differences in governance characteristics. For firm-year observations of firms that gave single-metric or multi-metric p-v awards, based on a logit model there is no significant difference in institutional ownership, board independence, board size, whether the CEO is chair, and compensation committee conflicts (when employees could serve on the comp. committee). Selection does not appear to be the source of measured upward bias.

standard simulation methods and accounting-metric awards are permitted flexible treatment that, for example, allows GDFV to be reported as target value.[36]

Another possible reason for the biases in reported GDFV is that we employ industry stock return volatility to simulate economic value. For example, if smaller (larger) firms give small (large) grants and have higher (lower) performance-metric volatility than the industry average, then we would expect upward (downward) bias for small (large) awards and a corresponding estimated elasticity of GDFV in estimated economic value that is less than 1. This does not appear to be the case. Using firm rather than industry volatility for each simulated value does not improve the regression results - the estimated elasticities of GDFV in economic value in the full sample and in the two subsamples actually decline slightly.

ASC 718 was intended, in part, to improve disclosure.[37] One aspect of the quality of disclosure is the extent to which economic value of the award drives GDFV. To compare the strength of this relation before versus after the enhancement of disclosure requirements, we regress GDFV on simulated economic value and the interaction of economic value with an indicator for when enhanced disclosure was in effect (Post-2005). To do so we augment the 2,350 single-metric awards with reported GDFV made in or after 2006 with the 306 such awards with GDFV reported prior to 2006.

Table 8 presents the results. Per model (1), the elasticity of GDFV in economic value after ASC 718 is significantly *lower* (0.474 = 0.733 – 0.259) than prior (0.733). This aggregate result is driven by the subsample of single-metric accounting-based awards (model 3), for which the interaction term is significantly negative (-0.389, $p < 0{,}01$). If the elasticity of GDFV in economic value is a

---

[36] Solving model (1) using the estimated parameters yields $910,148 as the economic value for which predicted disclosed GDFV would be the same as economic value. Above this figure, firms report GDFV that is below economic value, while the reported figure is predicted to be biased upward below that break-even point. The analogous break-even figure for model (3) is $1,140,946.

[37] "Equity awards must now be reflected in the year awarded based on their full aggregate grant date fair value computed in accordance with FASB Accounting Standards Codification Topic 718 ("FASB ASC 718"), rather than based on the expense attributable to them in the applicable fiscal year." See K&L Gates (2013, p. N-5).

measure of the quality of disclosure, the quality of disclosure declined significantly after the supposed enhancement of disclosure requirements.

### *7.3. Factors associated with the difference between disclosed GDFV and economic value*

We now examine the extent to which firm characteristics are associated with the difference between reported GDFV and economic value. There are several logical reasons to do so. Costs to NEOs and the board of directors of reporting large or upward-biased compensation figures can include those arising from addressing the objections of institutional investors, shareholders, and the media, such as reputational costs in the managerial labor market. For example, if institutional investors view excessive pay negatively and lower pay as desirable, then firms with large institutional holdings will tend to bias reported value downward. (We note here that causation reasonably would run in the other direction as well, with lower reported GDFV attracting higher institutional ownership.) This effect likely would be larger for p-v awards based on a stock-price metric, because the methods for calculating grant value are conventional and better-understood by investors than for awards based on an accounting metric. In addition, delegating some or all of the task of setting executive pay to a compensation consultant, especially a prominent consultant with significant market share, likely is a way to add credibility to, or shift responsibility for, a large GDFV. For these two effects, the presence of large institutional holdings (usage of a compensation consultant or large compensation consultant) should be associated with lower (higher) reported GDFV. Furthermore, a high marginal tax rate, to the extent that it implies a larger present value of the tax deduction (as the expense is amortized over the performance period), would provide the incentive to inflate GDFV.[38]

Table 9 reports results from regressing GDFV on the same primary determinants considered in Table 7, including economic and target value, as well as on variables that capture the hypotheses

[38] We thank John Graham for allowing us to employ his estimates of corporate marginal tax rates (Graham, 1996).

above. In addition, we control for: analyst coverage, in case such external scrutiny affects reporting bias; firm performance, if good performance is a reason for high compensation (though this should appear in economic value) or presents a way to manage external perceptions about executive pay-performance sensitivity and incentive alignment (so high GDFV would go with good stock performance); growth opportunities; firm size; volatility; and fixed effects for industry (2-digit SIC) and year.[39] We include firm volatility net of industry volatility to account for reporting biases that might be driven by firms, especially with relatively high volatility, to report lower GDFV through biased valuation assumptions (e.g., for volatility). We measure volatility as the standard deviation in drift of the stock-price or accounting metric. In models (2) and (5), we broaden the definition of target pay to be the closest of target, threshold, or ceiling, when these exist, to economic value. We do this to accommodate the idea that disclosure of reported value can be determined by either the threshold or maximum number of shares rather than the target number of shares.[40]

Several of the hypothesized effects appear in the data. For both stock-price (models 1-3) and accounting metrics (model 4), institutional ownership has a strong negative association with reported GDFV. As hypothesized, the use or type of a compensation consultant is associated with a higher reported GDFV. The use of a (high-market-share) compensation consultant has a strong positive effect on GDFV for p-v awards with a grant schedule based on (an accounting metric) stock price. In model (1), controlling for the size of the award and other firm characteristics, firms with higher volatility that use stock price metrics report lower GDFV, presumably through their assumptions about volatility. The marginal tax rate, analyst coverage, and other test variables provide little explanatory power.

[39] The approach would be to report high GDFV when stock performance is good so that pay-performance sensitivity appears to be higher than it actually is.
[40] Missing values of test variables, including and in particular the marginal tax rate, reduces sample size for stock-price (accounting-metric) p-v awards from 381 (1,969) to 249 (1,338).

Comparing the primary specifications in Table 9 (models 1, 4) and Table 7 (models 1, 4), including additional variables does little to affect the estimated elasticity of GDFV in economic value. In Table 9, in general target value continues to explain GDFV better, with an elasticity closer to one, even controlling for other potential sources of bias. For stock-price metrics fit is similar for economic versus target value, with adj. R-squared being above 0.910 for models (1) – (3). Again, as expected given the different reporting obligations for accounting-metric p-v awards, fit is significantly lower based on economic versus target value (adj. R-squared = 0.658 versus at least 0.920). The departure of disclosed value from economic value for p-v awards continues to invite explanation.

### *7.4. Additional discussion of the results on valuation*

These results bring into sharp relief the question of how firms and their accountants and compensation consultants determine the value of executive compensation as disclosed in public company filings with the SEC. While investors, employees, regulators, and others are interested in the value of executive pay, valuation reported in the proxy statement does not necessarily reflect the economic value of these awards. [41]

Our findings are important to academic research[42]. Per Murphy (2012, p. 5-6), "Underlying every intra-firm, cross-sectional, cross-country, or time-series analysis of executive compensation is an assumption (too often implicit) about how to measure the total compensation received by the executives." The results above suggest that studies that use the reported GDFV in proxies are likely to suffer from measurement error that potentially contaminates inference. The measurement error appears to be related in the cross section to the scale of the grant and to other firm characteristics, such

[41] The 2015 adoption by the SEC of a rule requiring disclosure of the ratio of CEO pay to the pay of the median employee (https://www.sec.gov/news/pressrelease/2015-160.html) is a further example of the relevance of accurate measurement of executive pay in the presence of p-v provisions. It is possible that this rule will lead to biases downward in reported GDFV.
[42] Notable contributions to the literature on the level and determinants of executive compensation include Jensen and Murphy (1990), Himmelberg, Hubbard, and Palia (1999), Johnson and Tian (2000), Core and Guay (2002), Bizjak, Bettis, and Lemmon (2005), Edmans, Gabaix, and Landier (2009), and Fernandez, Ferreira, Matos, and Murphy (2013), to name a few.

as institutional ownership and usage of a compensation consultant, in which case many empirical models implemented on reported GDFV are likely to be misspecified.

## 8. The Implications of P-V Provisions for Executive Incentives

Just as there is strong interest in the academic and practitioner communities in the value of executive compensation, so is there strong importance attached to the incentive properties of stock and option awards.[43] In the absence of measurement of the effect of p-v provisions on delta and vega incentives, empirical experiments that connect performance, firm risk, corporate investment or financial policy, or other organizational attributes to mismeasured delta and vega will be misspecified.

Tables 10 and 11 report our calculations of the effect on incentives of p-v conditions. We measure the implications for executive delta and vega arising from each individual p-v grant. For simplicity, we continue to restrict our analysis to contingent p-v grants based on a single performance metric, not just a single type of metric. Table 10 reports marginal stock price and accounting deltas, $\delta_P$ and $\delta_A$, and aggregate delta, $\delta_{Agg}$, as defined in Section 5. Table 11 provides marginal stock and accounting vegas, $v_P$ and $v_A$, and aggregate vega, $v_{Agg}$, all as set forth in Section 5.

One benchmark grant for assessing p-v delta and vega is the target grant without the p-v contingency. Here this means the delta or vega of the target number of shares or options times the expected value of the share or option discounted to the beginning of the performance period. In addition, in some instances we compare the incentive properties of this non-p-v benchmark with marginal and aggregate delta and vega of a value-neutral p-v award. In other words, to isolate the incentive effects of the p-v provision, we compare p-v and non-p-v grants with equal value.

[43] Contributions to the literature on delta and/or vega include Demsetz and Lehn (1985), Morck, Shleifer, and Vishny (1988), Bizjak, Brickley, and Coles (1993), Haubrich (1994), Guay (1999), Johnson and Tian (2000), Cohen, Hall, and Viceira (2000), Demsetz, and Villalonga (2001), Rajgopal and Shevlin (2002), Coles, Daniel, and Naveen (2006), and Coles, Lemmon, and Meschke (2012), among others.

### *8.1. The effect of p-v provisions on the delta (δ) incentives of equity-based awards*

Consider the two largest classes of grants. For the 1,306 p-v grants of stock with a grant schedule contingent on stock performance, column 5 of Panel A of Table 10 indicates that the effect on marginal stock delta of the average stock performance p-v provision is economically and statistically large. Without adjusting for the haircut to equalize value, the median p-v stock price delta is about 70% larger with ($\delta_P = \$14{,}073$) versus without ($\delta_P = \$8{,}309$) the p-v provisions ($p < 0.001$). Adjusting the scale of this type of award, so that it has the same value as a non-p-v award at target, amplifies delta. The median marginal stock price delta of a value-neutral stock-performance-based p-v stock grant is about 160% larger with ($\delta_P = \$21{,}632$) versus without ($\delta_P = \$8{,}309$) the p-v provisions ($p < 0.001$). In contrast, for the 6,818 stock awards using a p-v provision based on a single accounting metric, median marginal stock price delta is 49% *smaller* ($p < 0.001$) than for the stock grant at target unencumbered by the p-v schedule. Of course, by construction the value-neutral single-accounting-metric p-v grant conveys marginal stock delta that is precisely equal to that of the stock grant at target. Though the differences are somewhat smaller in magnitude, results that are similar in direction and statistical significance arise from parallel comparisons of p-v option grants based on stock performance or a single accounting metric.

Panel B reports results for our new measure of the sensitivity of the value of single-metric p-v awards to accounting performance. Stock and option grants conveyed at target with no p-v provision have no direct exposure to accounting performance. In contrast, a p-v grant schedule explicitly dependent on accounting performance exposes the value of the grant to the accounting metric by a median of $9,239 for a one percent change in the accounting metric at the beginning of the performance period. Scaling awards up to remove the haircut increases the median marginal accounting delta to \$20,410 for that same change. There is no basis for comparison available in prior literature to assess the economic significance of marginal accounting delta.

The calculation of aggregate delta, however, does blend accounting and stock-price deltas, thereby inviting comparisons of the economic importance of each component and their mixture. For the 6,818 restricted stock grants with a p-v schedule based on a single accounting metric, median grant date marginal stock and accounting delta based on a one percent change in the corresponding performance metric are $\delta_P$= \$3,205 (Panel A) and $\delta_A$ = \$9,246 (Panel B). Panel C reports aggregate delta for p-v grants based on a single accounting performance metric. For such grants, stock performance directly affects the value of the stock or options awarded, measured by $\delta_P$, and accounting performance has a direct effect through the grant schedule, per $\delta_A$. For a given change in stock price, there is an associated probabilistically "normal" change in accounting performance, given by $\beta_{AP}$, that arises because earnings drive stock price or something drives both together. Aggregate delta captures the sensitivity of the value of a grant to stock performance through both channels, which is approximately $\delta_{Agg} \cong \delta_P + \beta_{AP}\delta_A$. By way of illustration, again consider the 6,818 p-v awards of restricted stock based on an accounting metric. Comparing such unadjusted (value-neutral) grants across Panels C and A, median $\delta_{Agg} =$ \$5,172 (\$10,908) versus $\delta_P =$ \$3,205 (\$6,344). For stock as the back-end instrument, the unadjusted (value-neutral) accounting metric p-v provision conveys an additional 61% (72%) sensitivity to stock price through the indirect accounting channel. The increase in delta for the 279 p-v option grants from the accounting channel is substantial, 43% (67%), though not quite as large. Overall, the above comparisons indicate that the accounting channel is an important source of alignment of managerial incentives with shareholder interests. Including that channel has a significant effect on measured CEO incentive alignment.

### *8.2. The effect of single-metric p-v provisions on the vega (v) incentives of equity-based awards*

Table 11 reports the marginal and aggregate vegas for the p-v awards and the value-adjusted p-v awards compared to the awards absent the p-v provision. For some types of grants, p-v awards convey significantly more marginal stock return vega than the corresponding non-p-v award. For example, ignoring the very small vega arising from levered equity (per Core and Guay, 2002), all of any vega from a stock grant with a performance condition based on a stock price metric arises from the p-v provision. From Panel A, column 5, mean (median) $v_P$ = \$6,717 (\$1,243) versus $v_P$ = \$0 (\$0) at target. Per Panel A medians (column 3), a (non-) value-neutral p-v option grant using a stock-price metric has (18%) 77% more vega than the corresponding non-p-v grant, based on medians of $v_P$ = (\$5,958) \$8,865 versus \$5,021 at target.

Of course, performance conditions based on an accounting metric convey no marginal vega in volatility of stock return (Panel A, column 4). In contrast, accounting-based p-v grants, regardless of the back-end instrument, potentially affect the incentive to alter accounting metric drift volatility. Panel B rows 1 and 2 (means and medians) as well as row 5 indicate that the convexities of the grant schedule in accounting performance provide the incentive to increase accounting drift volatility.

Recollect that aggregate vega, as we define it, scales up the elements of the covariance matrix in equal proportions. For p-v awards based on a single accounting metric, Panel C quantifies the relevance of p-v provisions in providing overall risk-taking incentives and the role of accounting p-v provisions as they alter such incentives, versus those that arise directly from convexity of the award pay-off in stock performance. For example, comparing Panels A and C for accounting p-v option grants, median $v_{Agg}$ = \$2,358 versus $v_P$ = \$1,701. So, on average, for this class of p-v grants, aggregate vega is 39% higher than traditionally defined marginal stock return vega. It appears that the presence of an accounting metric in a p-v grant schedule provides additional risk taking incentives.

### *8.3. Grant vega and risk-taking incentives through time*

It continues to be an open question as to whether compensation-related vega is associated with the risk of policy choices made by executives and with firm risk. Guay (1999) and Coles, Daniel, and Naveen (2006) provide empirical evidence that higher vega implements riskier policy and causes higher stock return volatility. Hayes, Lemmon, and Qiu (2012) examine compensation convexity and firm risk around the implementation of ASC 718 in 2005. ASC 718 represents an exogenous increase in the relative accounting cost of stock options that should have had no effect on the economic costs and benefits of using options. HLQ (2012) find that on average firms dramatically reduce their usage of stock options soon after ASC 718 but find little evidence of less risky investment and financial policies following the accounting change. Under the assumption that risk-taking incentives come primarily from options, HLQ (2012) interpret their results as inconsistent with the view that the convexity in compensation implements risk-taking by executives on behalf of shareholders.

We find that p-v provisions can significantly affect the convexity and concavity of executive payoff in firm performance (e.g., Figure 2). Table 11 indicates that p-v provisions amplify the standard vega measures (and our new vega measures) of executive risk-taking incentives. Thus, we track through time around ASC 718 the convexity (vega) in the portfolio of t-v and p-v stock and option grants accumulated through time, net of dispositions, by the CEOs in our sample.[44] We calculate marginal stock vega of the accumulated portfolio of: all t-v option grants; all t-v option grants plus all p-v option and stock grants; and all t-v option grants plus all value-neutral p-v option and stock grants. To keep the exercise tractable, we approximate the portfolio of all p-v awards by including all outstanding p-v awards that are granted in the current year and in the prior two years. Figure 4 indicates p-v option and stock grants on average contribute positively to the marginal stock vega of

[44] HLQ (2012) remark on the existence of p-v provisions but do not otherwise treat them explicitly in the vega calculations.

the average CEO portfolio. Also note that, consistent with the hypothesis in HLQ (2012), ASC 718 had a negative effect on CEO vega. All three portfolio vega measures are lower in the 2007-2008 period than prior to ASC 718. Nonetheless, all three measures of vega recover significantly by 2009 and thereafter. Figure 4 also indicates that the CEO vega arising from p-v awards, relative to CEO vega from t-v stock options, increased significantly over time. By 2012, CEO vega from p-v awards represented 18% of vega from t-v stock options, and 30% measured on a value-neutral basis.

Table 12 reports evidence in the form of difference-in-difference experiments. We select yearly control firms by matching non-p-v firms with p-v firms on size (market value of equity) and industry (2-digit SIC). We regress firm risk, as measured by stock return volatility, on *PV*, *Post*, and *PV***Post*. *PV* takes the value one if the firm uses p-v provisions, and zero otherwise. *Post* takes the value one if the year follows the fiscal year of the grant of p-v awards (Years +1, +2, or +3), and zero if the year precedes the p-v grant (Year –1). Year 0 is the fiscal year of grant of the p-v awards.

For the full sample, Table 12 indicates that the estimated coefficients on *PV***Post* are positive and statistically significant for one ($p < 0.05$), two ($p < 0.01$) and three ($p < 0.01$) years beyond usage of p-v conditions, all else equal. In both of the subsamples, before and after 2005, all of the estimated coefficients for firm risk on p-v usage are positive. The results actually are stronger post ASC 718. In the 2006-2012 (1998-2005) subsample all three (one of three) coefficients on one, two, and three year risk increases are positive and significant at the 0.05 level. Moreover, all three coefficients in the post-2005 subsample are larger than in the earlier subsample. Despite matching on size and industry, because p-v usage is a choice we are unwilling to assert causation. Nonetheless, the results suggest that the volatility of stock returns is significantly elevated one, two and three years after a p-v award, especially *after* the regulatory change that appears to have caused a shift from option to stock grants.

### *8.4. The relation between CEO vega and firm risk*

We now provide evidence on whether variation in vega, correctly measured through inclusion of vega from p-v provisions, causes variation in firm risk and policy. To further assess the connection between vega and risk-taking, we replicate the empirical analysis in Coles, Daniel, and Naveen (2006), but measure CEO portfolio vega and delta based on full consideration of the structure of p-v grant schedules in stock and option awards. The portfolio, following Coles, Daniel, and Naveen (2006, 2013), is based on the accumulated sequence of awards held, net of dispositions. As discussed earlier in Section 8.3, for tractability purposes we approximate the portfolio of all p-v awards by including all outstanding p-v awards that are granted in the current year and in the prior two years.

Per Table 13, in 3SLS specifications of firm risk, vega, and delta, we find results on firm risk for the 1998-2012 period that support a strong connection between vega and firm risk. Firm stock return volatility is strongly, positively related to CEO portfolio aggregate vega when measured to include stock and option awards based on p-v provisions along with t-v option grants ($t = 4.39$, $p < 0.001$). To examine further the strength of the connection of firm risk to vega, we interact CEO portfolio vega with an indicator for the period following ASC 718 (after 2005). In a similar 3SLS model, the sensitivity of firm risk to vega is positive and significant both before ($t = 5.70$, $p < 0.001$) and after ASC 718, though with some diminution of the effect after 2005. Nonetheless, after 2005 the sum of the estimated coefficients on vega and vega interacted with the post-2005 dummy is positive and highly significant (chi-squared = 12.56, $p < 0.001$). See Panel A of Table 13.

To assess one potential policy channel through which investment policy can affect risk, Panel B of Table 13 reports 3SLS estimates of the relation between R&D expenditure and vega. In the overall sample, R&D intensity is significantly and positively related to vega ($p < 0.001$). The effect appears to be driven by the 1998-2005 period prior to ASC 718 ($p < 0.001$). The coefficient on the interaction of vega and the post-2005 indicator is significant and negative, with the sum of the two coefficients being positive but statistically insignificant ($p = 0.15$). R&D intensity appears not to be an aspect of investment policy that gives rise to the positive relation between firm risk and vega in the 2006-2012 period.[45]

In summary, while option usage has declined since 2006, our analysis indicates that compensation convexity has recovered since 2008. Moreover the 3SLS and difference-in-difference models indicate that there remains a strong connection between firm risk and the incentive for executives to take risk, measured using portfolio vega that incorporates nonlinearities in the p-v grant schedule. Our results potentially explain the lack of decline in firm risk-taking after 2006 that is purported by Hayes, Lemmon, and Qiu (2012) to be a puzzle.

## 9. Conclusion

Just as stock grants are replacing option awards, p-v provisions are displacing traditional vesting schedules and p-v accounting metrics are replacing p-v stock price metrics. The scale of usage documented in our sample proves correct the conjecture in GIL (2007) and BBCK (2010), based on early usage and correspondingly modest samples of rudimentary, all-or-none versions, that p-v provisions would become pervasive and increasingly complex.

This paper contributes in two modes to advance the literature. First, we examine the public disclosure by firms of the grant date fair value of these awards. Our analysis indicates that there are large biases in the reported value of executive compensation, with evidence of both positive and negative bias depending on the type and size of award. While overall statistical fit is quite good, the

[45] We also deploy the 3SLS models to assess other potential policy channels, specifically the effects of vega on capital expenditures and leverage. While Coles, Daniel, and Naveen (2006) find that vega decreases capital expenditure and increases book leverage, we find no statistically significant relation flowing from vega to capital expenditure or market or book leverage. Detailed results are available from the authors.

elasticity of reported value in economic value is far less than one, with additional bias downward (upward) for large institutional ownership (when the firm uses a compensation consultant or high-market-share consultant). Second, our analysis documents and reaffirms the presence of the empirical relation between compensation convexity and firm risk. Measured with full inclusion of the structure of p-v provisions, just as firm risk has not declined so the convexity in executive pay has not declined, even after the significant effect of ASC 718 on the use of option grants. Moreover, our empirical analysis, based on difference-in-difference and 3SLS specifications, documents the continuing presence of an empirical relation in both the time series and cross section between compensation convexity and firm risk. These results reaffirm those of Guay (1999), Rajgopal and Shevlin (2002), and Coles, Daniel, and Naveen (2006).

These two contributions require that we develop a means to measure the effect of p-v provisions on the value of p-v equity-based awards. Moreover, because the value of p-v grants often depends both directly and indirectly (through accounting performance metrics) on stock price and stock price volatility, we also develop and estimate new measures of delta and vega incentives. The effects of p-v provisions on value, delta, and vega are substantial.

Measurement that is correct and disclosed accurately is likely to be useful to individual and institutional investors, corporations, executives, compensation consultants, regulators (SEC, FASB), and policymakers. In closing, we argue that there can be no useful basis for scientific, policy, or regulatory discussion of executive compensation if the facts concerning value and incentive characteristics are unknown. Solving the measurement problem is a necessary condition for assessing whether the level and incentive properties of executive pay are appropriate, vary across firms and through time according to hypothesized economic factors, or affect firm value and risk.

## References

Anderson, J., Core, J., 2015. Managerial incentives to increase firm volatility provided by debt, stock, and options, working paper, Masschusetts Institute of Technology.

Babenko, I., B. Bennett, J. Bizjak, Coles, J., 2015. Clawback provisions, working paper, Arizona State University and University of Utah.

Bettis, C., Bizjak, J., Coles, J., Kalpathy, S., 2010. Stock and option grants with performance-based vesting provisions, Review of Financial Studies 23, 3849-3888.

Bettis, C., Bizjak, J., Coles, J., Young, B., 2013, Explicit relative performance contracts for executives, working paper, Arizona State University.

Bettis, J., Bizjak, J. Lemmon, M., 2005. Exercise behavior and the value and incentives of employee stock options. Journal of Financial Economics 76, 445-470.

Bettis, J., J. Bizjak, Kalpathy, S., 2015. Insiders' use of hedging instruments: An empirical examination. Financial Management 44, 655-683.

Bizjak, J., Brickley, J., Coles, J., 1993. Stock-based incentive compensation and investment behavior. Journal of Accounting and Economics 16, 349-372.

Bizjak, J., Kalpathy, S., Thompson, R., 2016. Modeling equity compensation under accounting contingencies. Accounting and Finance Research 5, 164-179.

Bizjak, J., Lemmon, M., Nguyen, T., 2011. Are all CEOs above average? An empirical analysis of compensation peer groups and pay design. Journal of Financial Economics 100, 538-555.

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

Bushman, R. J., Smith, A., 2003. Transparency, Financial Accounting Information, and Corporate Governance. FRBNY Economic Policy Review. April, 65-87.

Camara, A., Henderson, V., 2009. Performance based compensation and direct earnings management, working paper, Oklahoma State University and University of Oxford.

Carter, M., Lynch, L., Tuna, I., 2007. The role of accounting in the design of CEO equity compensation, The Accounting Review, 82, 327-357.

Carter, M., Ittner, C., Zechman, S., 2009. Explicit relative performance evaluation in performance-vested equity grants. Review of Accounting Studies, 14, 269-306.

Chen, M., D. Greene, Owers, J., 2015. Clawback provisions in executive compensation, Review of Corporate Finance Studies, 4, 108-154.

Cohen, R., Hall, B., Viceira, L., 2000. Do executive stock options encourage risk-taking? Working Paper. Harvard Business School.

Coles, J., Daniel, N., Naveen, L., 2006. Executive compensation and managerial risk-taking. Journal of Financial Economics 79, 431-468.

Coles, J., Daniel, N., Naveen, L., 2013. Calculation of compensation incentives and firm-related wealth using Execucomp: data, program, and explanation. Working paper, Temple University.

Coles, J., Lemmon, M., Meschke, J., 2012. Structural models and endogeneity in corporate finance, Journal of Financial Economics 103, 149-168.

Conyon, M., 2000, Peck, S., Read, L., Sadler, G., 2000. The structure of executive compensation contracts: UK evidence. Long Range Planning 33, 478-503.

Core, J., Guay, W., 2002. Estimating the value of employee stock option portfolios and their sensitivities to price and volatility. Journal of Accounting Research 40, 613-630.

Cox, J., Ross, S., 1976. The valuation of options for alternative stochastic processes. Journal of Financial Economics 3, 145-166.

Demsetz, H., Lehn, K., 1985. The structure of corporate ownership: Causes and consequences. Journal of Political Economy 93, 1155-1177.

Demsetz, H., Villalonga, B., 2001. Ownership structure and corporate finance. Journal of Corporate Finance 7, 209-233.

Edmans, A., Gabaix, X., Landier, A., 2009. A multiplicative model of optimal CEO incentives in market equilibrium, Review of Financial Studies 22, 4881-4917.

Equilar, Inc., 2014. 2014 Realizable Pay 101 Report, https://www.google.com.hk/?gws_rd=cr&ei=4MKhV7TEI8H60ASc8ZTADw#q=equilar+Realizable+Pay+101+Report.

Ernst and Young, 2014. Share-based payment, Revised July 2014, Financial reporting developments: A comprehensive guide.

Fernandes, N., Ferreira, M., Matos, P., Murphy, K., 2013. Are U.S. CEOs paid more? New international evidence. Review of Financial Studies 26, 323-367.

Financial Accounting Standards Board. Accounting for stock based compensation no. 123. October 1995.

Financial Accounting Standards Board. Statement of financial accounting standards no. 123 (revised 2004): share-based payment. December 2004.

Frydman, C., Jenter, D., 2010. CEO compensation, working paper, Stanford University.

Gerakos, J., Ittner, C., Larcker, D., 2007. The structure of performance-vested stock option grants. In: Antle, R., Liang, P., Gjesdahl, F. (Eds.). Essays on accounting theory in honour of Joel S. Demski. Springer.

Graham, J., 1996. Debt and the marginal tax rate. Journal of Financial Economics 41, 41-73.

Guay, W., 1999. The sensitivity of CEO wealth to equity risk: An analysis of the magnitude and determinants. Journal of Financial Economics 53, 43-71.

Hayes, R., Lemmon, M., Qiu, M., 2012. Stock option and managerial incentives for risk-taking: Evidence from FAS 123R. Journal of Financial Economics 105, 174-190.

Hall, B., Murphy, K., 2002. Stock options for undiversified executives. Journal of Accounting and Economics 33, 3-42.

Haubrich, J., 1994. Risk aversion, performance pay, and the principal-agent problem. Journal of Political Economy 102, 307-343.

Healy, P., Palepu, K., 2001. Information asymmetry, corporate disclosure, and the capital markets: A review of the empirical disclosure literature. Journal of Accounting and Economics 31, 405-440.

Himmelberg, C., Hubbard, R., Palia, D., 1999. Understanding the determinants of managerial ownership and the link between ownership and performance. Journal of Financial Economics 53, 353-384.

Holden, C., Kim, D., 2014. Performance share plans: valuation, optimal design, and empirical tests, working paper, Indiana University.

Holmstrom, B., 1979. Moral hazard and observability, The Bell Journal of Economics 10, 74-91.

Ingersoll, J., 2006. The subjective and objective evaluation of incentive stock options, Journal of Business 79, 453-487.

ISS, 2013. Institutional Shareholder Services Inc. Realizable Pay 101: What You Really Need to Know, https://www.issgovernance.com/file/publications/RealizablePay.pdf.

Jensen, M., Meckling, W., 1976. Theory of the firm: managerial behavior, agency costs, and ownership structure. Journal of Financial Economics 3, 305-360.

Jensen, M. Murphy, K., 1990. Performance pay and top-management incentives, Journal of Political Economy 98, 225-264.

Johnson, S., Tian, Y., 2000. The value and incentive effects of nontraditional executive stock option plans. Journal of Financial Economics 57, 3-34.

K&L Gates, 2013. Practical Guidebook to the Executive Compensation Disclosure Rules. K&L Gates LLP.

Kuang, Y., 2008, Performance-vested stock options and earnings management. Journal of Business, Finance and Accounting 35, 1049-1078.

Kuang, Y., Suijs, J., 2006. Incentive effects of performance-vested stock options. Working paper, Tilburg University.

Li, Z., Wang, L., 2016. Executive Compensation Incentives Contingent on Long-term Accounting Performance. Review of Financial Studies 29, 1586-1633.

Morck, R., Shleifer, A., Vishny, R., 1988. Management ownership and market valuation. Journal of Financial Economics 20, 293-315.

Murphy, K., 1999. Executive compensation. In: Ashenfelter, O., Card, D. (Eds.), Handbook of Labor Economics 3. North-Holland, Amsterdam, 2485-2563.

Murphy, K., 2012. Executive compensation: where we are and how we got there. Working paper, University of Southern California.

Murphy, K., and Jensen, M., 2011. CEO bonus plans: And how to fix them, working paper, University of Southern California.

Paul, J., 1992. On the efficiency of stock-based compensation. Review of Financial Studies 5, 471-502.

Prakash, A., 2014. Trends in realized/realizable pay disclosure: top 250 companies, Frederic W. Cook & Co., Inc.

Rajgopal, S., Shevlin, T., 2002, Empirical evidence on the relation between stock option compensation and risk taking, Journal of Accounting and Economics, 33, 145-171.

Sloan, R., 1993, Accounting earnings and top executive compensation, Journal of Accounting and Economics, 16, 55-100.

**Figure 1.a: L3 Communications 2008 Grant of Stock With Conditional Vesting Provision**

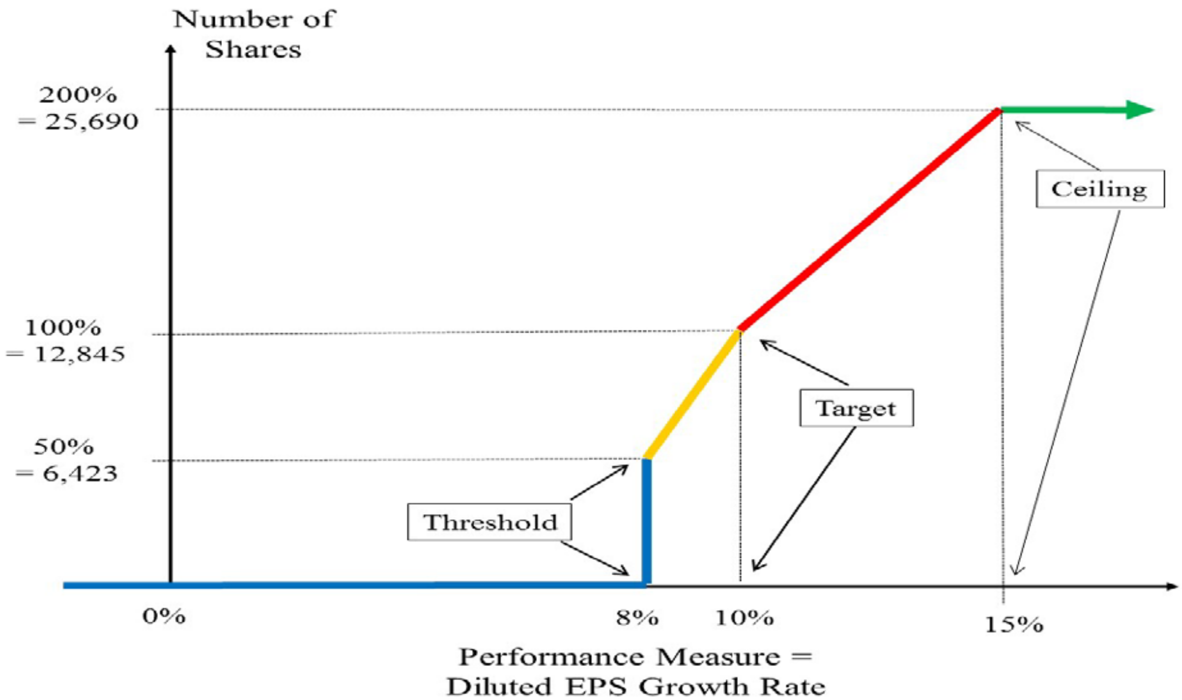



**Figure 1.b: Amgen 2008 Grant of Stock With Conditional Vesting Provision**

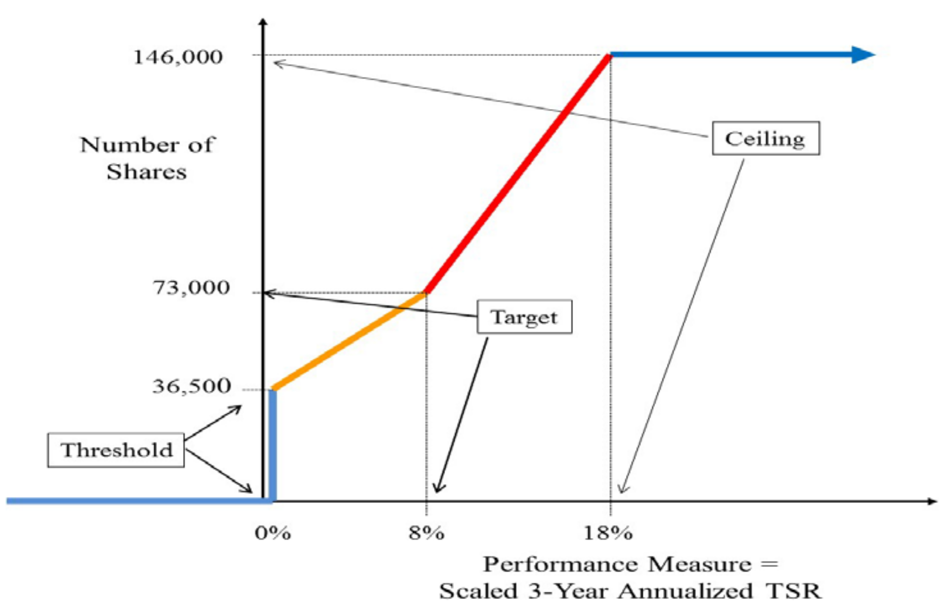


**Figure 2: Ex Post Value of Amgen 2008 Grant to CEO of Stock With Conditional Vesting Provision**

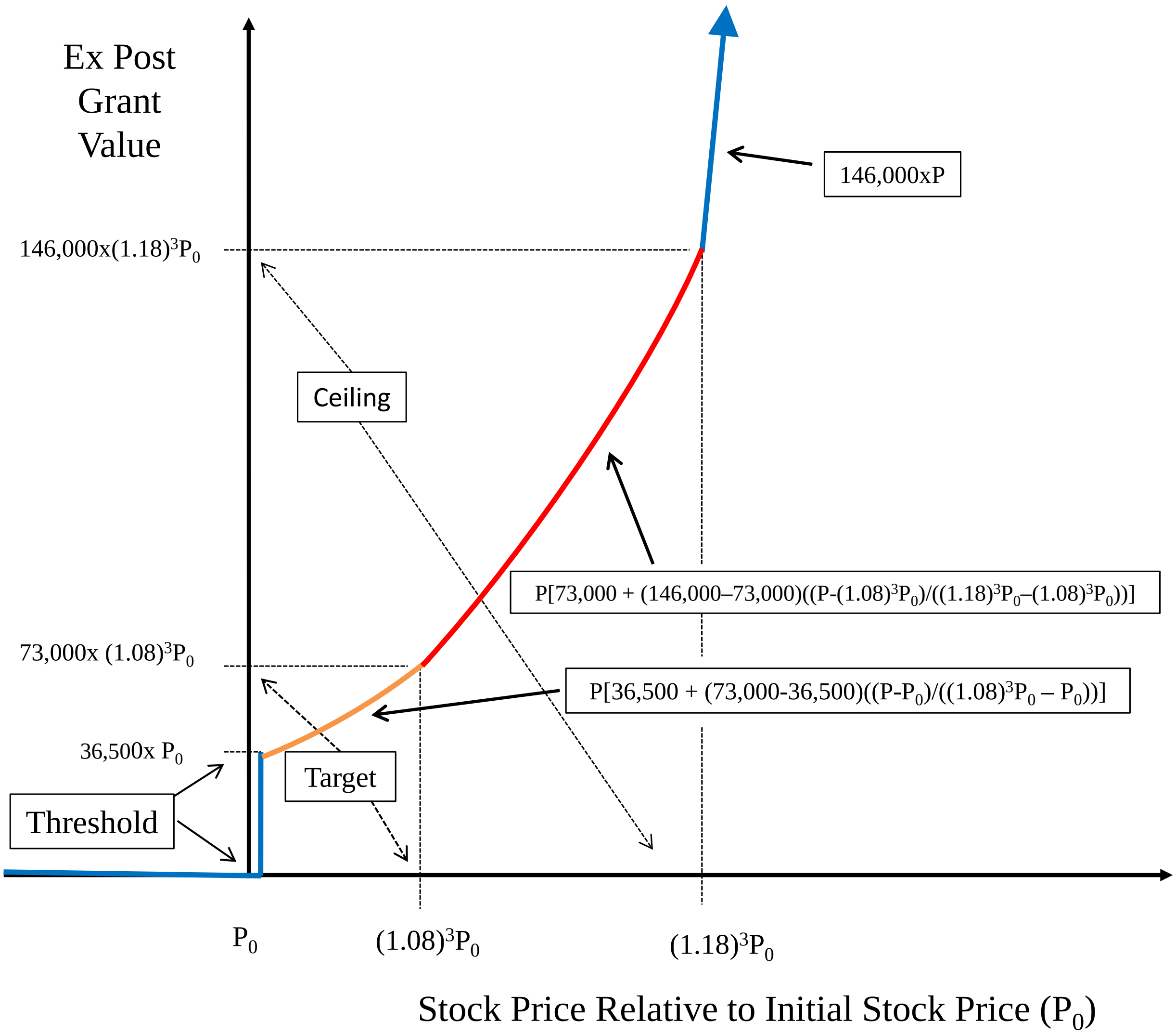


**Figure 3: Usage Rates for Large US Firms of Time-vesting and Performance-vesting Grants of Stock and Options to Executives** (one or more award of p-v stock or options to one or more named executive officer(s) in that year)

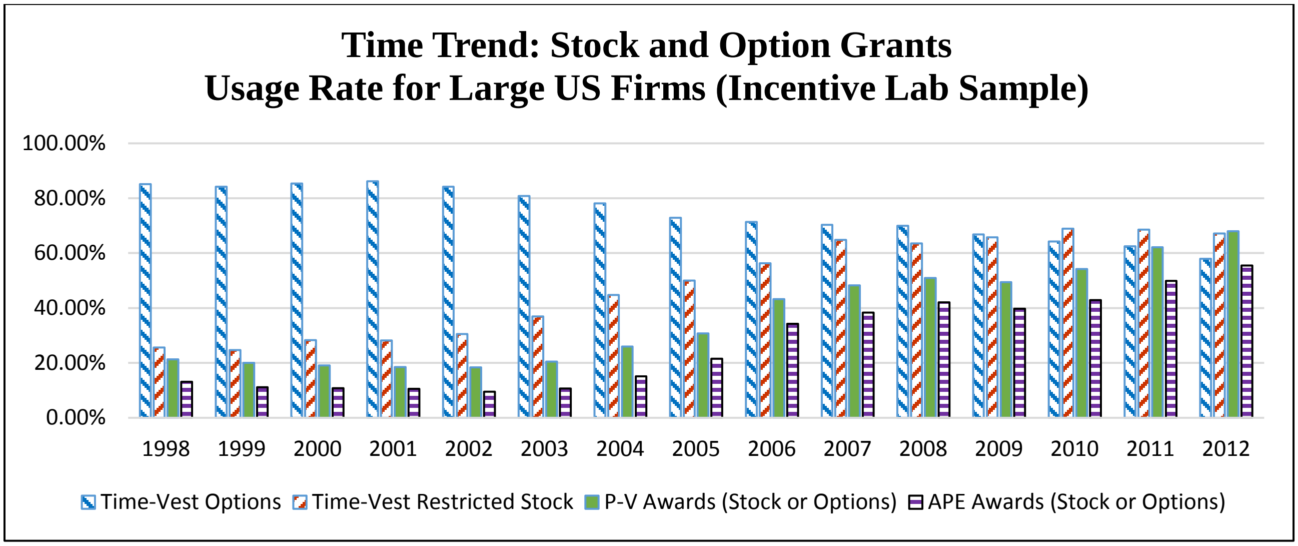
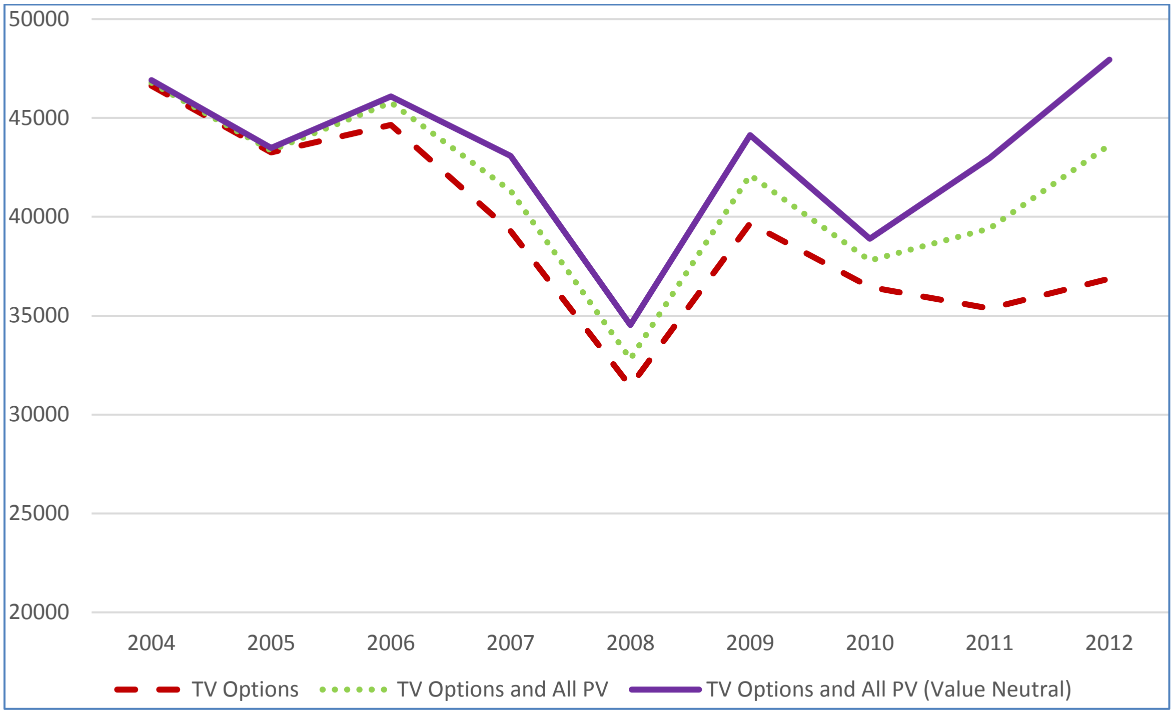
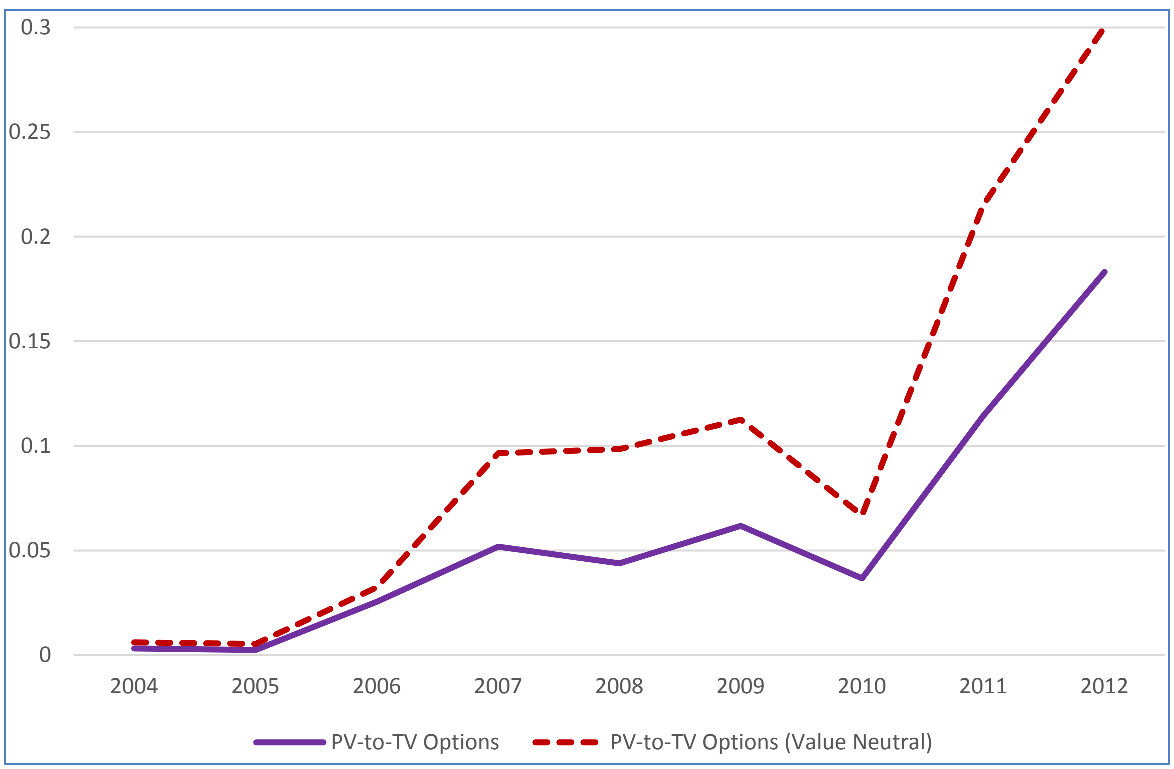


**Figure 4: Time Series Pattern (around ASC 718 (FAS 123R) (2005)) of Marginal Stock Price Vega Arising from the Portfolio of Accumulated (net of dispositions) Time-vesting and Performance-vesting Grants of Stock and Options to CEOs**



## Table 1: Performance-based and time-based vesting equity awards to executives (NEOs)

The table reports the distribution of firm-years that comprise our sample. The full sample consists of 1,833 firms during the period between 1998 and 2012. The sample includes 1,268 firms that at least once in the sample period made a p-v stock or option award to at least one NEO based on stock price, accounting, or other non-financial performance metrics ("performance-based awards") and 1,793 firms that at least once granted t-v (based on passage of time, "time-based awards") stock or options to at least one NEO. Most fields report the number of sample firms that in that year made one or more of the specified type of grant to one or more named executive officer (NEO). The reported value of stock or stock option awards is the grant-date fair value of awards disclosed in proxy statements under the new compensation disclosure rules of 2006. For the period prior to the new compensation disclosure rules, we use the value of stock or stock option awards disclosed by firms in their annual proxy statements and where values are missing we use the Black-Scholes model to value stock option awards and stock price during the grant year to value stock awards. To compute the ratio we add all performance-based and time-based awards across all executives (NEOs) for a firm in a given fiscal year. Some firms make more than one type of in a given year.

| Year | Time-based awards | | Performance-based awards | | Time-based awards: Stock or Options | Performance-based awards: Stock or Options | Absolute Performance Evaluation (APE) Awards | Reported or calculated value of all p-v awards/Sum of reported or calculated values of all p-v and t-v awards | Sample Firms |
|---|---|---|---|---|---|---|---|---|---|
| | Option [N=14,693] | Stock [N=9,237] | Option [N=1,017] | Stock [N=6,319] | [N=17,020] | [N=6,959] | [N=5,077] | [N=17,790] | [N=19,529] |
| 1998 | 1,096 | 330 | 92 | 199 | 1,132 | 274 | 169 | 12% | 1,287 |
| 1999 | 1,196 | 350 | 108 | 199 | 1,233 | 285 | 158 | 11% | 1,420 |
| 2000 | 1,197 | 397 | 98 | 194 | 1,249 | 268 | 152 | 9% | 1,403 |
| 2001 | 1,194 | 390 | 77 | 195 | 1,237 | 257 | 147 | 9% | 1,386 |
| 2002 | 1,169 | 424 | 59 | 211 | 1,231 | 255 | 132 | 9% | 1,388 |
| 2003 | 1,111 | 508 | 48 | 245 | 1,197 | 281 | 147 | 12% | 1,374 |
| 2004 | 1,070 | 613 | 53 | 317 | 1,189 | 356 | 207 | 15% | 1,369 |
| 2005 | 981 | 673 | 54 | 377 | 1,146 | 413 | 290 | 18% | 1,345 |
| 2006 | 926 | 730 | 66 | 535 | 1,107 | 561 | 444 | 26% | 1,297 |
| 2007 | 896 | 826 | 63 | 582 | 1,110 | 615 | 489 | 28% | 1,274 |
| 2008 | 873 | 793 | 63 | 606 | 1,081 | 636 | 525 | 30% | 1,248 |
| 2009 | 821 | 807 | 71 | 577 | 1,066 | 607 | 488 | 29% | 1,228 |
| 2010 | 776 | 832 | 45 | 635 | 1,064 | 654 | 517 | 32% | 1,207 |
| 2011 | 734 | 806 | 59 | 704 | 1,022 | 730 | 586 | 36% | 1,175 |
| 2012 | 653 | 758 | 61 | 743 | 956 | 767 | 626 | 41% | 1,128 |

## Table 2: Performance-based vesting equity awards to executives (NEOs)

The table provides details of the distribution of performance-based awards. The full sample consists of 1,833 firms during the period between 1998 and 2012. Of these, 1,268 firms at least once tie vesting of stock or stock options to stock price, accounting, or other non-financial performance metrics ("performance-based awards") and 1,793 firms tie at least once vesting of stock or stock options to passage of time ("time-based awards"). The fields report the number of sample firms that in that year made one or more of the specified type of grant to one or more named executive officer (NEO). Row or column numbers may not always total to N or 100% because some firms use more than one type of vesting provision.

*Panel A: Year-wise distribution of p-v grants*

| Year | Grant: Options [N=1,017] | | Grant: Restricted stock [N=6,319] | |
|---|---|---|---|---|
| | Performance-based Vesting Provision | | Performance-based Vesting Provision | |
| | Accelerated [N=479] | Contingent [N=579] | Accelerated [N=425] | Contingent [N=6,012] |
| 1998 | 62 | 34 | 20 | 185 |
| 1999 | 80 | 34 | 24 | 181 |
| 2000 | 69 | 34 | 26 | 172 |
| 2001 | 60 | 19 | 26 | 176 |
| 2002 | 45 | 14 | 39 | 176 |
| 2003 | 34 | 15 | 42 | 208 |
| 2004 | 41 | 13 | 52 | 274 |
| 2005 | 29 | 30 | 44 | 343 |
| 2006 | 17 | 54 | 33 | 511 |
| 2007 | 12 | 53 | 35 | 564 |
| 2008 | 12 | 53 | 33 | 587 |
| 2009 | 11 | 65 | 16 | 569 |
| 2010 | 3 | 43 | 10 | 630 |
| 2011 | 3 | 58 | 16 | 697 |
| 2012 | 1 | 60 | 9 | 739 |

*Panel B: Distribution of performance goals for contingent vesting awards*

| Year | N | Absolute performance Evaluation (APE) Awards | Relative performance Evaluation (RPE) Awards |
|---|---|---|---|
| 1998 | 208 | 81.3% | 38.9% |
| 1999 | 204 | 77.5% | 35.8% |
| 2000 | 193 | 78.8% | 40.4% |
| 2001 | 186 | 79.0% | 37.1% |
| 2002 | 184 | 71.7% | 48.4% |
| 2003 | 217 | 67.7% | 50.2% |
| 2004 | 280 | 73.9% | 46.4% |
| 2005 | 363 | 79.9% | 40.2% |
| 2006 | 529 | 83.9% | 34.0% |
| 2007 | 586 | 83.4% | 35.3% |
| 2008 | 615 | 85.4% | 35.6% |
| 2009 | 590 | 82.7% | 38.3% |
| 2010 | 649 | 79.7% | 41.0% |
| 2011 | 722 | 81.2% | 42.2% |
| 2012 | 761 | 82.3% | 48.0% |

*Panel C: Distribution of performance measures for contingent vesting APE awards*

| Year | N | Accounting | Stock Price | Other |
|---|---|---|---|---|
| 1998 | 169 | 66.9% | 41.4% | 21.9% |
| 1999 | 158 | 69.0% | 35.4% | 19.6% |
| 2000 | 152 | 65.8% | 40.8% | 21.7% |
| 2001 | 147 | 71.4% | 34.7% | 21.8% |
| 2002 | 132 | 75.0% | 37.9% | 23.5% |
| 2003 | 147 | 85.0% | 29.3% | 20.4% |
| 2004 | 207 | 81.6% | 28.5% | 21.7% |
| 2005 | 290 | 84.5% | 26.6% | 19.0% |
| 2006 | 444 | 87.2% | 21.4% | 18.0% |
| 2007 | 489 | 87.7% | 23.7% | 16.6% |
| 2008 | 525 | 88.4% | 25.1% | 16.2% |
| 2009 | 488 | 87.3% | 23.6% | 17.6% |
| 2010 | 517 | 90.7% | 22.8% | 16.6% |
| 2011 | 586 | 87.5% | 28.5% | 17.4% |
| 2012 | 626 | 85.6% | 35.1% | 15.2% |

*Panel D: Distribution of performance measures for contingent vesting APE awards by instrument type*

| Instrument | N | Accounting | Stock Price | Other |
|---|---|---|---|---|
| Options | 531 | 53.9% | 39.4% | 20.9% |
| Restricted Stock | 4,763 | 86.7% | 26.5% | 17.5% |

*Panel E: Distribution of accounting metrics for contingent vesting APE awards by instrument type*

| | Options | Restricted Stock |
|---|---|---|
| N | 286 | 4,129 |
| Earnings | 65.0% | 64.5% |
| Sales | 15.4% | 20.4% |
| Profit Margin | 4.5% | 5.2% |
| ROA | 1.4% | 3.5% |
| ROE | 5.9% | 9.0% |
| ROI | 7.3% | 16.3% |
| Cash Flow | 7.7% | 13.2% |
| EVA | 2.1% | 4.0% |
| Other | 19.9% | 14.8% |
| Vague | 1.4% | 1.4% |

*Panel F: Distribution of "other" metrics for contingent vesting APE awards by instrument type*

| | Options | Restricted Stock |
|---|---|---|
| N | 111 | 833 |
| Business Unit | 2.7% | 2.9% |
| Customer | 0.9% | 4.4% |
| Debt | 0.0% | 0.8% |
| FDA | 0.9% | 0.2% |
| IPO | 0.9% | 0.4% |
| Individual Goals | 34.2% | 19.1% |
| Operational | 6.3% | 11.3% |
| Same Store Sales | 2.7% | 2.3% |
| Other | 61.3% | 72.4% |
| Vague | 0.0% | 0.1% |

## Table 3: Descriptive analysis of the transition to usage of accounting metrics in performance-vesting provisions

This table provides maximum likelihood estimates from a logistic regression of use of accounting measures in p-v stock and stock options. The dependent variable takes the value one if the firm granted stock or stock options with p-v provisions that contain accounting measures, and zero if the firm used no p-v provisions in that year. This analysis excludes p-v awards based only on stock price performance. The full sample of p-v firms is explained in Tables 1 and 2, and explanatory variables are as explained in Table A in Appendix 2. Noise-to-signal ratios and correlation in noise are defined using methodology developed in Sloan (1993). All models include 2-digit SIC fixed effects. We report *z*-statistics in parentheses. Standard errors are corrected for heteroskedasticity and clustering at the firm level. ***, **, and * denote significance at less than 1%, 5%, and 10% levels, two-tailed tests, respectively.

| | (1) | (2) | (3) |
|---|---|---|---|
| Intercept | 16.669***<br>(14.80) | 17.577***<br>(16.25) | 17.095***<br>(33.13) |
| Post 2005 | 0.875***<br>(10.91) | 0.919***<br>(10.50) | 0.918***<br>(8.72) |
| Business segments | 0.071***<br>(3.03) | 0.078***<br>(3.08) | 0.075***<br>(2.79) |
| Ratio of Time-series Noise-to-Signal Ratios in Stock Returns and EPS Change (Sloan, 1993) | -0.005<br>(-0.42) | -0.011<br>(-0.57) | -0.016<br>(-0.70) |
| Time-series Correlation of Signal-Neutral Noise in Stock Returns and EPS Change (Sloan, 1993) | -0.268**<br>(-2.56) | -0.331***<br>(-2.76) | -0.297*<br>(-1.93) |
| Volatility | -16.988***<br>(-6.78) | -18.097***<br>(-6.43) | -26.858***<br>(-6.82) |
| Industry adoption | 3.005***<br>(14.48) | 2.515***<br>(9.68) | 1.869***<br>(5.93) |
| New CEO | 0.068<br>(1.12) | 0.105<br>(1.54) | 0.190**<br>(2.44) |
| Investment/Assets | -2.133***<br>(-3.12) | -2.267***<br>(-2.92) | -0.760<br>(-0.82) |
| Industry-adj. return on assets | -0.408*<br>(-1.76) | -0.313<br>(-1.25) | -0.444<br>(-1.50) |
| Log of market cap | 0.201***<br>(5.63) | 0.179***<br>(4.42) | 0.016<br>(0.31) |
| CEO ownership | | -3.684***<br>(-3.68) | -2.532*<br>(-1.75) |
| 5% inst. ownership | | 0.408<br>(1.21) | -0.029<br>(-0.07) |
| Outside directors | | | 2.016***<br>(5.37) |
| Board size | | | 0.035***<br>(3.25) |
| Director interlock | | | 1.467***<br>(5.83) |
| CEO Chair | | | 0.130<br>(1.39) |
| Pseudo R-square | 0.195 | 0.178 | 0.198 |
| N | 13,037 | 10,173 | 7,444 |

**Table 4: Performance-vesting equity-based awards to an NEO based on a single type of performance metric: threshold, target, and ceiling performance and probability of meeting performance conditions**

The table reports frequency with which firms meet performance conditions *ex-post* and provides comparison of this *ex-post* frequency with the simulated *ex-ante* probability of meeting performance conditions. The full sample of p-v firms is explained in Tables 1 and 2. The subsample includes 571 unique firms that grant stock or stock options with performance conditions based on either stock price or one or more accounting metrics ("performance-based awards") during the period between 1998 and 2012 for which we have sufficient information to run simulations. Information on performance period and hurdle rates are obtained from annual proxy statements. Accounting metric drift is assumed to be normally distributed, while sales and stock price drift are assumed to be log normally distributed. Multiple accounting measures require a multivariate distribution. We simulate one million paths of the state variables for each grant. The parameters required for simulation are expected stock returns using the CAPM, returns on accounting measures, covariance between stock returns and returns on accounting measures, covariance among drift of accounting measures, annual volatility in stock returns, and annual volatility in returns of accounting measures. For awards tied to accounting performance metrics, such as earnings or sales, the cumulative growth rate specified in the contract is applied over the performance period and Compustat data are used to examine whether the specified accounting targets are met *ex-post* when the performance period ends. For awards that are tied to stock price metrics, CRSP data are used to examine whether cumulative stock return conditions are met *ex-post* by the end of the performance period.

| | Overall<br>[N=9,214] | Options<br>[N=679] | Restricted Stock<br>[N=8,535] | Accounting<br>[N=7,431] | Stock Price<br>[N=1,783] |
|---|---|---|---|---|---|
| Performance period in years | 2.146 | 3.633 | 2.027 | 1.879 | 3.257 |
| (Median) | (2.000) | (3.000) | (2.000) | (1.000) | (3.000) |
| Annual threshold hurdle rate | 0.095 | 0.120 | 0.092 | 0.097 | 0.081 |
| (Median) | (0.047) | (0.077) | (0.045) | (0.042) | (0.060) |
| Simulated *ex-ante* probability of meeting threshold performance | 0.541 | 0.429 | 0.550 | 0.573 | 0.406 |
| *Ex-post* frequency of meeting threshold performance | 0.536 | 0.493 | 0.539 | 0.558 | 0.410 |
| Annual target hurdle rate | 0.130 | 0.151 | 0.128 | 0.135 | 0.105 |
| (Median) | (0.080) | (0.095) | (0.080) | (0.080) | (0.081) |
| Simulated *ex-ante* probability of meeting target performance | 0.487 | 0.395 | 0.495 | 0.514 | 0.374 |
| *Ex-post* frequency of meeting target performance | 0.466 | 0.465 | 0.466 | 0.484 | 0.361 |
| Annual maximum hurdle rate | 0.170 | 0.165 | 0.171 | 0.181 | 0.120 |
| (Median) | (0.103) | (0.100) | (0.105) | (0.110) | (0.090) |
| Simulated *ex-ante* probability of meeting maximum performance | 0.434 | 0.383 | 0.438 | 0.453 | 0.354 |
| *Ex-post* frequency of meeting maximum performance | 0.417 | 0.444 | 0.414 | 0.427 | 0.357 |

## Table 5: Simulated economic value of normalized stock and stock option awards to NEOs with performance conditions based on a single type of performance metric

The table reports simulated values of stock and stock option awards with performance conditions tied to stock price or one or more accounting-based measures, based on a current stock price of $1. The full sample of p-v firms is explained in Tables 1 and 2. The subsample includes 571 unique firms that grant stock or stock options with performance conditions based on either stock price or on one or more accounting metrics ("performance-based awards") during the period between 1998 and 2012 for which we have sufficient information to run simulations. Information on performance period, and hurdle rates are obtained from annual proxy statements. Accounting metric drift is assumed to be normally distributed, while market return and sales and stock-price drift are assumed to be log normally distributed. The parameters required for simulation are risk-free rate of return, covariance between stock returns and returns on accounting measures, annual volatility in stock returns, and annual volatility in returns of accounting measures. We simulate one million paths based on the multivariate distribution of market return and performance metric(s). In case of a stock option award, the value at the end of the performance period is the ex post Black-Scholes value. In case of a stock award, the value at the end of the performance period is the simulated stock price. The normalized simulation assumes a stock price of $1 on grant date and an exercise price of $1 for stock options.

| | | Back-end Instrument | | Performance Metric Type | |
|---|---|---|---|---|---|
| | Overall | Options | Restricted Stock | Accounting (1 or more) | Stock Price (single) |
| | [N=9,214] | [N=679] | [N=8,535] | [N=7,431] | [N=1,783] |
| Value at Target (without performance condition) (in $) (Median) | 0.964 (1.000) | 0.525 (0.524) | 1.000 (1.000) | 0.982 (1.000) | 0.894 (1.000) |
| Value with performance condition(in $) (Median) | 0.565 (0.569) | 0.346 (0.327) | 0.582 (0.580) | 0.558 (0.563) | 0.593 (0.609) |

**Table 6: Comparison of economic values with company disclosed values: sub-sample of single-metric p-v awards to NEOs with performance conditions from 2006-2012 with available information on grant date fair value**

The table reports simulated values of stock and stock option awards with performance conditions tied to stock price only or one or more accounting-based measures and comparison of simulated values with values disclosed by firms in annual proxy statements. The full sample of p-v firms is explained in Tables 1 and 2. The subsample includes 571 unique firms that grant stock or stock options with performance conditions based on either stock price or accounting metrics ("performance-based awards") during the period between 2006 and 2012 for which we have sufficient information to run simulations. Information on performance period, and hurdle rates are obtained from annual proxy statements. Accounting metric drift is assumed to be normally distributed, while market return and sales and stock-price drift are assumed to be log normally distributed. The parameters required for simulation are risk-free rate of return, covariance between stock returns and returns on accounting measures, annual volatility in stock returns, and annual volatility in returns of accounting measures. We simulate one million paths based on the multivariate distribution of market return and performance metric(s)In case of a stock option award, the value at the end of the performance period is the ex post Black-Scholes value. In case of a stock award, the value at the end of the performance period is the simulated stock price. Disclosed value is grant-date fair value of stock or options disclosed in the annual proxy statements.

| Mean (Median) | Overall [N=2,350] | Options [N=226] | Restricted Stock [N=2,124] | Accounting [N=1,969] | Stock Price [N=381] |
|---|---|---|---|---|---|
| Disclosed value (in $) (Median) | 1,188,301 (543,362) | 1,821,312 (437,833) | 1,112,096 (547,741) | 1,054,637 (519,552) | 1,829,736 (785,745) |
| Simulated risk-neutral value (in $) with performance condition (Median) | 910,706 (303,695) | 1,959,533 (370,466) | 799,108 (302,498) | 661,098 (285,262) | 2,200,675 (641,486) |
| Target value (in $) (target number of units times initial value of the stock, options, or cash) (Median) | 1,581,313 (580,668) | 2,789,454 (703,209) | 1,452,763 (561,514) | 1,216,239 (522,063) | 3,468,005 (1,052,314) |
| *p*-value of mean (median) difference in disclosed value and simulated risk-neutral value of p-v award | 0.000 (0.000) | 0.500 (0.286) | 0.000 (0.000) | 0.000 (0.000) | 0.078 (0.001) |
| *p*-value of mean (median) difference in disclosed value and target value | 0.000 (0.001) | 0.003 (0.000) | 0.000 (0.000) | 0.016 (0.101) | 0.000 (0.000) |

**Table 7: Relation between disclosed fair market value and underlying economic value and target value of the grant: sub-sample of single-metric p-v awards to NEOs with performance conditions from 2006-2012 with available information on grant date fair value**

This table provides ordinary least squares estimates from regression of the fair market value of each grant, as reported by the firm, on the economic value of the grant including the p-v provision (simulated per the model in Section 4), target pay (the target number of back-end units multiplied by the grant date value of the back-end unit), and the difference between these two values. All specifications require that the firm reports detailed data that is sufficient to calculate underlying economic value (as described in Table 5) of the p-v grant. All models include 2-digit SIC code and year fixed effects. We report *t*-statistics in parentheses. Standard errors are corrected for heteroskedasticity and clustering at the firm level. ***, **, and * denote significance at less than 1%, 5%, and 10% levels, two-tailed tests, respectively.

| | **Dependent Variable: Natural Logarithm of Reported Grant Date Fair Market Value** | | | |
|---|---|---|---|---|
| | **Stock Price Metric** | | **Accounting Metric** | |
| | (1) | (2) | (3) | (4) |
| Log(Economic Value) | 0.677*** | | 0.449*** | |
| | (7.60) | | (8.60) | |
| Log(Target Value) | | 0.884*** | | 0.964*** |
| | | (13.84) | | (48.53) |
| Constant | 4.432*** | 1.293 | 7.685*** | 0.488* |
| | 3.65 | (1.52) | (11.34) | (1.88) |
| Adjusted R-square | 0.778 | 0.878 | 0.557 | 0.932 |
| N | 381 | 381 | 1969 | 1969 |
| Economic Value for Which GDFV = Predicted GDFV | $910,148 | | $1,140,946 | |

## Table 8: Relation between disclosed fair market value and underlying economic value of the grant before versus after ASC 718: subsample of single-metric p-v awards of stock, options, and/or cash to NEOs with available information on grant date fair value

This table provides ordinary least squares estimates from regression of the fair market value of each grant, as reported by the firm, on the economic value of the grant including the p-v provision (simulated per the model in Section 4). Post 2005 is an indicator variable that takes the value one if the year is 2006 or later, and zero otherwise. All specifications require that the firm reports detailed data that is sufficient to calculate underlying economic value (as described in Table 5) of the p-v grant. All models include 2-digit SIC code and year fixed effects. We report *t*-statistics in parentheses. Standard errors are corrected for heteroskedasticity and clustering at the firm level. ***, **, and * denote significance at less than 1%, 5%, and 10% levels, two-tailed tests, respectively.

| | **Dependent Variable: Natural Logarithm of Reported Grant Date Fair Market Value** | | |
|---|---|---|---|
| | (1)<br>**All Awards** | (2)<br>**Stock Price Metric** | (3)<br>**Accounting Metric** |
| Log(Economic Value) | 0.733*** | 0.677*** | 0.839*** |
| | (13.57) | (8.03) | (7.16) |
| Log(Economic Value) x Post 2005 | -0.259*** | 0.008 | -0.389*** |
| | (-4.09) | (0.07) | (-3.18) |
| Constant | 4.493*** | 4.522*** | 9.296*** |
| | (5.31) | (4.65) | (14.23) |
| Adjusted R-square | 0.651 | 0.806 | 0.572 |
| N | 2,656 | 622 | 2,034 |

## Table 9: Relation between disclosed fair market value and underlying economic value and target value with controls: sub-sample of single-metric p-v awards to NEOs with performance conditions from 2006-2012 with available information on grant date fair value

This table provides ordinary least squares estimates from regression of the log of fair market value of each grant, as reported by the firm, on the log of economic value of the grant including the p-v provision (simulated per the model in Section 4), log of realizable value (closest = the number of back-end units closest to that used by firm in reporting multiplied by the grant date value of the back-end unit), log of realizable value (target = the target number of back-end units multiplied by the grant date value of the back-end unit), and other determinants. All specifications require that the firm reports detailed data that is sufficient to calculate underlying economic value (as described in Table 5) of the p-v grant. Log of market cap is logarithm of market value of equity. Market-to-book is the sum of book value of debt and market value of equity divided by book value of assets. Relative volatility is volatility of stock return or return on accounting measures (depending on whether the performance metric is accounting or stock price) minus the median value for firms in the same 2-digit SIC code. Marginal tax rate is the simulated marginal tax rate obtained from Professor John Graham. 5% inst. ownership is aggregate ownership by institutions owning at least 5% of the firm's common stock. Data on institutional ownership are obtained from 13F filings made available by Thomson Reuters. Use comp consult is an indicator variable set to one if a firm uses a compensation consultant, and zero otherwise. Big comp consult is an indicator variable set to one if a firm uses a large compensation consultant, defined as a compensation consultant that ranks in the top seven by market share, and zero otherwise. Performance is current year stock return or return on accounting measures (scaled by assets) matched on performance metric used in p-v grants minus the median value for firms in the same 2-digit SIC code. Analyst coverage is the number of financial analysts that provide annual earnings estimates for the fiscal year-end of the p-v award. Log of market cap, market-to-book, relative volatility, marginal tax rate, and 5% inst. ownership are lagged by one year. All models include 2-digit SIC code and year fixed effects. We report *t*-statistics in parentheses. Standard errors are corrected for heteroskedasticity and clustering at the firm level. ***, **, and * denote significance at less than 1%, 5%, and 10% levels, two-tailed tests.

| | **Dependent Variable: Natural Logarithm of Reported Grant Date Fair Market Value** | | | | | |
|---|---|---|---|---|---|---|
| | | **Stock Price Metric** | | | **Accounting Metric** | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Log(Economic Value) | 0.703*** | | | 0.469*** | | |
| | (12.85) | | | (10.35) | | |
| Log(Target Value) Closest | | 0.814*** | | | 0.966*** | |
| | | (11.80) | | | (46.32) | |
| Log(Target Value) Target | | | 0.753*** | | | 0.933*** |
| | | | (7.80) | | | (22.38) |
| 5% inst. ownership | -4.672*** | -3.085* | -3.659* | -1.110** | 0.032 | -0.067 |
| | (-2.91) | (-1.97) | (-1.90) | (-2.38) | (0.19) | (-0.34) |
| Use comp consult | -0.619* | -0.142 | -0.141 | 0.194 | 0.231*** | 0.325** |
| | (-1.77) | (-0.48) | (-0.40) | (0.62) | (2.66) | (2.47) |
| Big comp consult | 0.957*** | 0.749** | 0.870*** | 0.008 | -0.035 | -0.027 |
| | (2.92) | (2.47) | (2.72) | (0.07) | (-0.94) | (-0.62) |
| Marginal Tax Rate | -1.443 | -1.430 | -1.792 | -0.911 | 0.037 | 0.140 |
| | (-1.31) | (-1.30) | (-1.31) | (-1.39) | (0.27) | (0.69) |
| Analyst Coverage | 0.008 | -0.023 | -0.017 | 0.007 | 0.001 | -0.001 |
| | (0.32) | (-0.88) | (-0.66) | (0.79) | (0.26) | (-0.33) |
| Log of market cap | -0.102 | 0.102 | 0.130 | 0.076 | 0.028 | 0.072* |
| | (-0.73) | (0.81) | (1.03) | (1.09) | (1.02) | (1.77) |
| Market-to-book | 0.518 | -0.044 | 0.076 | 0.107 | 0.029 | 0.044 |
| | (1.58) | (-0.12) | (0.19) | (1.28) | (0.91) | (1.07) |
| Relative Volatility | -1.317** | -0.277 | -0.685 | 2.457 | 0.259 | 0.400 |
| | (-2.55) | (-0.50) | (-1.09) | (1.24) | (0.32) | (0.44) |
| Performance Current | 0.581** | -0.100 | -0.056 | 5.536 | -0.557 | -0.828* |
| | (2.18) | (-0.48) | (-0.22) | (1.35) | (-1.62) | (-1.76) |
| Constant | 6.015*** | 2.633** | 3.184** | 5.908*** | -0.160 | -0.228 |
| | (5.21) | (2.39) | (2.39) | (8.46) | (-0.80) | (-0.72) |
| Adjusted R-square | 0.919 | 0.921 | 0.910 | 0.658 | 0.949 | 0.920 |
| N | 249 | 249 | 249 | 1,338 | 1,338 | 1,338 |

## Table 10: Marginal and aggregate delta of equity-based awards with performance conditions based on a single accounting metric or a single stock-price metric

The table reports simulated deltas of stock and stock option awards with performance conditions tied to stock price or accounting-based measures. For the value-neutral grant, simulated delta with p-v is multiplied by the ratio of value without p-v and value with p-v (Table 6) for each award. Details of the sample and simulation are provided in Tables 4 and 5. Marginal stock delta (Panel A), $\boldsymbol{\delta_P}$, is $ change in simulated ex ante value of the p-v grant for a 1% chance in initial stock price. Marginal accounting delta (Panel B), $\boldsymbol{\delta_A}$, is $ change in simulated ex ante value of the p-v grant for a 1% chance in the initial value of the accounting metric. Aggregate delta (Panel C), $\boldsymbol{\delta_{Agg}}$, for cases in which the p-v grant schedule is contingent on an accounting performance metric, is $ change in value of security for a 1% change in stock price along with a $\boldsymbol{\beta_{AP}}$% change in the return of accounting measure.

*Panel A: Marginal stock delta,* $\boldsymbol{\delta_P}$

| | Overall [N=8,801] | Options [N=677] | | Restricted Stock [N=8,124] | |
|---|---|---|---|---|---|
| Mean in $ (Median in $) | | Accounting Metric [N=279] | Stock Price Metric [N=398] | Accounting Metric [N=6,818] | Stock Price Metric [N=1,306] |
| Simulated marginal stock price delta with p-v | 16,853 (4,191) | 11,181 (4,214) | 48,058 (17,779) | 11,079 (3,205) | 38,701 (14,073) |
| Simulated marginal stock price delta at target (without p-v) | 23,102 (7,055) | 36,561 (8,918) | 46,438 (14,799) | 19,690 (6,344) | 30,926 (8,309) |
| Simulated **value-neutral** marginal stock price delta with p-v | 28,775 (7,808) | 36,561 (8,918) | 67,203 (24,050) | 19,690 (6,344) | 62,827 (21,632) |
| *p*-value of difference between stock price delta of p-v award and award at target (without p-v) | 0.000 (0.000) | 0.000 (0.000) | 0.058 (0.364) | 0.000 (0.000) | 0.000 (0.000) |
| *p*-value of difference between stock price delta of **value-neutral** p-v award and award at target (without p-v) | 0.000 (0.000) | | 0.000 (0.000) | | 0.000 (0.000) |

*Panel B: Marginal accounting delta for p-v grants using one accounting metric,* $\boldsymbol{\delta_A}$

| Mean in $ (Median in $) | Overall [N=7,097] | Options [N=279] | Restricted Stock [N=6,818] |
|---|---|---|---|
| Simulated marginal accounting delta with p-v | 31,326 (9,239) | 27,873 (9,130) | 31,467 (9,246) |
| Simulated marginal accounting metric delta at target (without p-v) | 0 (0) | 0 (0) | 0 (0) |
| Simulated **value-neutral** marginal accounting delta with p-v | 83,070 (20,410) | 103,764 (22,389) | 82,223 (20,281) |
| *p*-value of difference between marginal accounting metric delta of p-v award and award at target (without p-v) | 0.000 (0.000) | 0.000 (0.000) | 0.000 (0.000) |
| *p*-value of difference between marginal accounting metric delta of **value-neutral** p-v award and award at target (without p-v) | 0.000 (0.000) | 0.000 (0.000) | 0.000 (0.000) |

*Panel C: Aggregate delta for p-v awards based on one accounting metric,* $\boldsymbol{\delta_{Agg}}$

| Mean in $ (Median in $) | Overall [N=7,097] | Options [N=279] | Restricted Stock [N=6,818] |
|---|---|---|---|
| Simulated aggregate delta with p-v | 18,317 (5,219) | 21,411 (6,022) | 18,190 (5,172) |
| Simulated aggregate delta at target (without p-v) | 20,353 (6,513) | 36,561 (8,918) | 19,690 (6,344) |
| Simulated **value-neutral** aggregate delta with p-v | 39,160 (11,072) | 73,875 (14,922) | 37,739 (10,908) |
| *p*-value of difference between aggregate delta of p-v award and award at target (without p-v) | 0.000 (0.000) | 0.000 (0.000) | 0.000 (0.000) |
| *p*-value of difference between aggregate delta of **value-neutral** p-v award and award at target (without p-v) | 0.000 (0.000) | 0.000 (0.000) | 0.000 (0.000) |

## Table 11: Simulated vega of stock and stock option grants with performance conditions based on one accounting or one stock performance metric

The table reports simulated vegas of stock and stock option awards with performance conditions tied to stock price or accounting-based measures. For value-neutral analysis, simulated vega with p-v is multiplied by the ratio of value without p-v and value with p-v (Table 6) for each award. Details of the sample and simulation are provided in Tables 4 and 5. Marginal stock (accounting) vega in Panel A (Panel B) is $ change in expected value of the grant for a 0.01 chance in stock (accounting) return volatility. Aggregate vega (Panel C) for cases involving an accounting hurdle is calculated by perturbing the variance-covariance matrix of stock and accounting drifts by $1.01^2$.

*Panel A: Marginal stock vega, $v_P$*

| | Overall [N=8,801] | Options [N=677] | | Restricted Stock [N=8,124] | |
|---|---|---|---|---|---|
| Mean in $ (Median in $) | | Accounting Metric [N=279] | Stock Price Metric [N=398] | Accounting Metric [N=6,818] | Stock Price Metric [N=1,306] |
| Simulated marginal stock vega with p-v | 1,713<br>(0) | 2,944<br>(1,701) | 13,784<br>(5,958) | 0<br>(0) | 6,717<br>(1,243) |
| Simulated marginal stock vega at target (without p-v) | 713<br>(0) | 7,513<br>(3,767) | 10,507<br>(5,021) | 0<br>(0) | 0<br>(0) |
| Simulated **value-neutral** marginal stock vega with p-v | 3,001<br>(0) | 7,513<br>(3,767) | 20,766<br>(8,865) | 0<br>(0) | 12,289<br>(2,043) |
| *p*- value of difference between marginal stock vega of p-v award and award at target (without p-v) | 0.000<br>(0.000) | 0.000<br>(0.000) | 0.000<br>(0.000) | | 0.000<br>(0.000) |
| *p*- value of difference between marginal stock vega of **value-neutral** p-v award and award at target (without p-v) | 0.000<br>(0.000) | | 0.000<br>(0.000) | | 0.000<br>(0.000) |

*Panel B: Marginal accounting vega for p-v grants based on a single accounting metric, $v_A$*

| Mean in $ (Median in $) | Overall [N=7,097] | Options [N=279] | Restricted Stock [N=6,818] |
|---|---|---|---|
| Simulated marginal accounting vega with p-v | 1,952<br>(457) | 3,812<br>(676) | 1,876<br>(439) |
| Simulated marginal accounting vega at target (without p-v) | 0<br>(0) | 0<br>(0) | 0<br>(0) |
| Simulated **value-neutral** marginal accounting vega with p-v | 11,634<br>(1,006) | 22,667<br>(2,036) | 11,183<br>(988) |
| *p*- value of difference between marginal stock vega of p-v award and award at target (without p-v) | 0.000<br>(0.000) | 0.000<br>(0.000) | 0.000<br>(0.000) |
| *p*- value of difference between marginal stock vega of **value-neutral** p-v award and award at target (without p-v) | 0.000<br>(0.000) | 0.000<br>(0.000) | 0.000<br>(0.000) |

*Panel C: Aggregate vega for p-v grants based on a single accounting metric, $v_{Agg}$*

| Mean in $ (Median in $) | Overall [N=7,097] | Options [N=279] | Restricted Stock [N=6,818] |
|---|---|---|---|
| Simulated aggregate vega with p-v | 3,717<br>(852) | 9,134<br>(2,358) | 3,495<br>(818) |
| Simulated aggregate vega at target (without p-v) | 295<br>(0) | 7,513<br>(3,767) | 0<br>(0) |
| Simulated **value-neutral** aggregate vega with p-v | 15,724<br>(1,933) | 37,668<br>(6,671) | 14,826<br>(1,752) |
| *p*- value of difference between aggregate vega of p-v award and award at target (without p-v) | 0.000<br>(0.000) | 0.044<br>(0.000) | 0.000<br>(0.000) |
| *p*- value of difference between aggregate vega of **value-neutral** p-v award and award at target (without p-v) | 0.000<br>(0.000) | 0.000<br>(0.000) | 0.000<br>(0.000) |

## Table 12: Firm risk surrounding use of performance-vesting

This table provides details of firm risk surrounding the use of p-v provisions in stock and stock option grants. The full sample of p-v firms is explained in Tables 1 and 2. Control firms are selected yearly by matching non-p-v firms with p-v firms by size (measured by market value of equity), and industry (defined as 2-digit SIC code). Firm risk is defined as the annualized standard deviation of daily stock return. We regress firm risk on: PV, Post and PV*Post. PV takes the value one if the firm uses p-v provisions, and zero otherwise. Post takes the value one if the year follows the fiscal year of the grant of p-v awards (Years +1, +2, +3), and zero if the year precedes the p-v grant (Year –1). Year 0 is the fiscal year of grant of p-v awards. Standard errors are corrected for heteroskedasticity and clustering at the firm level.

| **1998-2012** | | Year –1 | Year +1 | Year +2 | Year +3 |
|---|---|---|---|---|---|
| **Firm risk** | | | | | |
| Mean | PV firms | 0.337 | 0.343 | 0.346 | 0.339 |
| (Median) | | (0.289) | (0.289) | (0.289) | (0.281) |
| Mean | Control firms | 0.366 | 0.355 | 0.350 | 0.341 |
| (Median) | | (0.308) | (0.303) | (0.294) | (0.285) |
| Coefficient on *PV*Post* | Diff-in-Diff | | 0.016 | 0.025 | 0.026 |
| *p-value* | | | *0.024* | *0.002* | *0.004* |

| **1998-2005** | | Year –1 | Year +1 | Year +2 | Year +3 |
|---|---|---|---|---|---|
| *p-value* | | | *0.728* | *0.819* | *0.876* |
| **Firm risk** | | | | | |
| Coefficient on *PV*Post* | Diff-in-Diff | | 0.007 | 0.017 | 0.025 |
| *p-value* | | | *0.346* | *0.052* | *0.021* |

| **2006-2012** | | Year –1 | Year +1 | Year +2 | Year +3 |
|---|---|---|---|---|---|
| *p-value* | | | *0.121* | *0.121* | *0.173* |
| **Firm risk** | | | | | |
| Coefficient on *PV*Post* | Diff-in-Diff | | 0.022 | 0.033 | 0.031 |
| *p-value* | | | *0.035* | *0.007* | *0.029* |

**Table 13: Simultaneous equations (3SLS) of firm risk and R&D intensity on CEO incentives (vega)**

This table presents results from simultaneous regressions of firm risk and R&D intensity on CEO compensation convexity. R&D is research and development expenditures scaled by assets. Firm risk is logarithm of variance of daily stock returns. Vega and delta are portfolio vega and delta for the CEO based on full consideration of the p-v grant schedules and the accumulation net of dispositions of p-v stock and stock option awards and t-v grants of stock and options. Vega, delta and cash compensation are defined in millions of dollars. Control variables closely follow definitions in Coles, Daniel, and Naveen (2006). Intercepts not reported. All models include industry (2-digit SIC code) fixed effects. *t*-statistics based on bootstrapped standard errors are within parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

| | **Panel A** | | **Panel B** | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| | Firm Risk | Firm Risk | R&D | R&D |
| Vega | 64.219*** | 53.725*** | 4.042*** | 2.053*** |
| | (4.39) | (5.70) | (3.58) | (6.68) |
| Delta | -13.114*** | -7.504*** | -0.461*** | -0.003 |
| | (-3.79) | (-3.01) | (-2.67) | (-0.03) |
| Vega x Post 2005 | | -24.394*** | | -1.619*** |
| | | (-3.37) | | (-5.74) |
| Post 2005 | | 1.414*** | | 0.086*** |
| | | (4.06) | | (7.85) |
| CEO Tenure | 0.007 | 0.005 | 0.000 | -0.000 |
| | (1.21) | (1.33) | (0.62) | (-0.10) |
| Cash comp. | -0.035 | -0.375** | -0.014 | -0.016*** |
| | (-0.29) | (-2.37) | (-1.53) | (-3.94) |
| Log (Sales) | -0.294** | -0.273** | -0.046*** | -0.033*** |
| | (-2.44) | (-2.56) | (-3.20) | (-7.67) |
| Market-to-book | 0.217** | 0.214* | -0.009 | -0.011* |
| | (2.47) | (1.69) | (-1.02) | (-1.92) |
| Surplus cash | -1.657*** | -2.382*** | 0.137*** | 0.136*** |
| | (-4.04) | (-3.39) | (4.19) | (4.36) |
| Sales growth | 0.836* | -0.284 | 0.039** | -0.006 |
| | (1.71) | (-0.78) | (2.30) | (-0.66) |
| Stock return | 0.777** | 0.009 | 0.029*** | -0.001 |
| | (2.00) | (0.03) | (2.71) | (-0.30) |
| Market leverage | 2.954*** | 2.101*** | 0.127*** | 0.032*** |
| | (5.70) | (7.85) | (3.16) | (2.71) |
| Vega + Vega x Post 2005 | | 29.331 | | 0.434 |
| *p*-value | | *0.0004* | | *0.1552* |
| N | 10,059 | 10,059 | 10,059 | 10,059 |

| | Vega | | | |
|---|---|---|---|---|
| Delta | -0.075 | 0.274*** | -0.097*** | 0.267*** |
| | (-0.95) | (13.44) | (-3.35) | (25.24) |
| Cash comp. | 0.013*** | -0.001 | 0.014*** | -0.004*** |
| | (3.99) | (-0.27) | (6.43) | (-3.50) |
| Log (Sales) | 0.026*** | -0.007*** | 0.025*** | 0.002 |
| | (3.35) | (-4.30) | (11.79) | (1.47) |
| Market-to-book | 0.013*** | -0.010*** | 0.015*** | -0.012*** |
| | (2.72) | (-6.61) | (6.48) | (-10.73) |
| Market Leverage | -0.071*** | 0.030 | -0.065*** | 0.005 |
| | (-2.65) | (1.44) | (-6.99) | (0.82) |
| R&D | 0.079*** | 0.116*** | 0.001 | 0.434*** |
| | (4.04) | (3.12) | (0.02) | (4.45) |
| CAPEX | -0.104* | 0.104*** | -0.110*** | 0.087*** |
| | (-1.79) | (4.99) | (-3.80) | (5.71) |
| Firm Risk | 0.008 | -0.021* | 0.001 | -0.001 |
| | (0.92) | (-1.72) | (1.07) | (-0.80) |
| Post 2005 | | -0.015*** | | -0.018*** |
| | | (-6.25) | | (-11.86) |

| | Delta | | | |
|---|---|---|---|---|
| Vega | 7.896 | 3.571*** | 8.307*** | 3.628*** |
| | (0.83) | (4.98) | (6.62) | (21.49) |
| CEO Tenure | -0.000 | 0.000 | -0.000 | 0.000 |
| | (-0.09) | (0.28) | (-0.13) | (1.10) |
| Log (Sales) | 0.063 | 0.024 | -0.212*** | 0.024* |
| | (0.68) | (0.91) | (-3.94) | (1.85) |
| Market-to-book | -0.047 | 0.039** | 0.009 | 0.044*** |
| | (-0.27) | (2.15) | (0.51) | (10.84) |
| Surplus cash | 1.181 | -0.048 | 2.420*** | -0.491* |
| | (0.50) | (-0.15) | (3.15) | (-1.92) |
| Market Leverage | -0.954 | -0.063 | -0.099 | 0.043 |
| | (-0.44) | (-0.19) | (-1.30) | (1.23) |
| R&D | -2.835 | -0.318 | -14.698*** | 1.091 |
| | (-0.57) | (-0.44) | (-4.28) | (0.84) |
| CAPEX | -1.196 | -0.338 | -1.093*** | -0.140 |
| | (-0.58) | (-1.14) | (-3.78) | (-1.42) |
| Firm Risk | 0.734 | 0.044 | 0.144*** | -0.027* |
| | (0.47) | (0.21) | (3.59) | (-1.80) |
| Post 2005 | | 0.049** | | 0.046*** |
| | | (2.57) | | (6.04) |

## APPENDIX 1: Examples of P-V Awards

Performance-vesting provisions depend on a wide variety of metrics and in some cases multiple metrics. From the 2009 Brunswick proxy, we have:

> With respect to the special 2008 PS award, the number of PSs earned will be based on performance against several key strategic factors by the end of 2010. Those measures and target performance include Sales per Salaried Employee (7 percent increase versus 2007), Sales Per Capital Employed (3.2) and Return on Capital Employed (11%). Payout of 50 percent to 125 percent of target award is based solely on performance against performance criteria referenced above. An additional 25 percent of target award could be earned if stock price exceeds $25 and relative total shareholder return versus the S&P 500 is equal to or greater than the 60th percentile. In addition, there will be a minimum Company stock price threshold of $20 per share prior to any award being earned.

This grant of PSs ("performance shares") employs several performance metrics. Also note that a portion of the award is defined based on TSR relative to shareholder return of firms in the S&P 500.

For accounting awards firms often disclose a grant date fair value (GDFV) based on target pay (the product of the target number of units of the back-end instrument times a per-unit price for the shares or options). In 2008 Walmart granted p-v shares to top executives based on sales growth over a three-year performance period. At threshold (9% annual sales growth) the award paid 50% of the target number shares, at target (11% sales growth rate) the executive earned 100% of target, and at the maximum (13% sales growth) the executive earned 150% of target. The value reported by Walmart was based on target pay:

> The grant date value of the performance shares and Shares of restricted stock awarded is determined based on a per Share amount of $47.58, which is the fair market value, as defined in the 2005 Stock Incentive Plan, of the Shares as of the date of the grant. As the NYSE was closed for trading on the date of the grant, the fair market value was determined using the closing price on the prior trading day, which was January 18, 2008.

Walmart reported a GDFV of $14.25 million which is target number of p-v shares (299,496) multiplied by the closing price of $47.58.

## APPENDIX 2: Summary Statistics for Selected Control Variables

### Table A: Summary statistics for firm years

The table reports summary statistics for firm-years with and without a performance-based vesting (p-v) provision. The full sample consists of 1,833 firms during the period between 1998 and 2012. The sample includes 1,268 firms that tie vesting of stock or stock options to stock price, accounting, or other non-financial performance metrics ("performance-based awards") and 1,793 firms that tie vesting of stock or stock options to passage of time ("time-based awards"). New CEO is an indicator variable that takes the value 1 if the CEO was appointed to the company in the year (or the previous year) of the grant, and 0 otherwise. Business segments is the total number of business segments obtained from the Compustat industry segment file. Volatility is defined as the standard deviation of daily stock return. Investments is the sum of R&D, advertising and capital expenditures. Industry-adjusted stock return is defined as annual stock return minus the median stock returns for firms in the same two-digit SIC code. Market cap is stock price multiplied by total common shares outstanding. Industry adoption is the percentage of firms in the same two-digit SIC code that have any p-v provisions in equity awards. Post 2005 is an indicator variable that takes the value one if the year is 2006 or later, and zero otherwise. CEO ownership is defined as the aggregate number of shares owned (including exercisable stock options) by the CEO divided by total number of shares outstanding. 5% inst. ownership is aggregate ownership by institutions owning at least 5% of the firm's common stock. Data on institutional ownership are obtained from 13F filings made available by Thomson Reuters. Outside directors is the proportion of outside directors on the board. Board size in number of directors sitting on the board. Data on directors are obtained from IRRC. CEO Chair is an indicator variable that takes the value 1 if the CEO is also the chairman of the company in the fiscal year prior to the grant, and 0 otherwise. Director interlock is the proportion of directors of a firm that share common directorships with firms that use any type of p-v provisions in equity awards. The Student's *t*-test (Wilcoxon rank-sum test) is used to test whether there is a statistically significant difference between the means (medians). ***, **, and * denote significance at less than 1%, 5%, and 10% levels, two-tailed tests, respectively.

| | **P-V firm-years** [N=6,959] | | **Non P-V firm-years** [N=12,570] | | ***t*-stat** | **Wilcoxon *Z*** |
|---|---|---|---|---|---|---|
| | **Mean** | **Median** | **Mean** | **Median** | **(Means)** | **(Medians)** |
| New CEO | 0.250 | 0.000 | 0.222 | 0.000 | 4.26*** | 4.30*** |
| Business segments | 2.648 | 2.000 | 2.219 | 1.000 | 14.51*** | 16.87*** |
| Volatility | 0.024 | 0.020 | 0.029 | 0.025 | 25.07*** | 24.11*** |
| Investment/Assets | 0.075 | 0.059 | 0.096 | 0.069 | 14.77*** | 8.50*** |
| Industry-adj. stock return | 0.115 | 0.047 | 0.210 | 0.064 | 8.86*** | 4.78*** |
| Market cap (in $ million) | 12,911 | 4,176 | 8,805 | 2,459 | 9.39*** | 28.65*** |
| Industry adoption | 0.442 | 0.461 | 0.273 | 0.226 | 57.25*** | 53.73*** |
| Post 2005 | 0.656 | 1.000 | 0.317 | 0.000 | 48.19*** | 45.79*** |
| CEO ownership | 0.020 | 0.006 | 0.044 | 0.012 | 18.10*** | 25.21*** |
| 5% inst. ownership | 0.162 | 0.138 | 0.151 | 0.127 | 5.02*** | 6.04*** |
| Outside directors | 0.767 | 0.800 | 0.686 | 0.714 | 27.33*** | 25.62*** |
| Board size | 11.726 | 11.000 | 10.369 | 10.000 | 16.26*** | 18.48*** |
| CEO Chair | 0.657 | 1.000 | 0.632 | 1.000 | 2.57*** | 2.56*** |
| Director interlock | 0.207 | 0.181 | 0.131 | 0.909 | 20.95*** | 23.58*** |