The role of CEO compensation in stock splits*

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Abstract

We provide evidence that the decision to split a firm's stock is related to CEO incentives. CEOs who have option-based compensation are more likely to split their stock, and the degree of option convexity is a significant indicator of the magnitude of the split (as measured by the split factor). To quantify CEO incentives, we use the delta and vega of the compensation package and find that higher delta and vega compensation is associated with a higher propensity to undertake a stock split. These findings are robust to other documented motivations for stock splits, including the trading range, signaling, and tick size explanations. Our findings are economically significant: for the average firm in our sample, a stock split results in a CEO wealth gain of $7 million. Lastly, a large proportion of CEO option grants are made during the two days preceding and the day of the stock split announcement. Our findings suggest that managers can increase the risk profile (i.e., volatility) of the firm by cosmetically changing the firm (i.e. splitting the shares), and that they are induced to do so through the composition of their compensation packages.

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ABSTRACT

We provide evidence that the decision to split a firm's stock is related to CEO incentives. CEOs who have option-based compensation are more likely to split their stock, and the degree of option convexity is a significant indicator of the magnitude of the split (as measured by the split factor). To quantify CEO incentives, we use the delta and vega of the compensation package and find that higher delta and vega compensation is associated with a higher propensity to undertake a stock split. These findings are robust to other documented motivations for stock splits, including the trading range, signaling, and tick size explanations. Our findings are economically significant: for the average firm in our sample, a stock split results in a CEO wealth gain of $7 million. Lastly, a large proportion of CEO option grants are made during the two days preceding and the day of the stock split announcement. Our findings suggest that managers can increase the risk profile (i.e., volatility) of the firm by cosmetically changing the firm (i.e. splitting the shares), and that they are induced to do so through the composition of their compensation packages.

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1. Introduction

Since the seminal paper by Fama, Fisher, Jensen, and Roll (1969), a large number of authors have examined stock splits and various theories have been developed to explain their existence. However, despite these collective efforts there remain a number of unresolved questions, and, as Easley, O'Hara, and Saar (2001) note: *"On balance, it remains a puzzle why companies ever split their shares."*[1]

Several potential explanations for splits have been suggested in the literature. These include the trading range hypothesis (Copeland, 1979; Lakonishok and Lev, 1987; Conroy and Harris, 1999; Dyl and Elliott, 2006), reduction of information asymmetries (Grinblatt, Masulis, and Titman, 1984; Brennan and Copeland, 1988; Brennan and Hughes, 1991), and optimal tick size (Harris, 1997; Angel, 1997; Schultz, 2000). In addition to the aforementioned explanations for splits, a number of stylized facts surrounding stock splits have been well documented. These include positive abnormal returns on the announcement date and effective date (Grinblatt et al., 1984; Lamoureux and Poon, 1987; Kadapakkam, Krishnamurthy, and Tse, 2005), increased post-split volatility (Ohlson and Penman, 1985), and larger post-split spreads and/or increased transaction costs (Copeland, 1979; Conroy, Harris, and Benet, 1990; Schultz, 2000; and Easley et al., 2001).

In this paper, we propose a little-explored explanation for stock splits based upon the observed price and volatility effects surrounding stock splits. Specifically, we examine the link between CEO compensation and the decision to split the shares of the firm. We hypothesize that

[1] Similar sentiments are echoed by others, including Lin, Singh, and Yu (2009) and Weld, Michaely, Thaler, and Benartzi (2009).

the quantity of shares and options a CEO holds (as measured by delta and vega) is positively related to the probability that the firm will split its shares. The positive return on the announcement and pay date (i.e., on average, an increase in price) will increase the value of the CEO's compensation portfolio, and the greater post-split price volatility will further increase the value of the CEO's option portfolio (i.e., in a Black and Scholes (1973) option framework). This explanation has some attractive features. Most notably, it provides a direct link between the decision to split and the benefits of this action accruing directly to the decision makers.[2] Trading range, information asymmetry, and tick size explanations do not benefit decision makers in such a direct way.

Based on Core and Guay (2002), and Guay (1999), we relate delta (the sensitivity of CEO wealth to a 1% change in stock price) and vega (the sensitivity of CEO wealth to a 1% change in the standard deviation of stock returns) to the decision to split.[3] As noted by Coles, et al. (2006) and Core and Guay (2002), delta and vega are superior proxies over raw measures (e.g., number of options held, value of options held, and number of options granted) when attempting to measure the sensitivity of CEO compensation to changes in the value and volatility of the firm. We test the relationship between delta and vega and the decision to split, using a logistic framework.

Earlier literature posits that the motivations for splitting differ by split factor (e.g., Desai, Nimalendran, and Venkataraman, 1998; Kamara and Koski, 2001), and therefore we examine the

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[2] We acknowledge that our hypothesis does not necessarily compete with previous theories that explain split behavior. In particular, our hypothesis does not attempt to explain the price reaction nor the post-split volatility increase. However, conditioned upon these well documented price effects, we add to the literature that investigates predictability and timing of stock split announcements and, additionally, relate CEO compensation to decision making.

[3] The use of delta and vega to investigate issues surrounding managerial compensation has increased substantially in popularity over the last decade or so. Examples are Anderson, Bates, Bizjak, and Lemmon (2000), who use delta; Cohen, Hall, and Viceira (2000) and Knopf, Nam, and Thornton (2002) who use vega; and Rogers (2002), Rajgopal and Shevlin (2002); Coles, Daniel, and Naveen (2006); Pagach and Warr (2009); and Billet, Mauer, and Zhang (2008), who use delta and vega in their analyses.

influence of the delta and vega of the CEOs compensation portfolio on the split factor.[4] Lastly, we investigate whether there is a link between split dates and option grant dates. This analysis is based on insights provided by Lie (2005) and Heron and Lie (2007), who show that option grants are strategically timed. We relate the announcement date of the split with scheduled, unscheduled, and unclassified option grants to determine whether CEOs opportunistically time either option grants or the announcement of stock splits to ensure the maximum wealth benefit.

Our paper aims to make several contributions to the literature. First and foremost, to our knowledge, our paper is one of the first that addresses the link between splits and executive compensation.[5] After controlling for known determinants of splits, we show that the decision to split is directly related to executive compensation.[6] Our results are economically significant. For the average firm in our sample, the CEO wealth gain (in terms of her option and stock portfolio) is about $7 million. For the median firm in the sample, the gain is about $1 million. We confirm that split factors are positively correlated with post-split volatility increases and provide evidence that higher vega components of CEO compensation lead to higher split factors. To determine whether these relationships translate into observable behavior by CEOs, we compare option grant dates with stock split announcements. We find that CEOs appear to behave opportunistically by timing option grants immediately before stock split announcements.

Secondly, we contribute to the ongoing debate concerning the link between executive compensation components (i.e., delta and vega) and managerial actions. Higher levels of delta

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[4] Nayar and Rozeff (2001) find that different split factors affect announcement and pay day returns differently.

[5] The only other paper that deals with this issue that we are aware of is a short, contemporaneous working paper by Baghai-Wadji and Gabarro (2009). However, their paper uses only rudimentary ownership data, does not investigate the split factor, and does not analyze the relation between splits and option grants.

[6] In Section 2, we describe these other determinants in more detail, whereas in Section 3, we discuss our empirical methods to deal with these determinants.

should lead to an alignment between managerial actions and shareholder interests. The decision to split may be viewed in this context.

The role of vega is more contentious. Higher levels of vega may encourage managers to undertake riskier projects, as the manager's compensation is a function of the volatility of the stock. Several authors show that higher delta and/or vega compensation is associated with increased risk-taking behavior.[7] However, it might be the case that the risk-taking incentive of vega is altered by the shape of the manager's utility curve as in Ross (2004) and Carpenter (2000). Our paper provides an experiment where managers can choose to undertake an action that increases volatility (i.e., stock splits) without having to change the firm's operational activities. Thus, stock splits provide a clean experiment relating risk-taking incentives (measured by vega) to managerial actions. Given the increased use of stocks and options in executive compensation over the last two decades, a better understanding of the incentives that these contracts provide is an important policy issue.

Our third contribution provides up-to-date evidence on the characteristics of splitting firms as well as some of the effects of splitting. For example, we provide evidence that shows that the abnormal returns around the announcement date are significantly positive (about 1%), whereas earlier literature finds abnormal returns of about 3%.[8] We also document the Ohlson and Penman (1985) finding of increased post-split price volatility during recent times, even after decimalization of market prices. Further, when we bifurcate our sample by split factor, we find that large split factors exhibit larger increases in volatility.

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[7] For example, Coles et al. (2006) show that higher vega is associated with more investment in R&D, less investment in PPE, more focus; Erickson, Hanlon, and Mayhew (2006) find that stock-based compensation (delta) is directly related to accounting fraud accusations; Efendi, Srivatava, and Swanson (2007) and Burns and Kedia (2006) find that delta is related to accounting misstatements.

[8] However, our sample firms tend to be relatively large (S&P 1500 firms), we survey a sample period that includes a later period (1992-2005), and our methodology may be slightly different.

The rest of the paper proceeds as follows: Section 2 provides a brief literature review while Section 3 describes the hypotheses and method. Section 4 contains a description of the data and the variables used in the empirical tests. This section also contains a univariate analysis of the splitting and non-splitting firms. Section 5 presents our multivariate results. Section 6 reports the analysis related to the split factor, and Section 7 examines the split announcement dates and option grant dates. Finally, Section 8 states our conclusions.

2. Literature review

2.1. Stock splits

Different authors group the various determinants of stock splits into broad sub-groups. We follow Easley et al. (2001), who distinguish between the trading range hypothesis, the reduction of information asymmetries hypothesis, and the optimal tick size hypothesis.[9]

The trading range hypothesis was originally developed by Copeland (1979) and suggests that firms desire to have their shares traded at a particular stock price in order to attract certain clienteles. Some recent evidence consistent with the idea that some groups of investors are more likely to want shares of a particular price is provided by Dyl and Elliott (2006) and Fernando, Krishnamurthy, and Spindt (2004). Both studies suggest that individual investors prefer lower priced stocks. Gompers and Metrick (2001) also find that individuals tend to hold lower priced stocks. Earlier evidence suggests that institutional ownership increases after splits (e.g., Maloney and Mulherin, 1992), suggesting a clientele effect. More recently, Baker, Greenwood, and Wurgler (2009) find that managers seek a given share price in order to mimic share prices of firms that have high valuations.

[9] An alternative sub-grouping is provided by Weld et al. (2009), who distinguish between the marketability, pay to play, and signaling hypotheses. We include some of these theories in our bifurcation.

A number of theories have hypothesized that splitting behavior is related to information asymmetry and that splitting reveals private information or is an attempt to attract attention to the firm. Brennan and Copeland (1988) suggest that splits signal increased performance; however, studies by Lakonishok and Lev (1987) and Asquith, Healy, and Palepu (1989) provide evidence of performance increases prior to the split, not after. Dharan and Ikenberry (1995) and Ikenberry, Rankine, and Stice (1996) find positive abnormal performance after the split.

Other evidence suggests that information asymmetry decreases after a split. For example, Brennan and Copeland (1988) find that the number of shares outstanding is related to the announcement return, and Brennan and Hughes (1991) find that changes in analyst coverage are related to the split factor. Others conclude the opposite; for example, Desai et al. (1998) use a spread decomposition approach and conclude that information asymmetry does not decrease after a split.

Angel (1997) and Harris (1997) suggest that splitting behavior is related to tick size. Firms split to increase the ratio of minimum tick size and share price such that dealers are induced to provide increased liquidity for the stock (see Schultz, 2000 and Kadapakkam et al., 2005).

A variety of studies have examined the effects of split factors. Nayar and Rozeff (2001) find that the magnitude of the split factor affects the abnormal announcement returns. This finding is consistent with earlier literature that posits that the motivations for splitting differ by split factor. For example, McNichols and Dravid (1990) suggest that the split factor is related to the amount of private information disclosed.

2.2. Executive compensation incentives

To diminish the agency problems related to managerial risk aversion and better align managerial risk-taking behavior with their own, shareholders often use equity-based compensation (Jensen and Meckling, 1976). Equity compensation also mitigates perquisite consumption and increases effort levels. Stock options, in particular, have become an increasingly important element of managerial compensation. According to Hall and Murphy (2003), from 1992 to 2000, there has been a tenfold increase in the value of options granted to executives of S&P 500 firms; by 2004, the total value has fallen by over 50 percent relative to 2002. As a result, a substantial literature has developed that analyzes the relationship between CEO equity compensation, risk-taking, and firm performance.[10]

During the last decade or so, based on insights provided by Core and Guay (2002) and others, researchers have begun to use delta and vega as measures of executive compensation. This literature focuses on whether managerial stock and option compensation affects managerial risk-taking. The difference between stock and stock options is relevant, since greater equity ownership may lead to more risk aversion. However, stock options, which lack the downside risk of equity, encourage managerial risk-taking.

Guay (1999) shows that options significantly increase risk-taking, relative to equity. However, Ross (2004) challenges the "common folklore" that call options induce managers to take risk, and shows that this relationship depends on the wealth effect of the options; increases in stock options may increase or decrease risk aversion, depending on whether the options move the manager into more or less risk averse portions of his utility function. Ross' results are consistent with those of Carpenter (2000), who models option compensation and risk-taking in

[10] See Core, Guay, and Larcker (2003) for a survey of this literature.

an intertemporal context and shows that increased use of options does not always lead to greater risk-taking.

Generally speaking, empirical studies support the concept that risk-taking is directly related to employee stock options.[11] For example, Rajgopal and Shevlin (2002) study oil and gas producers; they find that higher levels of employee stock options is directly related to more volatile future cash flows. Cohen et al. (2000) also find that increases in option compensation leads to increases in firm risk; however, they fail to find a significant stock return response to option-induced risk-taking. They conclude that the option induced risk effect is relatively small. Knopf et al. (2002) attempt to separate the risk incentive effects from equity and options. They show that firms with higher levels of managerial stock ownership hedge more, while firms whose managers hold higher levels of options, hedge less. Coles et al. (2006) focus exclusively on vega. They find that higher levels of vega are associated with a greater propensity to take risky actions, including more R&D spending, less spending on fixed assets, greater firm focus, and higher proportions of debt. In contrast, Hanlon, Rajgopal, and Shevlin (2004) document a low correlation between vega and future stock volatility.

3. Hypotheses and method

Conditioned on previous findings that stock splits lead to announcement and pay day price appreciation along with increased price volatility in the year following the split, we hypothesize that CEOs with compensation that is more sensitive to share price increases and increased volatility (i.e., high delta and vega components) should be more likely to split a firm's

[11] Compensation induced risk-taking behavior may result in negative consequences for shareholders. For example, Erickson, Hanlon, and Mayhew (2006) find that stock-based compensation is directly related to accounting fraud accusations, and Cheng and Warfield (2005) find that equity incentives are related to earnings management.

shares. To test this hypothesis, we examine the extent to which delta and vega are associated with the decision to split. However, as described in the previous section, there are a number of other factors that determine whether managers split their firms' shares. We control for these other potential explanations by employing the following logistic regression framework:

$$P(Split_{j,t} = 1/x_{j,t}) = G(x_{j,t}\alpha) \quad (1)$$

where, $G(x_{j,t}\alpha) = \frac{1}{1+e^{-x_{j,t}\alpha}}$ and $x_{j,t}\alpha = \alpha_0 + \alpha_1$ *CEOcomp*$_{j,t}$ + α_2 *TRDNGRNG*$_{j,t}$ + α_3 *INFOASYMM*$_{j,t}$ + α_4 *TICKSIZE*$_{j,t}$ + α_5 *market-to-book*$_{j,t}$ + α_6 *ln[totalassets$_{j,t}$]*. *CEOcomp*$_{j,t}$ measures the sensitivity of CEO compensation to changes in share price (i.e., *ln[delta]*) or to changes in share price volatility (i.e., *ln[vega]*). Both variables are calculated at the beginning of each fiscal year. Given that on average a split results in an increase in both the level and the volatility of the stock price,, we expect the coefficients on *delta* and on *vega* to be positive. *Market-to-book*$_{j,t}$ is the market value of equity scaled by book value, and *ln[totalassets$_{j,t}$]* is the natural log of the book value of total assets, both at the beginning of the year.[12]

We follow Dyl and Elliott (2006) and include three proxies to control for trading range explanations (*TRDNGRNG*$_{j,t}$). The first, *traderange,* is a binary variable that is equal to 1 when the actual share price is 50 percent or more of the predicted share price, where predicted share price is the predicted value from an annual regression of average share price on book-value of equity, average value of shareholdings, and earnings per share (in Section 4.2 we describe this variable in more detail). The second variable is *stockappreciation.* It captures the amount of stock appreciation prior to the split (computed as the ratio of fiscal year-end *shareprice*$_{t-1}$ to

[12] To control for industry and time effects, we also include industry (based on 2-digit SIC codes) and year dummies.

shareprice$_{t-3}$, where *shareprice* is the closing price on the last day of the fiscal year). The last control for the trading range hypothesis is *institown*, which is the percent of shares owned by institutions.[13]

To control for explanations based upon information asymmetry ($INFOASYMM_{j,t}$), we include analyst following (*analysts*) and the number of shareholders (*shareholders*) prior to the split. Finally, to control for optimal tick size ($TICKSIZE_{j,t}$) explanations, we include the actual *shareprice* (prior to the split). Because the decimalization of stock prices may impact optimal tick sizes (e.g., Kadapakkam et al., 2005; Lipson and Mortal, 2006), we include dummies labeled *predecimalization* (*postdecimalization*) that equal 1 for firm years prior to (after) 1997 (2000).

Our second hypothesis explores the size of the split with respect to CEOs' compensation structure. If stock splits on average result in a positive stock price reaction and an increase in the volatility of the firm's stock price, we expect that the magnitude of the split factor will be correlated with the magnitude of the price reaction and the volatility change. Empirically, the announcement price effect is invariant with the split factor, while the post-split price volatility is positively correlated with the split factor. Conditioned on this observation, we hypothesize that the split factor will be negatively related to delta and positively related with vega. The intuition behind this hypothesis is that a manager with a relatively high delta should select a smaller split factor, because her wealth increases with increases in the price level, and the increase in price caused by a split is not related to the split factor. Therefore, a high-delta manager gets the most 'bang' for her stock split by selecting a small split factor. On the other hand, if a manager has a relatively high vega, she should select a split factor that maximizes the price volatility. Given that larger split factors lead to larger increases in price volatility (no matter the reason), a

[13] Given that most trading range explanations for splitting assume that managers split in order to attract individual shareholders (vis-à-vis institutional shareholders), we include institutional ownership prior to the split.

manager with a high vega should select a large split factor. To test this hypothesis, we estimate the regression described in Equation 1, except the dependent variable is replaced with a binary variable that captures the probability that a splitting firm selects a large split factor (the variable is coded as 1 if the firm splits by at least 2:1 and as 0 if it uses a 3:2 split factor).

4. Data

In this section we describe the sample of splitting and non-splitting firms. We also describe the variables used in the analysis and provide univariate tests to explore the differences between splitting and non-splitting firms.

4.1. Sample

To generate our sample we use the following algorithm. First, using the Execucomp universe of firms[14], we compute a delta and vega for each firm with available data between the years 1992 and 2005. This produces a sample of 21,414 firm-years, covering a total of 2,704 unique firms. We then merge the sample firms from Execucomp with the Compustat data to gather the financial accounting data necessary to compute our control variables. This merge reduces the sample to a total of 20,863 firm-years and 2,643 unique firms.[15] Market data and split data are gathered from the Center for Research in Security Prices (CRSP) database. Any firm in the sample that engages in at least a 3:2 split (CRSP distribution code of 5523) at any time during the sample period is said to have split its stock. We find a total of 1,837 splits made by 1,107 unique firms. We also gather return data around the split declaration and pay dates as

[14] From the Execucomp data description manual: "The universe of firms cover the S&P 1500 plus companies that were once part of the 1500 plus companies removed from the index that are still trading, and some client requests. Data collection on the S&P 1500 began in 1994. However, there is data back to 1992 but it is not the entire S&P 1500."

[15] We require that total assets (#6) and total revenues (#12) be positive.

well as price data (to compute price appreciation in the preceding years as well as price volatility in the post-split year) from CRSP. The institutional holdings data and number of analysts are from Compact Disclosure and IBES, respectively.

We filter the sample to remove extreme outliers and potential coding errors by the following restrictions. The share price must be greater than $5 and less than $10,000. We remove firms with a debt-to-assets (Compustat item #181 divided by item #6) or debt-to-equity (Compustat item #181 divided by [item #6 – item #181]) ratio greater than 1 or 500, respectively. We restrict the sample to firms that have a positive value for total common equity (Compustat item #60). Finally, to allow computation of a price appreciation measure, we require that the firm exist in the CRSP database for 3 years prior to the sample year.[16] This reduces the sample size to 19,178 firm-years from 2,501 unique firms. During the sample period, there were a total of 1,617 splits made by 1,027 firms.

We show the temporal distribution of splitting and non-splitting firms in Table 1, panel A. The table provides several insights. First, there are 1,617 stock splits, while there are 17,561 firm years where firms do not split. Second, the number of splits ranges from 41 (in 1992) to 172 (in 1995). However, as a percentage of all sample firms, firms that split range from 5% (in 2002) to 13% (in 1995 and 1997). For most years this percentage is around 10%. Only the 2000-2002 period seems to have a smaller number of splits. Panel B reveals that the stock splits are distributed across all the broad industrial groups. Unsurprisingly perhaps, the utilities industry has relatively fewer splits, consistent with this industry being more heavily comprised of income stocks.

[16] In unreported results, we replicate the tests using 4- and 5-year restrictions. The results are qualitatively similar.

Our hypotheses critically depend on whether splits lead to positive returns around the announcement date and an increase in volatility after the split. In Table 2 we show the abnormal returns around the announcement dates and pay dates and the volatility (both pre- and post-split). We calculate a 2-day (day 0 to +1) and 3-day (day -1 to +1) market-adjusted holding period return on the announcement and pay dates of the split, using the CRSP value-weighted dividend-adjusted returns as the market index. Our results are generally consistent with the previous literature. We find a mean abnormal 3-day announcement return of about 2.0 percent and a median return of about 1.3 percent. This return is lower than Ikenberry et al. (1996), who report a mean of 3.38% for 1,275 two-for-one stock splits initiated by NYSE and Amex firms in the years during 1975-1990. However, they report a declining trend in announcement returns.[17] The mean abnormal return around the pay date is approximately 0.6 percent. We also report a compound return for the announcement plus pay date (using a 3-day window around each date). The mean (median) return is 2.5% (1.9%). In order to determine whether volatility increases after the split, we follow Olson and Penman (1985), who calculate volatility as the mean of the squared daily returns for the 252 days before and after the split. The mean (median) volatility prior to the split is 0.0008 (0.0004), whereas after the split the mean (median) increases to 0.0011 (0.0006). A pairwise test for the difference in pre- and post-year volatility shows that this increase is statistically significant (the mean difference is 0.0003). In addition, more than 70% of the splitting firms show a volatility increase. This finding is consistent with the prior literature (e.g., Ohlson and Penman, 1985) and may provide the impetus for managers to split their shares, especially when the vega component of the CEO's compensation package is relatively high.

[17] Lin et al. (2009) also report an announcement return of over 3%. Their sample period is 1975-2004.

4.2. Variables and univariate analysis

Summary statistics for our sample are presented in Table 3. The table shows the means, medians, and standard deviations for splitting and non-splitting firms. We also provide test statistics to assess the difference between the sub-samples. We use Compustat data to calculate market-to-book ([#25 multiplied by #199] divided by #60), totalassets (#6), netsales (#12), debt-to-equity (#181 divided by [#6 - #181]), EPS (#58), and ROE ([#25 multiplied by #58] divided by #60). Splitting firms have an average (median) market-to-book of 4.99 (3.42), whereas non-splitting have an average (median) market-to-book of 3.35 (2.21). Both the mean and median are significantly different at the one-percent level. This finding suggests that splitting firms are relatively more highly valued and are more typically growth stocks. Splitting firms are slightly smaller in terms of assets, but have nearly the same level of annual sales. For example, the mean (median) *totalassets* for splitting firms is \$10.2 billion (\$1.4 billion), whereas the mean (median) for non-splitting firms is \$11.5 billion (\$1.5 billion). Splitting firms have lower debt-to-equity ratios and are more profitable in terms of EPS and ROE, again consistent with their being more growth-oriented stocks.

We now turn to the characteristics related to the three potential split explanations, as discussed in Section 3 (*TRDNGRNG*, *INFOASYMM*, and *TICKSIZE*). First, we look at variables that may proxy for the trading range explanation. We follow Dyl and Elliott (2006) to calculate *traderange* and *stockappreciation*. The variable *traderange* indicates whether or not the price of the stock is "too high," and the variable *stockappreciation* measures the increase in the firm's stock price over the two years preceding year t. $Traderange_{j,t}$ is defined as follows:

$$traderange_{j,t} = shareprice_{j,t} \,/\, E(shareprice_{j,t} \mid BVEquity_{j,t},\ AvgHldg_{j,t},\ EPS_{j,t}) \qquad (2)$$

where, $E(shareprice_{j,t-1} \mid BVEquity_{j,t-1}, AvgHldg_{j,t-1}, EPS_{j,t-1})$ is estimated by Equation 3,

$$E(shareprice_{j,t-1} \mid \text{etc}) = \delta_0 + \delta_1 BVEquity_{j,t-1} + \delta_2 AvgHldg_{j,t-1}, + \delta_3 EPS_{j,t-1} \tag{3}$$

where, $BVEquity_{j,t-1}$ is the book value of equity (#60), $AvgHldg_{j,t-1}$ is the total equity per shareholder, and $EPS_{j,t-1}$ is the year t-1 earnings per share. $Traderange_{j,t-1}$ is the ratio of a firm's actual share price in year t-1 to its predicted share price from Equation 3, conditioned on the firm's size, average holdings per shareholder, and earnings per share. We convert $traderange_{j,t-1}$ into a binary variable. The variable is set to 1 if the share price is more than 50% above the predicted price, and 0 otherwise. The mean (median) value of *traderange* for splitting firms is 1.14% (1.12%), whereas for non-splitting firms the corresponding values are 0.98% (0.99%). The mean difference is statistically significant and indicates that a significantly higher percentage of splitting firms have share prices that are "too high," and the split will thus bring them back in line with their expected share price. The *stockappreciation* variable is the proportional increase in the jth firm's split-adjusted average stock price over the two years preceding the split year, and is computed as follows:

$$stockappreciation_{j,t-1} = shareprice_{j,t-1} / shareprice_{j,t-3} \tag{4}$$

The table shows that *stockappreciation* is significantly higher for splitting firms. We find that splitting firms had an average *stockappreciation* of 37%, compared to 22% for non-splitting firms. The medians show a similar pattern.

Institutional ownership data from Compact Disclosure represents the ownership by all institutions as a percentage of total shares outstanding. However, data for this variable is only available until 2004. Splitting firms have significantly higher institutional ownership (i.e., the mean for splitting firms is 60% versus 59% for non-splitting firms; the medians show the same pattern). While these differences are statistically significant, the economic significance would appear to be small. Overall, these findings suggest that trading range explanations may indeed be related to the splitting decision.

Turning to the variables that proxy for the amount of information asymmetry (*INFOASYMM)*, we find that splitting firms are followed by an average (median) of 9.1 (6.9) analysts, whereas non-splitting firms are followed on average (median) by 8.1 (6.2) analysts. The number of shareholders (*shareholders*) is slightly smaller for splitting firms. These results seem to be mixed, given that we expect firms with greater information asymmetry to have lower levels of both analyst following and number of shareholders.

Optimal tick size explanations (*TICKSIZE*) suggest that splitting firms should have higher stock prices. Indeed, we find that the mean share price is higher for splitting firms. The mean share price is over $54 for splitting firms and about $32 for non-splitting firms.

Finally, we investigate whether there is a relationship between the sensitivity of CEOs' compensation and the decision to split. We use the approach of Rogers (2002) and Core and Guay (2002) to create measures of a CEO's incentive to engage in risk-taking activities for the firm. The first measure, delta, is the partial derivative of the Black-Scholes equation with respect to the level of the stock price, and measures the incentive to increase stock price. The second measure, vega, is the partial derivative of the dividend-adjusted Black-Scholes equation with respect to the standard deviation of stock returns, and measures the incentive to take risk. We compute delta and vega for each CEO's stock and option portfolio to measure CEO risk-taking incentives.[18] Consistent with our main hypothesis, CEOs of splitting firms have significantly higher deltas and vegas. They have a mean delta (vega) of 2,967 (163) compared to 1,027 (212) for managers of non-splitting firms. These results suggest that managers may indeed be incentivized to split their shares.

Table 4 presents the correlations between the key variables in our analysis. Focusing on the first two columns, we note that delta and vega are highly correlated. The correlation coefficient is 0.45, and significant at the <0.001 level. Because of this correlation, we do not include both delta and vega in the same model as separate regressors. However, in an effort to ascertain the influence of each measure relative to the other, we employ the ratio of vega and delta (Rogers [2002]). As Rogers mentions, the economic meaning of the variable is not clear, albeit we use the ratio to determine whether the influence on the dependent variable is driven by risk-taking (vega) or value-increasing (delta) incentives.

5. Multivariate results

To examine our primary hypothesis, that firms whose CEOs have compensation portfolios with a higher delta and vega are more likely to split their firms' stock, we estimate a logit regression (see Equation 1). The results are presented in Table 5. Panel A focuses on models that include the natural logarithm of delta in the specification (Models 1-6). Consistent with our univariate finding in the previous section, the coefficient is always positive and highly significant. For example, in Model 1, the coefficient estimate on *ln(delta)* is 0.3567 with a chi-squared value of about 272. The relation between delta and the likelihood to split the firm's shares remains stable across different model specifications. For the most part, the coefficients on

[18] For pure stock holdings, delta = 1 and vega = 0. A detailed description of the calculation of delta and vega is provided in Appendix 1.

the control variables are in line with our univariate findings and existing literature. Overall, consistent with our main hypothesis, these results suggest that delta may indeed be related to splitting behavior.

In Panel B, we repeat the same regressions, but replace *ln(delta)* with *ln(vega)*. Consistent with our univariate analysis, the coefficient on *ln(vega)* is always positive and statistically significant (at the 1% level in four of the models and at the 5% level for the remaining two models). Again, the coefficients on many of the control variables are also significant and generally of the same sign as found in previous literature. These results suggest that, in addition to delta, vega is positively related to the probability of splitting.

Panel C uses the ln(vega/delta) as an independent variable. The ratio is expected to allow us to determine the relative strength of the two CEO incentive parameters as they relate to the split decision. In all six of the models estimated, the coefficient on the ratio is negative and significant at the 1 percent level. We interpret this as evidence that the value-increasing effect (i.e. delta effect) appears to drive the decision to split, relative to the risk-taking effect (i.e. vega effect).

After controlling for other determinants of stock splits, our results indicate that CEO compensation deltas and vegas are positively related to the decision to split the stock of the firm and the delta effect seems to have the greatest impact. These findings are consistent with managers capitalizing on the abnormal returns surrounding the split, on the increase in volatility that follows the split itself, or both.

6. Split factor, delta, and vega

6.1. Univariate analysis

First, we investigate whether returns and volatility changes following a split announcement are different when we bifurcate the sample of splitting firms by the split factor. These results are reported in Table 6. For 3:2 splits, we find a mean (median) 3-day announcement return of 1.79% (1.22%), whereas splits of 2:1 or larger generate mean (median) returns of 2.04% (1.40%). These returns are not statistically different from one another, nor are the pay date or compound returns (accumulated across the announcement and pay dates). Likewise, we find only marginally significant differences in volatility (only for the median), prior to the split. However, 2:1 splitters exhibit a mean increase in volatility after the split of 0.0004, compared to 0.0002 for 3:2 splitters. The mean and medians are significantly different across the split factor. Therefore, it appears that the split factor does not affect the abnormal announcement or pay date returns; however, it does affect the post-split volatility. It therefore follows that delta and vega could have different effects on the decision to undertake a large (2:1 or greater) or small (3:2) split. Given that the returns are not different, one should expect that delta should have little effect on the choice of split factor. On the other hand, if a large split (2:1 or larger) has a larger impact on volatility, one would expect that CEOs who have relatively more exposure to vega in their compensation portfolio (i.e., greater sensitivity to price volatility) would opt for these larger split factors. We investigate this issue in the next two tables.

In Table 7 we present univariate results when the splitting sample is bifurcated by large versus small (i.e., 2:1 and greater versus 3:2) split factor. The table shows that there are significant differences between these groups. Firms with split factors of 2:1 or greater have significantly higher market-to-book ratios. They also are significantly larger, when measured by sales, but not when measured by total assets. Earnings per share for firms using large split factors are also significantly higher.

All three variables that proxy for the trading range explanation are different across split factors. Nearly 2% of those firms using large split factors were at least 50% above their predicted price range, while only 0.2% of firms using 3:2 factors were similarly situated. Stock price appreciation during the two years prior to the split was also slightly higher for firms using large split factors. Large splitters have slightly higher institutional ownership, although the difference is of questionable economic significance (61% versus 59%). Proxies for information asymmetry split explanations are also substantially different between the two split factors. Two-for-one splitters have significantly more analysts and shareholders, which suggests that they exhibit relatively less information asymmetry.

Firms that engage in larger splits have, on average, significantly higher pre-split share prices. For example, the mean share price for large splits is 62.23, compared to a mean share price of 37.65 for firms that split by 3:2, consistent with the optimal tick size explanation. Finally, both the mean and median for delta and vega are significantly larger for 2:1 splitters. However, the significance levels are substantially lower for delta.

6.2. Multivariate analysis

In Table 8 we examine the relationship between the delta and vega of CEO compensation and split factor in a multivariate setting. In Panel A we estimate a series of logistic regressions, all with a dependent variable that equals 1 if the firm engages in a 2:1 or larger split, and 0 if the split factor is 3:2. We find that the regression coefficients on *ln(delta)* are negative and significant in all six of the regressions. These results are inconsistent with the univariate results in Table 7. However, this does make sense in light of the findings presented in Table 6. Statistically, there is no difference in the announcement date nor pay date abnormal returns across different split factors. However, the post-split volatility increase is significantly greater for the larger split factors. Therefore, one could conclude that for CEOs with higher delta exposure, but little or no vega exposure, a smaller split factor would achieve the same increase in CEO wealth as a larger split factor.

Panel B reports the coefficients when we run the same six regressions, but replace *ln(delta)* with *ln(vega)*. Consistent with the outcomes in the univariate analysis, we find that *ln(vega)* is positively related to the split factor. In all six models, the coefficient on *ln(vega)* is significantly positive at the one-percent level.

The results from Panel C, using *ln(vega/delta)* as an independent variable, corroborate the evidence from Panels A and B. The coefficient on *ln(vega/delta)* is positive and significant for all six models. For CEOs with greater risk-taking incentives (vega) and/or lower value-increasing incentives (delta), they are more likely to use a larger split factor.

This analysis provides support for our second hypothesis. Delta appears to be negatively related to the split factor, while vega is positively related. These findings are consistent with CEOs with higher vega compensation selecting higher split factors because such factors result in higher post-split volatility.

6.3. Robustness

To assure that the results from our primary tests are not caused by factors absent from our models, we present the following robustness tests. First, during our sample period, the data contains a number of firms that engage in multiple splits. This may induce biases in our primary regressions due to lack of independence and/or a positive bias in subsequent vega and delta estimates, as the first split increases the post-split price volatility and that volatility is used to estimate vega and delta for the following years. One firm splits 7 times during the 14-year sample, two firms engage in 6 splits, four firms split 5 times, twenty firms split 4 times, ninety-seven firms split 3 times, and two hundred fifty-seven firms split twice. Clearly, this could impact our coefficient estimates. We remove all multiple splits from the sample that are not separated by at least 2 years. This removes a total of 141 splits from the sample. We repeat our multivariate analysis (i.e., Tables 6 and 8) and find, in unreported results, that our main conclusions do not change.

6.4 Economic significance

Table 2 shows a mean pre-split volatility of 0.0008 and a post-split volatility of 0.0011. Converting these to daily standard deviations and annualizing them (assuming 250 trading days), the change in the annualized standard deviation is 7.72%. The average vega (from Table 3) is 163 and represents the change in wealth (in thousands of dollars) for a 0.01 change in the standard deviation. Thus the economic effect of a 7.72% increase in standard deviation on the average option portfolio is 7.72*163,000 = $1,258,360. For the effect of the stock price increase, we take the 3-day split announcement abnormal return of 1.96% (from Table 2) multiplied by the average delta of 2,967 (from Table 3), which represents (in thousands) the dollar change in the value of the option and stock portfolio for a 1% change in the stock price. Thus the total wealth gain is 1.96*2,967,000 = $5,815,320. The total wealth effect of both vega and delta combined is therefore $7,073,531. Performing the same analysis on the median values results in a wealth gain of $985,194.

7. Relationship between announcement dates and option grants

In this portion of our analysis, we explore a potentially more direct indicator of the relationship between stock splits and CEO stock and option compensation. Namely, the timing of CEO option grants and split announcements. Because executive option grants are offered at par (i.e., the strike price is set at the current share price), if CEOs are opportunistically attempting to time an option grant and a stock split announcement, the pattern of announcements across time will not be random. For example, if CEOs expect to split the company's stock, they may choose to time their option grants prior to the split date in order to gain the most benefit from the expected price increase due to the split. Alternatively, CEOs may delay splits until after scheduled option grants, again in order to obtain the presumably lower, pre-split strike price. In either case, we expect to observe more option grants prior to a stock split announcement. Opportunistic timing of option grants is documented in Lie (2005), and later Heron and Lie (2007), who show that option grants appear to cluster around periods of low stock prices. They argue that in some cases, this phenomenon is consistent with the practice of option backdating. We follow the method of Lie (2005) and identify scheduled, unscheduled, and unclassified option grants. We then examine the distribution of these grants around the split date. Option grants reported in Execucomp do not explicitly state the grant date; however, by assuming that the options are granted for whole year terms, we can infer the grant date based on the expiration date of the option and the fiscal year of the option grant. If the option grant occurs within a week of the one-year anniversary of the prior year's grant, we consider the option to be a scheduled grant. If either there is no grant in the prior year, or the option is granted outside of the anniversary week, we classify the option grant as unscheduled. All other grants, (such as those for which there are no prior year observations for that particular firm) are designated as unclassified.

Table 9 presents the summary of the distributions of the grants for splitting firms for the 100-day window surrounding the split (-50 to +50 days). The table reveals two striking patterns. First, unscheduled grants tend to occur before the split date, by a margin of 58% to 42%. This result is consistent with, though certainly not proof positive of, firms timing option grants to take advantage of the price and volatility increase associated with splits. Second, scheduled grants demonstrate the same pattern, but to a greater degree, with 72% of scheduled grants occurring before split announcements. As scheduled grants are, by definition, issued during the same week from year to year, this result implies that firms appear to be adjusting the split announcement date to a time after the scheduled option grant. To explore these effects graphically, we plot the daily number of grants relative to the split announcement date for the three classifications of grant.

Figure 1 presents the unscheduled grants. Noticeably, there is a clustering of 14 grants on the day prior to the split announcement. While this is not a large number, the next highest number of grants (6) on a single day occurs on day -35. This clustering is consistent with grants being made immediately prior to the split announcement. Figure 2 shows the distribution of scheduled grants (as opposed to unscheduled grants in Figure 1), and, again, the same pattern of grants clustering before the split announcement occurs, a result consistent with CEOs timing the choice of split date to follow that of option grants. Finally, Figure 3 combines Figures 1 and 2 and adds in the unclassified option grants. It clearly shows that overall grants cluster on days -2, -1, and 0. The number of grants on these days is 10 on day -2, 39 on day -1 and 23 on day 0, for a total of 72 grants on the split announcement and preceding two days. Seventy-two grants represent nearly 19% of the 382 option grants that occur over the 101-day window. Conditioned on no cluster around the split announcement, the average number of grants that we would expect on these three days should be approximately 11. In sum, this appears to be compelling evidence that firms behave as though CEO compensation and split announcements are related.

Finally, Lie (2005) and Heron and Lie (2007) argue that their evidence is consistent with the practice of option backdating. We can test for this effect by noting that on August 29, 2002, the SEC mandated that option grants be reported within two working days of the grant. Our data extends for more than three years after the new reporting requirements, so by examining the post-August 29, 2002 grants, we are able to observe whether clustering persists in our sample. First, there are a total of 83 grants in the 101 days surrounding the split announcement. Of these 83, 16 occur on days -1 and 0 (about 19% of the total). Thus there does not appear to be any difference between the two time periods.

These findings support our conjecture that splits and option compensation are closely related. At least some CEOs appear to time either the grant of the option or the announcement of the split to ensure the maximum wealth benefit.

8. Conclusion

During the past 40 years, a sizeable amount of research has been generated in an attempt to understand why firms split their shares. Despite several separate streams of theory (i.e., optimal trading range, information asymmetry, and optimal tick size explanations) and a large number of empirical tests, the literature has yet to present a conclusive answer to the question: why do firms split their shares? In this paper we provide an additional explanation for the stock split phenomena: the sensitivity of CEO compensation to share price levels and volatility.

Specifically, if CEOs receive stock and option compensation that is increasing in value with either the stock price or the volatility of the firm's stock, the CEO will be incentivized to undertake splits, to the extent that splits result in a higher stock price and a more volatile post-split stock price. Stock splits are particularly attractive to CEOs faced with such incentives due to the low direct cost of a split.

Using a large sample of splitting and non-splitting firms, we test whether the delta and vega components of CEO compensation are related to the decision to split. Delta measures the sensitivity of the CEO's compensation to a stock price increase, while vega measures the sensitivity of the compensation to an increase in volatility. We find that both the delta and vega components of CEO compensation are related to the decision to split, after controlling for alternative theories of stock splits. Our results are economically significant: on average CEOs gain about $7 million by completing a stock split.

We also investigate the effect of delta and vega on the split factor. First, we show that abnormal returns across different split factors are similar. However, larger split factors are associated with higher post-split price volatility. We find that firms whose CEOs have compensations packages with higher vega are more likely to opt for higher split factors.

To determine whether executives behave as though the above relationships matter, we also analyze the timing of option grants and stock split announcements. We find that a large proportion of CEO option grants occur on the two days prior to and the day of a stock split announcement. We interpret this finding as consistent with our prior findings that splitting behavior is related to a CEO's compensation plan.

In addition to adding to the literature on stock split determinants, these findings have implications for the literature that deals with managerial risk-taking behavior (or factors incentivizing managers to undertake more risky projects; that is, to increase volatility). This literature (e.g., Coles et al. (2006)) has shown that vega is positively related to increases in risk-taking activities such as acquisitions, etc. Our paper shows that CEOs seem to use splits in a similar manner, and therefore our findings offer an example of a cosmetic action by CEOs with real volatility consequences. Clearly, given the interest in the literature on the incentivizing role that different forms of compensation (e.g., options and stocks) create, and the sizable increases in option compensation over the last decade or so, these are issues of considerable importance for both academics and practitioners.

Appendix 1

Computing Vega and Delta for the CEO's Stock and Option Holdings

We follow Rogers (2002), who in turn follows Core and Guay (2002) in computing the option sensitivities to volatility and price. Delta measures the option value's sensitivity with respect to a 1% change in stock price, and vega measures the option value's sensitivity to a 0.01 change in standard deviation. These values are computed as:

$$\text{Delta: } \frac{\partial Value}{\partial S}\frac{S}{100} = e^{-dT} N(d_1) \frac{S}{100} \tag{A.1}$$

$$\text{Vega: } \frac{\partial Value}{\partial \sigma} \times 0.01 = 0.01 \left[e^{-dT} N^{'}(d_1) S \sqrt{T} \right] \tag{A.2}$$

where $d_1 = \dfrac{\ln(S/X) + T(r - d + \sigma^2/2)}{\sigma\sqrt{T}}$

N(·) is the cumulative probability function for the normal distribution, $N^{'}(\cdot)$ is the normal probability density function, S is the share price of the stock at the fiscal year-end, d is the dividend yield as of fiscal year-end, X is the exercise price of the option, r is the risk free rate. We use the risk free rate provided in ExecuComp. σ is the annualized standard derivation of daily stock returns measured over 120 days prior to fiscal year-end, and T is remaining years to maturity of option.

The data for estimation is from ExecuComp (and originally from the proxy statements); however, the exercise price and maturity are only available for the current year's option grants. Therefore, to estimate prior years' exercise prices and maturities, we follow the Core and Guay (2002) algorithm, which is detailed on page 617 of their paper. The proxy statement provides realizable values of options grants (i.e., the excess of the stock price over the exercise price).

Because X and T are computed separately for new options, the number and fiscal year-end realizable value of new options must be deducted from the number and realizable value of unexercisable options. Dividing unexercisable (excluding new grants) and exercisable realized values by the number of unexercisable and exercisable options held by the executive, respectively, yields estimates of, on average, how far each of the groups of options are in the money. Subtracting this number from the stock price yields the average exercise price. The exercise price is computed for exercisable and unexercisable options. The time to maturity for the exercisable options is the maturity of the new grants less one year (or nine years if no new grant is made). For the unexercisable options, the time to maturity is the maturity of the new grants less three years (or six years if no grant is made). We treat the stock holdings of the CEO as having a vega of zero and a delta of one and include them in the computation of vega to delta.

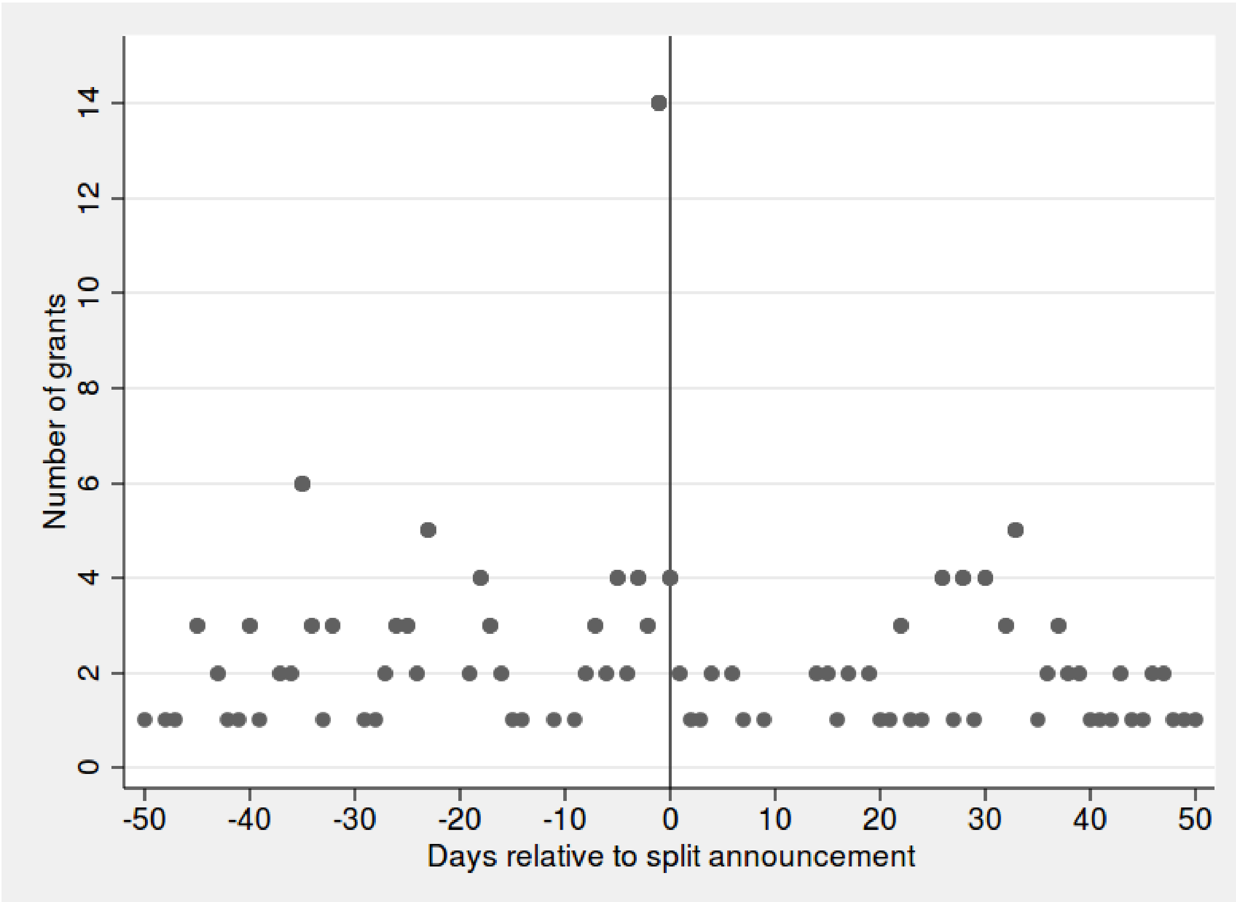

Fig1. Unscheduled grants around split announcements.
This figure plots the number of unscheduled grants made by firms that also announced a stock split during a given year. All dates are aligned relative to the split announcement date.

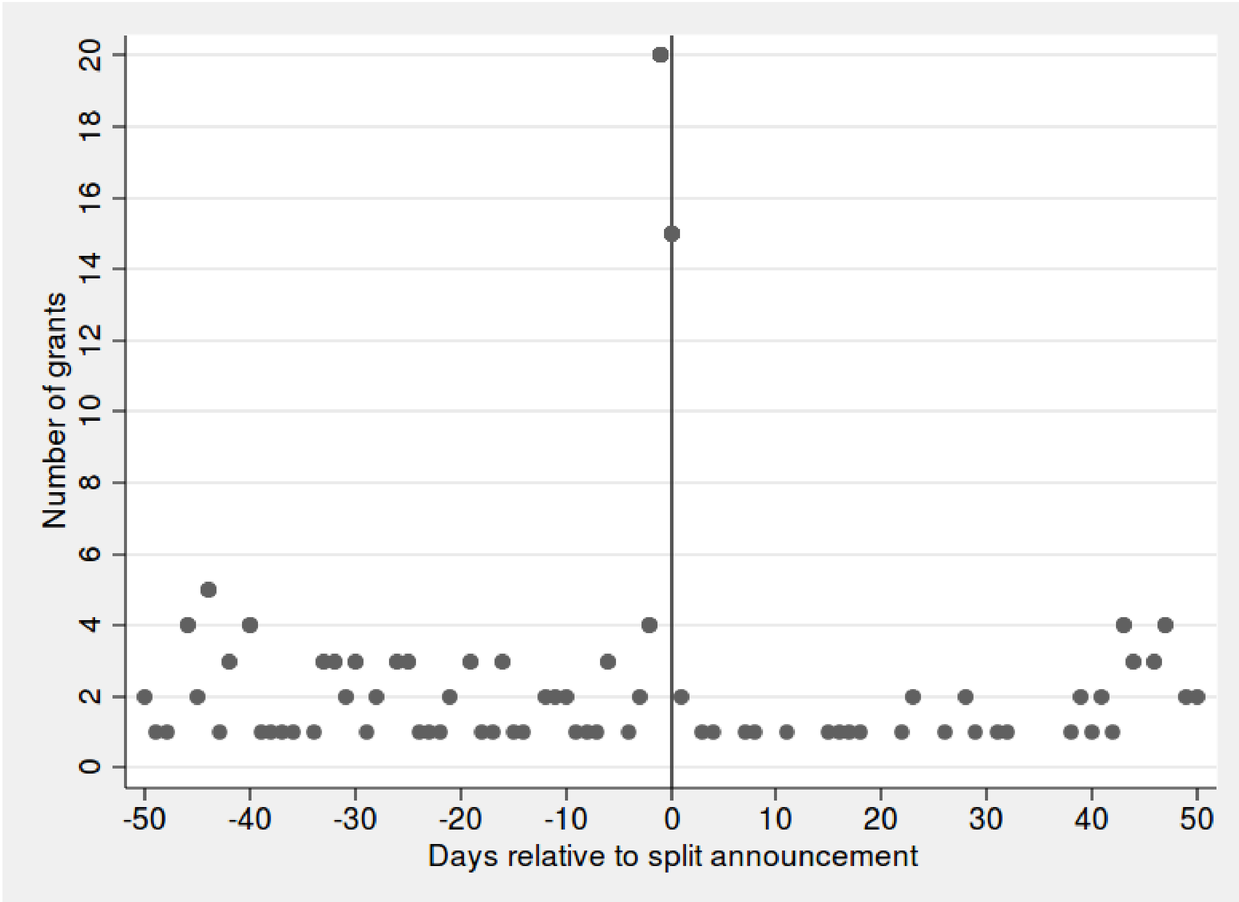

Fig2. Scheduled grants around split announcements.
This figure plots the number of scheduled grants made by firms that also announced a stock split during a given year. All dates are aligned relative to the split announcement date.

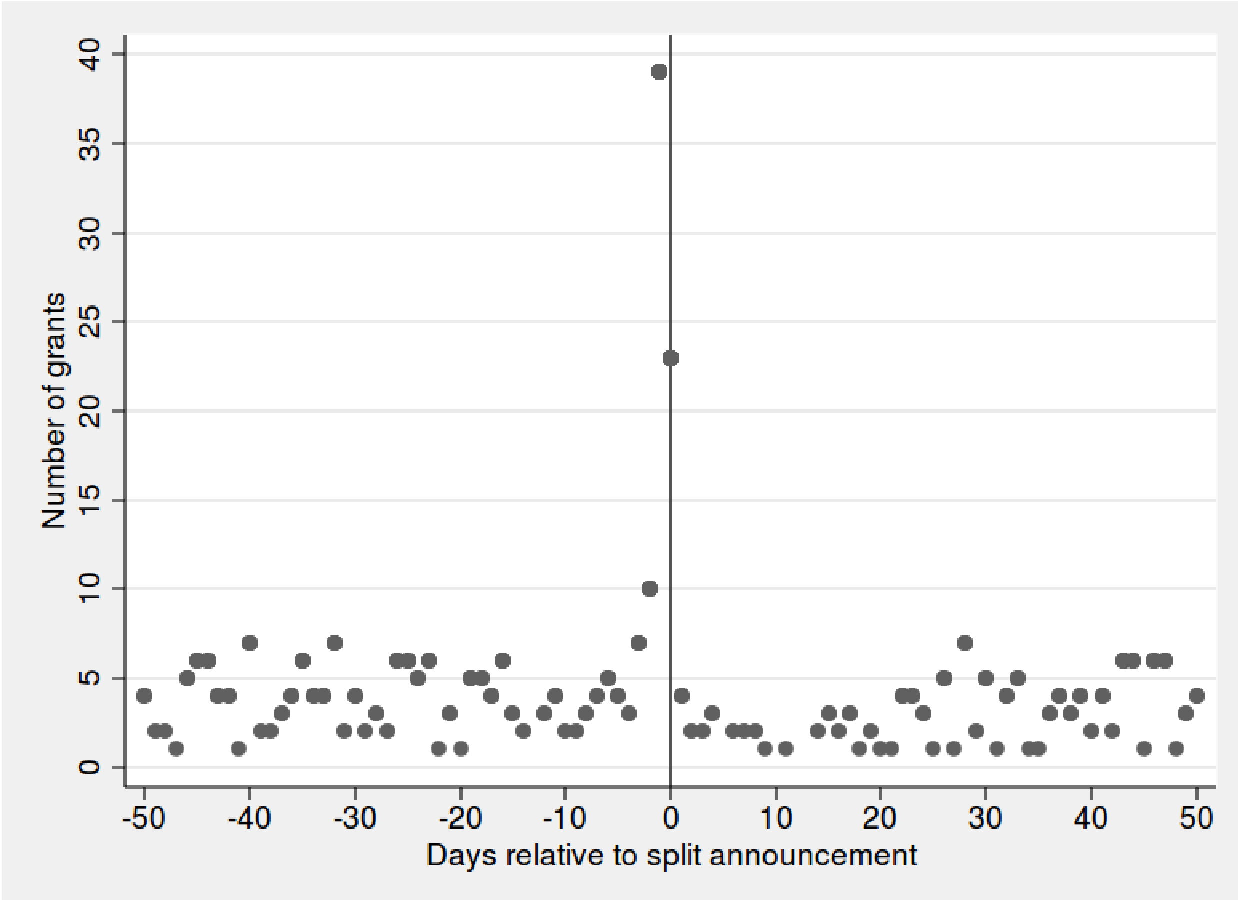

Fig3. All grants around split announcements.

This figure plots the number of unclassified, unscheduled and scheduled grants made by firms that also announced a stock split during a given year. All dates are aligned relative to the split announcement date.

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Table 1
This table presents the number of splitting (firms that engage in at least 3:2 stock split) and non-splitting firms by year (Panel A) and by 2-digit SIC industry (Panel B). We only report industries representing at least 5% of splitting or non-splitting firms (from Compustat).

	Splitting	Non-splitting	% Splits
A. Firm distribution by year			
1992	41	366	11%
1993	77	990	8%
1994	126	1,299	10%
1995	172	1,314	13%
1996	153	1,347	11%
1997	166	1,328	13%
1998	161	1,392	12%
1999	163	1,411	12%
2000	91	1,410	6%
2001	78	1,397	6%
2002	64	1,361	5%
2003	113	1,427	8%
2004	132	1,397	9%
2005	80	1,122	7%
	1,617	17,561	9%
B. Firm distribution by industry			
Industry (% of total sample)			
28 - chemicals and allied products manufacturing (6.9%)	92	1,223	8%
35 - industrial and commercial machinery manufacturing (5.8%)	106	1,010	10%
36 - electronic and other elec. equipment manufacturing (6.8%)	140	1,161	12%
49 – electric, gas, and sanitary service (7.5%)	57	1,375	4%
60 – depository institutions (6.3%)	110	1,099	10%
73 – business services (7.5%)	167	1,279	13%

Table 2

This table presents market-adjusted returns over various windows as well as pre- and post-split return volatility. Panel A displays the average compounded announcement date and pay date returns for stock splits with a split factor of at least 1.5 (i.e., 3:2) between 1992 and 2005. We use the CRSP value-weighted dividend-adjusted returns for the market. In Panel B, volatility is calculated as the mean squared daily return for the 252 trading days on either side of the pay date. In the third row of the panel, paired difference in volatility is calculated using a (pairwise) t-test.
***, **, *: Significant at the 1%, 5%, 10% level, respectively.

	Split sample (N = 1,617)	
	Mean	Median
A. Returns		
Announcement date (0 to +1)	0.0175***	0.0121***
Announcement date (-1 to +1)	0.0196***	0.0132***
Pay date (0 to +1)	0.0037***	0.0013***
Pay date (-1 to +1)	0.0058***	0.0028***
Compound announcement (-1 to +1) and pay date (-1 to +1)	0.0254***	0.0186***
B. Volatility		
Prior to split	0.0008***	0.0004***
Post split	0.0011***	0.0006***
Paired difference (post – pre)	0.0003***	0.0002***

Table 3

This table presents the univariate characteristics for splitting and non-splitting sample firms during the 1992 to 2005 sample period. From Compustat we get market-to-book (labeled M/B; #25*#199/#60), total assets (#6, in $mln.), net sales (#12, in $mln.), debt-to-equity (#9/#60), EPS (#58), and ROE (#25*#58/#60), shareholders (#100, in 1,000s), and shareprice (#199). Traderange is a binary variable that has a value of 1 if the actual share price is 50% greater than the predicted price (calculated following Dyl and Elliott, 2006) and 0 otherwise. Stockappreciation is the ratio of the t-1 year-end shareprice over the t-3 year-end shareprice; institutional ownership (labeled institown) is from CD Spectrum; and analyst coverage (labeled analyst) is from IBES. Vega and delta are calculated similar to Rogers (2002). We also report differences in means (t-test) and medians (signed rank test).
***, **, *: Significant at the 1%, 5%, 10% level, respectively.

	Splitting firms (N = 1,617)			Non-splitting firms (N = 17,561)			Difference (Splitting – Non-splitting)	
	Mean	Median	SD	Mean	Median	SD	Mean	Median
Financial characteristics								
M/B	4.99	3.42	5.94	3.35	2.21	9.64	9.98***	25.55***
total assets	10,195.24	1,432.36	40,856.78	11,504.78	1,548.87	52,898.76	-1.20	-2.31**
net sales	4,654.40	1,183.15	11,834.49	4,53.66	1,213.71	12,798.55	0.39	-0.41
debt-to-equity	2.50	1.08	4.11	2.85	1.37	5.93	-3.11***	-7.23***
EPS	2.53	2.09	2.44	1.44	1.34	2.60	17.09***	22.24***
ROE (%)	16.99	16.05	22.54	8.44	12.01	150.94	6.73***	21.13***
Trading Range (TRDNGRNG)								
traderange	1.14	1.12	0.14	0.98	0.99	0.18	41.08***	37.42***
stockappreciation	1.37	1.24	0.75	1.22	1.11	0.68	7.87***	13.03***
Institown (%)	60.17	61.70	22.18	58.63	60.80	22.19	2.43***	2.41***
Information Asymmetry (INFOASYMM)								
analyst	9.05	6.92	8.75	8.14	6.17	8.04	4.06***	3.63***
shareholders	30.73	4.33	144.29	32.91	5.51	250.86	-0.53	-4.64***
Tick Size (TICKSIZE)								
shareprice	54.75	47.88	33.46	31.52	27.19	26.68	27.13***	37.84***
Managerial characteristics								
vega	163.28	52.76	342.02	147.43	46.83	341.35	1.78*	2.49**
delta	2,966.63	461.33	22,463.30	1,027.28	211.55	7,669.59	3.45***	18.78***

Table 4
This table presents correlation coefficients between variables used in subsequent logit models. Pre-decimal (post-decimal) is a dummy equal to 1 if the split occurs prior to 1997 (after 2000). All other variables are as defined in Table 3.

	delta	vega	traderange	stockappr	institown	analyst	sh.holders	shareprice	pre-dec.	post-dec.	M/B
vega	0.4544										
	(0.000)										
traderange	0.2037	0.1029									
	(0.000)	*(0.000)*									
stock appreciation	0.1265	0.0113	0.1715								
	(0.000)	*(0.000)*	*(0.000)*								
institown	0.0785	0.2444	0.0928	0.0071							
	(0.000)	*(0.000)*	*(0.000)*	*(0.206)*							
analyst	0.3072	0.3358	0.0315	-0.0372	0.1352						
	(0.000)	*(0.000)*	*(0.242)*	*(0.000)*	*(0.000)*						
shareholders	0.0466	0.0894	-0.0006	-0.0039	-0.0436	0.0895					
	(0.000)	*(0.000)*	*(0.934)*	*(0.601)*	*(0.000)*	*(0.000)*					
shareprice	0.3104	0.1727	0.4321	0.1465	0.0798	0.1730	0.0424				
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*				
pre-decimal	-0.2025	-0.2338	-0.0036	0.0276	-0.1718	-0.1346	-0.0052	-0.0194			
	(0.000)	*(0.000)*	*(0.627)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.483)*	*(0.007)*			
post-decimal	0.1376	0.2030	0.0256	-0.0540	0.3090	0.0863	0.0147	-0.0248	-0.5142		
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.046)*	*(0.001)*	*(0.000)*		
M/B	0.1189	0.0605	0.2120	0.0658	-0.0029	0.0513	0.0040	0.1010	-0.0386	-0.0101	
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.717)*	*(0.000)*	*(0.0588)*	*(0.000)*	*(0.000)*	*(0.163)*	
totalassets	0.2964	0.3976	0.0063	-0.0063	0.0757	0.4142	0.1704	0.3552	-0.0782	0.1039	-0.0332
	(0.000)	*(0.000)*	*(0.390)*	*(0.384)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.003)*

Table 5

Logit analysis is used to study the relationship between the decision to split during any given year and measures of CEO compensation exposure to changes in share price and volatility, as well as variables to control for other split explanations. The dependent variable is coded as 1 if the firm splits and 0 for non-splitting firms. *Ln[delta]* is the natural log of the option value's sensitivity with respect to a 1% change in stock price and *ln[vega]* measures the option value's sensitivity to a 0.01 change in standard deviation. *M/B* is the equity market-to-book (#25*#199/#60), *ln[assets]* is the natural log of total assets (#6, in $000,000), *pre-dec (post-dec)* is a dummy equal to 1 if the split occurred prior to 1997 (after 2000), *traderange* is a binary variable that has a value of 1 if the actual share price is 50% greater than the predicted price (calculated following Dyl and Elliott, 2006) and 0 otherwise, *stockappr* is the ratio of the t-1 year-end shareprice over the t-3 year-end shareprice, institutional ownership (labeled *institown*) is from CD Spectrum, *analysts* is the number of analysts following the stock (from IBES), and shareholders is item #100 (000s) from Compustat. Chi-squared statistics are reported in parentheses.
***, **, *: Significant at the 1%, 5%, 10% level, respectively.

A. Relationship between the decision to split and delta

Model	*ln*[delta]	M/B	*ln*[assets]	pre-dec.	post-dec.	traderange	stockappr	institown	analysts	shrholders
1	0.3567***	0.0028	-0.1330***	0.8005***	-0.0261	1.0671***	----	0.0072***	----	----
	(272.06)	*(1.74)*	*(32.95)*	*(26.92)*	*(0.02)*	*(11.30)*		*(21.22)*		
2	0.3590***	0.0033*	-0.1528***	0.8088***	0.1885	1.2222***	----	----	0.0075*	----
	(345.70)	*(2.71)*	*(43.85)*	*(32.80)*	*(1.36)*	*(18.45)*			*(3.61)*	
3	0.3613***	0.0033**	-0.1257***	0.8710***	0.2532	1.2115***	----	----	----	<0.0001
	(343.31)	*(2.67)*	*(35.65)*	*(35.39)*	*(2.31)*	*(18.08)*				*(0.06)*
4	0.3387***	0.0037*	-0.1240***	0.7755***	0.0397	----	0.4368***	0.0066***	----	----
	(241.02)	*(3.19)*	*(28.41)*	*(25.09)*	*(0.05)*		*(38.05)*	*(18.35)*		
5	0.3379***	0.0042**	-0.1468***	0.7849***	0.2006	----	0.4705***	----	0.0090**	----
	(298.78)	*(4.48)*	*(40.00)*	*(30.57)*	*(1.53)*		*(53.48)*		*(5.18)*	
6	0.3411***	0.0041**	-0.1155***	0.8535***	0.2700	----	0.4868***	----	----	<0.0001
	(299.22)	*(4.40)*	*(29.79)*	*(33.59)*	*(2.61)*		*(55.34)*			*(0.04)*

B. Relationship between the decision to split and vega

Model	ln[vega]	M/B	*Ln*[assets]	pre-dec.	post-dec.	traderange	stockappr	institown	analysts	shrholders
1	0.0459**	0.0060**	-0.0115	0.7056***	0.0411	1.2068***	----	0.0040***	----	----
	(6.44)	*(5.42)*	*(0.24)*	*(21.37)*	*(0.06)*	*(15.40)*		*(6.86)*		
2	0.0489***	0.0073**	-0.0628***	0.6762***	0.1355	1.3196***	----	----	0.0157***	----
	(8.92)	*(6.05)*	*(7.16)*	*(23.49)*	*(0.72)*	*(22.64)*			*(15.86)*	
3	0.0584***	0.0074***	-0.0141	0.7483***	0.1988	1.3089***	----	----	----	<-0.0001
	(12.31)	*(6.00)*	*(0.41)*	*(26.76)*	*(1.45)*	*(22.24)*				*(0.15)*
4	0.0425**	0.0067***	-0.0055	0.6760***	0.0482	----	0.5988***	0.0038***	----	----
	(5.54)	*(6.77)*	*(0.06)*	*(19.43)*	*(0.08)*		*(73.75)*	*(6.07)*		
5	0.0434***	0.0082***	-0.0588**	0.6511***	0.1502	----	0.6488***	----	0.0170***	----
	(7.08)	*(7.06)*	*(6.20)*	*(21.49)*	*(0.87)*		*(104.20)*		*(18.50)*	
6	0.0536***	0.0084**	-0.0064	0.7302***	0.2168	----	0.6586***	----	----	<-0.0001
	(10.43)	*(6.98)*	*(0.09)*	*(25.14)*	*(1.71)*		*(103.42)*			*(0.14)*

C. Relationship between the decision to split and the ratio of vega to delta

Model	ln[vega/delta]	M/B	*Ln*[assets]	pre-dec.	post-dec.	traderange	stockappr	institown	analysts	shrholders
1	-2.0224***	0.0059***	0.0682***	0.5788***	-0.0305	1.2355***	----	0.0074***	----	----
	(161.41)	*(5.30)*	*(9.83)*	*(14.14)*	*(0.03)*	*(15.71)*		*(22.58)*		
2	-1.9472***	0.0069***	0.0198	0.5836***	0.1376	1.3162***	----	----	0.0169***	
	(190.62)	*(6.24)*	*(0.76)*	*(17.22)*	*(0.73)*	*(21.91)*			*(18.31)*	
3	-1.9293***	0.0071***	0.0744***	0.6470***	0.1986	1.2996***	----	----	----	<0.0001
	(182.53)	*(6.29)*	*(13.82)*	*(19.68)*	*(1.43)*	*(21.31)*				*(0.07)*
4	-1.9218***	0.0068***	0.0668***	0.5582***	-0.0172	----	0.4996***	0.0069***	----	----
	(143.66)	*(6.73)*	*(9.42)*	*(13.05)*	*(0.01)*		*(51.22)*	*(19.84)*		
5	-1.8428***	0.0079***	0.0154	0.5669***	0.1511	----	0.5506***	----	0.0179***	----
	(167.89)	*(6.94)*	*(0.45)*	*(16.08)*	*(0.87)*		*(75.39)*		*(20.40)*	
6	-1.8234***	0.0082***	0.0734***	0.6362***	0.2150	----	0.5606***	----	----	<-0.0001
	(160.29)	*(6.91)*	*(13.41)*	*(18.81)*	*(1.66)*		*(75.17)*			*(0.04)*

Table 6

This table presents market-adjusted returns over various windows as well as pre- and post-split return volatility for small (defined as 3:2) and large (defined as 2:1 or greater) split factors. Panel A displays the average compounded announcement date and pay date returns for stock splits with a split factor of at least 1.5 (i.e., 3:2) between 1992 and 2005. We use the CRSP value-weighted dividend-adjusted returns for the market. In Panel B, volatility is calculated as the mean squared daily return for the 252 trading days on either side of the pay date. In the third row of the panel, paired difference in volatility is calculated using a (pairwise) t-test.

***, **, *: Significant at the 1%, 5%, 10% level, respectively.

	2:1 Splits or larger		3:2 Splits		Difference (3:2 - 2:1 or larger)	
	Mean	Median	Mean	Median	Mean	Median
A. Returns						
Announcement date (0 to +1)	0.0183***	0.0127***	0.0157***	0.0113***	1.02	0.72
Announcement date (-1 to +1)	0.0204***	0.0140***	0.0179***	0.0122***	0.88	0.50
Pay date (0 to +1)	0.0035***	0.0007**	0.0041***	0.0020***	-0.28	-0.01
Pay date (-1 to +1)	0.0061***	0.0034**	0.0051***	0.0011***	0.36	0.67
Compound announcement (-1 to +1) and Pay date (-1 to +1)	0.0263***	0.0186***	0.0236***	0.0184***	0.64	0.56
B. Volatility						
Prior to split	0.0008***	0.0004***	0.0007***	0.0005***	1.57	2.14**
Post split	0.0011***	0.0007***	0.0009***	0.0006***	3.28***	0.75
Paired difference (post – pre)	0.0004***	0.0002***	0.0002***	0.0001***	3.28***	3.81***

Table 7

This table presents the univariate characteristics for splitting firms only, by split factor. The sample covers the period from 1992 to 2005. From Compustat we get market-to-book (labeled M/B; #25*#199/#60), total assets (#6, in $mln.), net sales (#12, in $mln.), debt-to-equity (#9/#60), EPS (#58), and ROE (#25*#58/#60), shareholders (#100, in 1,000s), and shareprice (#199). Traderange is a binary variable that has a value of 1 if the actual share price is 50% greater than the predicted price (calculated following Dyl and Elliott, 2006) and 0 otherwise. Stockappreciation is the ratio of the t-1 year-end shareprice over the t-3 year-end shareprice; institutional ownership (labeled institown) is from CD Spectrum; and analyst coverage (labeled analyst) is from IBES. Vega and delta are calculated similar to Rogers (2002). We also report differences in means (t-test) and medians (signed rank test).
***, **, *: Significant at the 1%, 5%, 10% level, respectively.

	2:1 Splits or greater (N = 1,125)			3:2 Splits (N = 492)			Difference (3:2 - 2:1 or larger)	
	Mean	Median	SD	Mean	Median	SD	Mean	Median
Financial Characteristics								
M/B	5.35	3.59	6.51	4.17	3.15	4.25	4.32***	4.16***
total assets	11,293.47	1,852.50	40,986.17	7,684.04	728.80	40,488.91	1.64	7.58***
net sales	5,667.83	1,589.80	13,476.55	2,337.09	728.23	6,120.58	6.83***	8.70***
debt-to-equity	2.46	1.12	4.17	2.59	0.97	3.97	-0.58	0.85
EPS	2.83	2.37	2.75	1.86	1.60	1.30	9.60***	9.50***
ROE (%)	17.24	16.41	25.69	16.42	15.38	12.70	0.85	2.19**
Trading Range (TRDNGRNG)								
traderange (%)	1.96	0	13.85	0.20	0	4.51	3.81***	2.74***
stockappreciation	1.39	1.26	0.80	1.32	1.20	0.62	1.94*	2.09**
institown (%)	60.86	63.10	21.82	58.61	58.92	22.92	1.69*	2.18**
Information Asymmetry (INFOASYMM)								
analyst	9.79	7.50	9.35	7.39	5.63	6.95	5.74***	3.76***
shareholders	37.13	4.41	142.13	16.01	4.07	148.26	2.61***	3.24***
Tick Size (TICKSIZE)								
Shareprice	62.23	55.88	37.09	37.65	34.84	16.81	18.68***	18.81***
Managerial Characteristics								
vega	188.96	64.49	377.79	104.56	33.42	230.90	5.50***	6.91***
delta	3,434.43	490.98	26,559.52	1,896.95	329.61	6,654.99	1.82*	3.13***

Table 8

Logit analysis is used to study the relationship between the split factor decision and measures of CEO compensation exposure to changes in share price and volatility, as well as other control variables. The dependent variable is coded as 1 if the split factor is at least 2:1 and 0 for 3:2 split factors. *Ln[delta]* is the natural log of the option value's sensitivity with respect to a 1% change in stock price and *ln[vega]* measures the option value's sensitivity to a 0.01 change in standard deviation. *M/B* is the equity market-to-book (#25*#199/#60), *ln[assets]* is the natural log of total assets (#6, in $mln.), *pre-dec (post-dec)* is a dummy equal to 1 if the split occurred prior to 1997 (after 2000), *traderange* is a binary variable that has a value of 1 if the actual share price is 50% greater than the predicted price (calculated following Dyl and Elliott, 2006) and 0 otherwise, *stockappr* is the ratio of the t-1 year-end shareprice over the t-3 year-end shareprice, institutional ownership (labeled *institown*) is from CD Spectrum, *analysts* is the number of analysts following the stock (from IBES), and shareholders is item #100 (000s) from Compustat. Chi-squared statistics are reported in parentheses.
***, **, *: Significant at the 1%, 5%, 10% level, respectively.

A. Relationship between split factor and delta

Model	*ln*[delta]	M/B	*ln*[assets]	pre-dec.	post-dec.	traderange	stockappr	institown	analysts	shrholders
1	-0.1053**	0.0474**	0.4258***	0.1703	-0.1526	1.39	----	0.0025	----	----
	(4.18)	*(4.96)*	*(53.85)*	*(0.26)*	*(0.16)*	*(1.63)*		*(0.55)*		
2	-0.1045**	0.0623***	0.4367***	0.1498	0.0323	1.79	----	----	-0.0019	----
	(4.91)	*(8.38)*	*(54.14)*	*(0.24)*	*(0.01)*	*(2.41)*			*(0.03)*	
3	-0.1222**	0.0595***	0.4549***	0.1487	0.0986	1.86	----	----	----	-0.0004
	(6.47)	*(7.88)*	*(67.57)*	*(0.22)*	*(0.07)*	*(2.57)*				*(0.39)*
4	-0.1092**	0.0504**	0.4275***	0.1267	-0.1770	----	0.1605	0.0020	----	----
	(4.47)	*(5.66)*	*(54.07)*	*(0.14)*	*(0.21)*		*(0.84)*	*(0.35)*		
5	-0.1111***	0.0672***	0.4364***	0.1111	0.0049	----	0.1543	----	-0.0011	----
	(5.51)	*(9.84)*	*(54.07)*	*(0.13)*	*(<0.01)*		*(0.89)*		*(0.01)*	
6	-0.1288***	0.0652**	0.4566***	0.1140	0.0746	----	0.1544	----	----	-0.0004
	(7.12)	*(9.55)*	*(67.89)*	*(0.12)*	*(0.04)*		*(0.88)*			*(0.43)*

B. Relationship between split factor and vega

Model	*ln*[vega]	M/B	*ln*[assets]	pre-dec.	post-dec.	traderange	stockappr	institown	analysts	shrholders
1	0.1339***	0.0258	0.3083***	0.2987	-0.0615	1.4847	----	0.0014	----	----
	(11.57)	*(1.95)*	*(31.02)*	*(0.78)*	*(0.02)*	*(1.86)*		*(0.17)*		
2	0.1184***	0.0401**	0.3394***	0.2746	0.1067	1.9675*	----	----	-0.0064	----
	(11.09)	*(4.99)*	*(34.56)*	*(0.79)*	*(0.08)*	*(2.79)*			*(0.40)*	
3	0.1123***	0.0357**	0.3366***	0.2912	0.1806	2.0345*	----	----	----	-0.0002
	(9.50)	*(4.26)*	*(40.59)*	*(0.81)*	*(0.22)*	*(2.96)*				*(0.16)*
4	0.1318***	0.0298	0.3087***	0.2647	-0.0782	----	0.1279	0.0009	----	----
	(11.20)	*(2.63)*	*(31.03)*	*(0.60)*	*(0.04)*		*(0.53)*	*(0.07)*		
5	0.1149***	0.0461**	0.3380***	0.2487	0.0894	----	0.1085	----	-0.0059	----
	(10.46)	*(6.45)*	*(34.27)*	*(0.63)*	*(0.06)*		*(0.44)*		*(0.34)*	
6	0.1089***	0.0421**	0.3365***	0.2662	0.1639	----	0.1138	----	----	-0.0003
	(8.93)	*(5.81)*	*(40.54)*	*(0.67)*	*(0.18)*		*(0.48)*			*(0.18)*

C. Relationship between split factor and the ratio of vega to delta

Model	*ln*[vega/delta]	M/B	*ln*[assets]	pre-dec.	post-dec.	traderange	stockappr	institown	analysts	shrholders
1	0.9883**	0.0368*	0.3607***	0.2553	-0.1016	1.4461	----	0.0029	----	----
	(5.35)	*(3.57)*	*(46.65)*	*(0.57)*	*(0.07)*	*(1.78)*		*(0.76)*		
2	1.0198***	0.0516***	0.3768***	0.2493	0.1079	1.9626*	----	----	-0.0035	----
	(6.99)	*(7.10)*	*(44.95)*	*(0.65)*	*(0.09)*	*(2.72)*			*(0.12)*	
3	1.0155***	0.0467***	0.3838***	0.2740	0.1811	2.0354*	----	----	----	-0.0004
	(6.58)	*(6.23)*	*(58.64)*	*(0.72)*	*(0.23)*	*(2.90)*				*(0.44)*
4	1.0136**	0.0393**	0.3604***	0.2112	-0.1274	----	0.1815	0.0024	----	----
	(5.60)	*(4.13)*	*(46.54)*	*(0.38)*	*(0.11)*		*(1.06)*	*(0.50)*		
5	1.0280***	0.0556***	0.3732***	0.2097	0.0781	----	0.1750	----	-0.0028	----
	(7.09)	*(8.30)*	*(44.13)*	*(0.45)*	*(0.05)*		*(1.14)*		*(0.07)*	
6	1.0251***	0.0515***	0.3823***	0.2393	0.1548	----	0.1750	----	----	-0.0004
	(6.68)	*(7.63)*	*(58.24)*	*(0.54)*	*(0.16)*		*(1.12)*			*(0.48)*

Table 9
Distribution of option grants in the 100-day window surrounding stock split announcements.

	Total	Before split		After split	
		Number	Percent	Number	Percent
scheduled	162	117	72%	45	28%
unscheduled	173	101	58%	72	42%
unclassified	47	31	66%	16	34%
all grants	382	249	65%	133	35%