CEO Risk Preferences and Hedging Decisions: A Multiyear Analysis

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Abstract

Theory and previous empirical studies suggest that CEO risk preferences affect hedging. We challenge this idea in a 5-year time series setting by using inside debt (i.e., CEO pension and deferred compensation) and the CEO Vega and CEO Delta, as proxies of CEO risk preferences, and document that neither risk-averse (i.e., debt like compensation) nor risk-seeking (i.e., convex compensation) inducing CEO compensation packages influence corporate hedging. Moreover, we find CEOs who have more previous work experience and high job tenure to be positively related to hedging.

Keywords: Hedging, CEO risk preferences, CEO personal characteristics

JEL classification: G30, G10, G32, G02, G39, G3.

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1. Introduction

Theory suggests that the extent of corporate hedging by managers depends upon the risk preferences of the CEO. Risk seeking CEOs take more risk due to the higher payoff of convex compensation contracts (CEO options) while risk-averse managers are more likely to act conservatively due to the linear payoff of the equity-like (i.e., CEO equity share compensation, CEO inside debt and CEO cash compensation) compensation contracts (Knopf et al. 2002; Smith and Stulz, 1985, Tufano, 1996). On the other hand, Smith and Stulz (1985), argue that derivatives usage is motivated by growth opportunities, reduction in expected taxes or for reducing the probability of financial distress. Despite the large literature on hedging, previous empirical evidence on these hedging explanations has been mixed.[1]

The inconsistency in the empirical literature about the forces behind corporate hedging could be attributed to several reasons that motivate this study. First, most of the previous studies on the relation between derivatives hedging and managerial compensation, controlling for firm characteristics, perform cross-sectional analyses relying on just one year of data (Knopf et al. 2002; Tufano, 1996). Using a hand collected unique dataset that spans a 5-year period from 2008-2012 period, a comprehensive investigation

[1] Campbell and Kracaw (1987), Bessembinder (1991), Dolde (1995), Mian (1996) and Haushalter (2000) find support for the reduction in distress costs argument; Froot et al. (1993), Nance et al. (1993), Mian (1996) and Graham and Smith (1999) obtain results in support of the reduction in expected taxes view while Froot et al. (1993), Haushalter (2000), Allayannis and Ofek (2001), and Geczy (1997) report evidence in support of the reduction in underinvestment costs. On the other hand, Tufano (1996) does not find that hedging is associated with any of the above-mentioned reasons except for the managerial risk aversion while Sprcic and Sevic (2012) find empirical evidence only in support of the reduction in underinvestment costs motive. Knopf et al. (2002) fail to find a relation between delta and hedging, but report a stronger relation between vega and hedging, significant only at 10%. This relatively weak evidence seems to suggest that convex CEO compensation motivates risk-taking at the expense of hedging. Geczy et al. (1997) and Haushalter (2000), however, find no relation between CEO option holdings and hedging, implying that the relationship between options related compensation and hedging is inconclusive.

is conducted on the relation between hedging and managerial risk preferences. This approach permits to draw inferences about the role of managerial risk preferences and hedging over a five-year period rather than relying on 1 year of data. Second, unlike previous studies that have mainly focused on currency hedging, in this paper both currency and non-currency (interest rate and commodity) corporate hedging activities are analyzed since non-FX derivatives constitute more than 50% (see Table 2) of total derivatives used by our sampled firms. Focusing on all derivatives used (foreign exchange, interest rate and commodity) permits to overcome the selection bias likely to be present in studies that focus exclusively on a subset of derivatives used by corporations. Moreover, the exclusion of a subset can influence the statistical significance of the empirical tests or produce distorted results. Third, different from most previous studies that attribute hedging to a number of different factors, in this study, besides the role of managerial risk preferences, managerial past experiences and education are examined as potential influences on corporate hedging decisions.[2]

One of the main contributions of this paper is that it examines whether CEO characteristics (i.e., risk preferences, education, age, past experiences, and sex) affect hedging decisions after controlling for managerial compensation and firm level characteristics. Since it is the CEO who makes the final decision to hedge or not to hedge, his personal characteristics and past experiences/education may exert considerable influence on corporate hedging. The "Upper Echelon theory" of Hambrick and Mason (1984), which states that firm outcomes can be partially predicted by managerial characteristics, past experiences and values, supports this notion. To the best of our

[2] Beber and Fabbri (2012) is the only study that looks at the role of managerial past experiences and education affects hedging, but focuses only on currency hedging.

knowledge, only Beber and Fabbri (2012) have examined the role of CEO characteristics on hedging but they focused only on firm's currency derivatives. However, when they address the role of managerial past experiences and education in the context of corporate currency hedging they concentrate on derivatives which are used for speculation rather than hedging. Since firms disclose derivatives that are used for speculation and hedging separately, in this paper derivatives marked as "hedging" are used to determine if CEO characteristics affect firms' hedging decision.

Another interesting feature of this study is that it draws inferences about the relation between managerial compensation and hedging relying on a panel level regression analysis. Most of the previous studies have looked at cross-sectional data, and this could be the reason for the mixed evidence regarding the motives of hedging as mentioned earlier.

Using a hand collected unique dataset over the 2008-2012 period, the evidence yields the following results. First, we find that CEO risk-preferences, based on Delta and Vega metrics, have no significant bearing on hedging decisions in our baseline regression and alternative regression specifications and the results hold even after controlling for endogeneity. This casts considerable doubt on the view that managerial risk sensitivity measures (Vega and Delta) influence corporate hedging decisions. Similarly, none of the other CEO risk preference measures (i.e., cash compensation, CEO firm equity and inside debt) are significant.

Second, using firm level control variables to test the validity of the three theories of Smith & Stulz (1985), we find no support for any of these theories even after addressing endogeneity concerns. We find firm size (Assets) to be negatively related to hedging

consistent with the results obtained by Warner (1977) and O'Brien & Bhushan (1990). We also find the foreign sales and idiosyncratic firm risk to be positively related to hedging.

Moreover, examining the role of CEO characteristics, including their past experiences and education, we find CEO job-tenure to be statistically significant and positively associated with hedging suggesting that CEOs with longer tenure are more likely to be risk averse and as a result hedge more. This result holds even after we control for endogeneity. Next, we examine the effect of the number of companies a CEO worked before joining the current company, and find that it has a positive and significant impact on hedging contradicting the evidence of Beber and Fabbri (2012) who report a negative effect on hedging, but mildly significant. The significance and positive sign of this variable suggests that CEOs with greater work experience tend to favor hedging. This result holds even after controlling for endogeneity.

Finally, CEO education and past work experience do not appear to be significantly associated with hedging as none of the education and experience variables (i.e., MBA, previous financial, technical education, Finance and technical experience) are significant.

One problem in examining the relation between managerial compensation and hedging is endogeneity bias. CEOs self-select firms with specific firm characteristics like larger firm size, larger R&D expenses, and lower firm risk resulting in endogeneity. To address the problem of endogeneity, we use the Shen and Zhang (2013) method. First, we regress the CEO compensation variables (i.e., CEO cash compensation, CEO Delta and Vega, CEO inside debt, and CEO share equity) against the firm characteristics mentioned in Shen and Zhang (2013). Then, we use the excess compensation values (residuals) from the previous step as the independent variables and replicate the fixed effect regression. This

partially solves the endogeneity problem mentioned earlier and thus we can control for the likely contamination effect of the CEO compensation determinants on our main risk preference variables. Using the excess compensation variables, the risk preference variables are insignificant in all of the models. The signs and significance of firm variables and CEO characteristics variables are similar as the previous regression results. None of the CEO education variables are significant.

The remainder of the paper is organized as follows. In section 2, we provide the related literature review of factors affecting hedging leading to the hypothesis development. Section 3 explains the data and methodology. Section 4 presents and discusses the results. Section 5, provides avenues for future research. Section 6 concludes.

2. Literature review and Hypotheses development

2.1. CEO incentives and risk taking

Jensen and Meckling (1976) show that agency costs arise due to the owners and managers' trying to maximize their own interests resulting in conflicts of interest between them. To reduce agency costs, owners devise compensation contracts to align the conflicting interests of managers and shareholders. Managers are usually risk averse since they are invested both personally and monetarily in the firm they manage and so their policy decisions are normally conservative compared to a well-diversified shareholder. Option based compensation contracts are one-way shareholders (owners) use to incentivize managers take more risk owing to their convex payoff structure (Smith and Stulz, 1985; Tufano, 1996; Rajgopal and Shevlin, 2002; Hemmer et al. 2010). Guay (1999) documents

that stock options add convexity to managers' portfolios which, in turn, mitigate managerial risk aversion. That is, encourage risk-taking decisions Delta and Vega are two measures that have been used extensively to proxy for CEO's risk sensitivities. Vega measures an option's sensitivity to changes in the volatility of the underlying asset while Delta measures the price change of an option to the change in price of the underlying asset.[3] Both measures have been used in previous studies to gauge the influence of compensation packages on managerial corporate decisions, as they aim to incentivize risk-taking (Vega) and/or risk-aversion (Delta) (Knopf et al. 2002; Caliskan and Doukas, 2015). Since hedging is viewed as a conservative policy, CEO Vega is expected to be negatively associated with hedging (i.e., hedge less in line with shareholders' risk-seeking desire) due to the convex nature of this payoff, while Delta is predicted to be positively associated with hedging due to the CEOs high equity stake in the company which makes them risk averse and thus hedge more. However, previous empirical studies have failed to provide any concrete evidence in support of more (less) hedging when managers' compensation is loaded with concave (convex) contacts. Guay (1999), for example, shows that Vega of the option portfolio induces CEOs to take more risk while Knopf et al. (2002) find no relation between Vega and hedging. Coles et al. (2006) find higher Vega and lower Delta of CEO option portfolio to be associated with risky firm policy choices.

The Vega and Delta measure the sensitivity of the value of the CEO's accumulated equity-type compensation to a one percent change in the volatility of stock price, and to one-percent change in the stock price, respectively. Hence, CEO options create two

[3] Vega represents the amount that an option contract's price changes in reaction to a 1% change in the volatility (σ) of the underlying asset. Delta is the first derivative of the value of the option with respect to the underlying instrument's price. Delta is also known as the hedge ratio.

contrasting effects on the risk attitude of CEOs (Lambert, Larcker and Verrecchia, 1991; Carpenter 2000; Knopf et al. 2002): (i) sensitivity to stock return volatility which motivates risk-taking behavior (less hedging) due to the convexity payoff structure of CEO compensation (i.e., stock options become valuable (in-the money) with less derivatives hedging) and (ii) sensitivity to stock price which motivates risk-averse behavior (more hedging) due to the linear association between the CEOs' stock options (wealth) to the stock price (i.e., stock options link a CEO's wealth to the stock price). Thus, higher Vega (Delta) means CEOs will take more (less) risk and hedge less (more) with derivatives.

In addition, CEO stock ownership is also expected to play a part in corporate hedging decisions. Specifically, CEOs with high stock ownership are expected to be less diversified and as a result be more conservative favoring greater hedging (Stulz, 1996). Similarly, CEOs with higher cash compensation (i.e., salary and bonus payments), are expected to be more risk averse and exhibit a stronger preference for hedging as a large fraction of their wealth would be attached to the firm performance (Knopf et al. 2002). The final CEO variable examined in our analysis is inside debt, debt like compensation contracts, which comprises of CEO pension and CEO deferred compensation. Jensen and Meckling (1976) and Edmans and Liu (2011) argue that debt like compensation increases CEO risk aversion leading to less risky decisions. Hence, we hypothesize that CEOs with greater inside debt holdings are expected to be less risk tolerant and thus be in favor of hedging.

2.2. Hedging and firm risk management

Firms use derivatives to hedge or speculate depending upon the industry they are in. Tufano (1996) finds that more option like compensation incentivizes managers to take more risk due to the convex payoff structure of the options. Non-financial firms use derivatives to hedge their interest rate (IR) risk, commodity price (COMD) risk and foreign currency (FX) risk. Allayannis and Ofek (2001) have shown that firms use currency derivatives to hedge currency exposure rather than to speculate. There are many reasons firms would want to hedge. Firms hedge to reduce the financial distress costs arising due to bankruptcy (Smith and Stulz, 1985; Graham and Rogers, 2002), to reduce the underinvestment costs associated with investment opportunities when external financing costs are high (Gay and Nam 1998; Geczy et al., 1997; Knopf et al. 2002; Froot et al., 1993) or to reduce the expected tax liability (Mayers and Smith, 1982; Nance et al. 1993; Graham and Rogers, 2002). Also, many firms hedge to reduce cash flow volatility and thus increase firm value (Allayannis and Weston, 2001; Carter et al. 2006; Mackay and Moeller, 2007). The evidence, however, on these hedging motives is mixed. Most of the previous literature has used cross-sectional data to test the above-mentioned hedging motives (Knopf et al. (2002); Rogers (2002) etc.). In this paper, all hedging motives arising from the work of Smith and Stulz (1985) (i.e., managerial risk aversion and efforts to reduce (i) expected taxes, (ii) distress costs, and (iii) underinvestment costs) are tested using a panel data set.

2.3. CEO personal characteristics and risk taking

The relationship between managerial characteristics and decision-making has been looked upon extensively in the management literature. The most popular theory in this context is the "Upper Echelon theory" created by Hambrick and Mason (1984), which states that firm outcomes can be partially predicted by managerial characteristics, past experiences and values. Weisbach (1995), Chevalier and Ellison (1999) and Bertrand and Schoar (2003) have shown that individual managers shape corporate decisions even after controlling for firm fixed effects and market level factors. There is a large body of literature that talks about past experiences and personal characteristics and how it affects managerial decision-making.

However, to this date, not much research focus has been directed in exploring how managerial characteristics and past experiences affect firms' hedging decisions. The psychology literature shows that personal experiences affect one's personal decision making (Hertwig et al. 2004; Weber et al. 1993, among others). Thakor (2010) also talks about the "experience based beliefs" where personal experiences that one encounters play a big part in decision-making. Kaustia and Knupfer (2008), Chiang et al. (2011) and Choi et al. (2009) among others show that personal experiences affect economic decisions. Even though hedging policies are taken by a group of individuals and not one individual, it is the CEO who is ultimately responsible for the signing off and enacting and reinforcing these policies. The overconfidence model of Gervais and Odean (2001) can be used to explain the role of CEO characteristics, like CEO age, CEO gender, and CEO education qualifications and work experience, on corporate hedging. One CEO characteristic that has been seen to affect risk-taking behavior is age, but the empirical evidence is mixed. Holmstrom (1999), Zwiebel (1995), Hirshleifer and Thakor (1992) among others find that

younger CEOs are risk averse while Serfling (2014), Prendergast and Stole (1996), Hambrick and Mason (1984) among others, show that younger CEOs take more risk. Thus, the relation between CEO age and hedging could be positive or negative. In line with the CEO life cycle literature (Pan et al., 2016; Limbach, Schmid, and Scholz, 2016), it's also likely that an inverse U-shaped relationship could also emerge. CEO gender is another characteristic that may affect hedging decisions. Huang and Kisgen (2013), Barksy et al. (1997) and Prince (1993) among others report that women managers are risk averse (and so should hedge more) while Schubert et al. (1999) and Atkinson et al. (2003) fail to find any relation between risk aversion and gender. Thus, we hypothesize that male CEOs are more likely to hedge less compared to their female counterparts.

CEO tenure is another feature that might affect CEO hedging decisions. Chen (2010), Fu and Li (2010), and Hermalin (1993) among others show that tenure is associated with positive risk taking (and so should hedge less) while Bertrand and Mullainathan (2003), John et al. (2008), and Pathan (2009) among others find tenure to be negatively related to risk taking (and so should hedge more). Hence, the sign of the CEO tenure measure is expected to be positive or negative. Past experiences, also tend to affect CEO's decision-making process. Elder (1986), Elder et al. (1991) and Malmendier and Tate (2011) have shown that individuals who have served in the military are more aggressive and risk tolerant. Hence, we expect CEOs with military experience to be less conservative and as a result hedge less. Malmendier and Tate (2005) find that CEO financial education and past finance work experience make them overconfident and so tend to engage in risky investments. Thus, consistent with the prediction of the overconfidence model of Gervais and Odean (2001), we hypothesize that CEOs with greater education qualifications or

financial/technical education would enhance CEO overconfidence leading to less hedging. Additionally, previous CEO financial experience or greater working experience in more firms before joining the current firm would raise the level of CEO overconfidence and thus we hypothesize less hedging and take more risk-taking (Beber and Fabbri, 2012)

3. Data sources and Methodology

3.1. Data Collection

Data for the analysis are obtained from the Fortune 500 list. We chose the Fortune 500 list for our analysis for two reasons. First, most of the Fortune 500 companies are big and are more likely to use derivatives, compared to smaller firms as usage of derivatives is costly (Bodnar and Marston, 1998). Second, the Fortune 500 list encompasses companies from a wide array of industries, and so that would negate any industry bias. The initial sample consists of 500 companies out of which commercial banks, diversified financials, securities and insurance companies are omitted as their purpose of using derivative is completely different (mainly speculation) from non-financial firms (mainly hedging risk). That reduces the sample size to 434 companies. The gross notional derivative information is obtained from the Mergent online database which was used to pull out 10K's of all the 434 companies for 5 years, i.e. , from 2008 to 2012 for a total of 2170 firm-year observations. To search for derivatives, we used the terms "hedge", "notional", "swaps", "foreign currency", and "forwards". We use the notional amount of derivatives from the 10k's to account for the derivatives. Some of the previous literature has used fair value of derivatives as the dependent variable but using fair value has many problems. First, the total notional amount of derivatives is the aggregate number that the CEO has used for

hedging which correctly depicts his risk taking ability and currently denotes the total price the hedge has been established. Since the market value (fair value) of derivatives changes with the economy, it is not a reliable source for evaluating firm's total financial risk. Second, very few firms report fair value in their 10ks and so using fair value would result in loss of many observations. On the other hand, all firms reveal their total notional amount of derivatives in their 10ks. Thus, firms which do not report notional value of their derivatives in their 10ks (only fair values mentioned) are removed. In addition, private companies are excluded because they do not have public accounting data. Consistent with Geczy et. al. (1997), firms involved in mergers and acquisitions (M&A) in the course of 5 years, are also removed from our sample. This reduced the sample to 350 firms with 1630 total firm-year observations.

The Thomson Reuters' database and Google finance are used as the main sources to obtain firm financial data. For managerial compensation data, only the CEO's compensation/past experiences/education data are used. Some previous papers have used COO/CFO data with the CEO data (Rogers, 2002). We use only the CEO's compensation/characteristics data for two reasons. First, and most importantly, even though financial hedging decisions are taken by a group of individuals, including the CFO, it is the CEO who ultimately approves/disapproves the hedging decision. Second, using managerial compensation data of other corporate officers along with the CEO's will produce a set of mixed hedging incentives because the hedging motives of other corporate officers differ from the hedging incentives of CEOs (Knopf et al. 2002). Finally, focusing on CEOs hedging incentives, captured through their compensation structure, allows to draw comparisons with previous studies.

CEO managerial compensation information is obtained from the ExecuComp database and proxy statements. Out of 350 companies, 10 companies did not have appropriate exercised and non-exercised options data in the ExecuComp database reducing the sample to 340 firms and a total of 1446 firm-year observations. Data for the CEO's past job qualifications/experience and education are obtained from the proxy statements, 10k's and the website www.nndb.com. We can't find appropriate experience information for 8 CEOs bringing the total sample to 332 firms with observations 1446 firm-year observations. The 332 firms of this study have made use of derivatives for commodity price fluctuations (commodity futures and swaps), interest rate risk (interest rate swaps and locks) and foreign currency risk (FX forwards and futures). In 10ks, firms report separately derivatives which are used for hedging and which are used for trading or speculation. We only include companies that use derivatives for hedging purposes and not for trading or speculation.

Also, for some companies using commodities, the10Ks had the notional amount of commodity hedged. For example, firm A had hedged 10mmBtu of natural gas and 45 million barrels of crude oil. In that case to find the derivatives amount, we multiply the total amount by the underlying price of the asset at that time. In addition, some companies had total number of contracts mentioned in their 10Ks; to get the notional amount we multiply the number of contracts by the total contract unit from the CME website and the underlying price at that time. In case of foreign currency forwards or futures, all values are converted to the dollar values using the exchange rate at that time of the initiation of the contract.

As far as we know, this is the first paper that looks at the relationship between managerial compensation and derivatives hedging over the course of a 5-year period. Also, CEO managerial characteristics/past experience variables have not been analyzed in the context of hedging. As mentioned above, only Beber and Fabbri (2012) have analyzed this relationship but they only looked at currency hedging. Finally, our data encompasses the financial crisis period, where CEO's decision making would be highly correlated with his past experiences and educational qualifications.

Fixed effect regression analysis is used to regress the log of the derivatives divided by assets of the firm on CEO compensation and personal characteristics, firm characteristics and CEO past experience and education.

3.2. Variables description

3.2.1. Dependent variables

The dependent variable in this study is the logarithm of the total notional value of firm's derivatives divided by the book value of its assets (*Log Derivatives/Assets*). Total derivatives consist of commodity derivatives (forwards and futures), interest rate derivatives (futures, forwards and swaps) and currency derivatives (futures, forwards and swaps). All the derivative data is hand-collected from the company's 10k filings for 5-year period, 2008-2012.

3.3. Independent variables

3.3.1. Managerial compensation variables:

3.3.1.1. Total CEO Delta of option and stock portfolio

CEO's options Delta is defined as the sensitivity of a CEO's option portfolio with respect to the stock price of the underlying security, also known as the "hedge ratio". In other words, Delta is the change in the option's Black-Scholes price in response to a 1% change in the share price. This measure has been used extensively in the previous literature as a proxy for risk aversion (Knopf et al. 2002, Rogers, 2002, Coles et al. 2006 among others). In the context of this study, the total Delta of a CEO's compensation portfolio (*Total CEO Delta*) is defined as the sum of the Delta due to the option portfolio and the stock portfolio. In accord with the main prediction of our hypothesis, we expect a positive relation between the CEO's option Delta and hedging since the payoff of the CEO option is directly related to the firm's stock price which is designed to encourage risk aversion.

3.3.1.2. CEO Vega of option portfolio

CEO's option Vega is defined as the sensitivity of a CEO's option portfolio with respect to the volatility of the stock price. In other words, Vega is the change in the price of the option portfolio in response to a 1% change in the stock volatility. This variable is used extensively in the previous literature as a proxy for CEO high risk tolerance (Knopf et al. 2002, Beber and Fabbri, 2012). The CEO's stock Vega is not significant as volatility of stock is close to zero (Guay, 1999). Thus, the total Vega of the CEO option portfolio (Total *CEO Vega*) is only due to the volatility of the option portfolio. Hence, we expect a negative relation between Vega and derivative holdings (hedging) due to the convex payoff of the option-like contracts.

3.3.1.3. Calculation of total Vega and total Delta of option and stock portfolios

The Delta and Vega of the stock option portfolios are calculated using the Core and Guay (2002) approach. Core and Guay (2002) separately calculated the option grants for the current year and the previously granted options. For the current year option grants, we collect data for CEOs' number of options from the ExecuComp database. Exercise price and time of maturity variables for current year option grants are obtained from ExecuComp. Other variables which are required to estimate the Delta and Vega like stock price, volatility, interest rate and dividend yield are collected from the firm proxy statements and 10k reports. Consistent with the previous literature, the Black-Scholes option valuation formula is used to calculate the option price for the current-year options (Knopf et al. 2002; Rogers, 2002).

For the previously granted options, ExecuComp lists separately the number of exercisable and un-exercisable options in their database but it does not contain the exercise price and time of maturity variables for them. The Core and Guay (2002) approach is used to approximate the time of maturity and exercise price for both exercisable and un-exercisable options. We calculate the Delta and Vega of the exercisable and un-exercisable options separately. Time of maturity of the previously exercisable options, is approximated as the time of maturity of current options minus four, and for previously un-exercisable options, time of maturity minus one. We calculate the exercise prices by subtracting the total value of the option portfolio and the current year option portfolio value. Then, we divide this number by the number of options to get the difference of the stock and exercise price. Finally, we subtract this number with the stock price to get the exercise price. We calculate the exercise price separately for exercisable as well as un-exercisable options. Core and Guay (2002) have shown that this approximation is very close to actual values.

Other variables which are required to estimate the Delta and Vega of previously granted options like stock price, volatility, interest rate and dividend yield are collected from the firm proxy statements and 10k reports. Appendix B provides the calculation of Delta and Vega using the Black-Scholes Options model.

We also calculate the Delta of the stock portfolio of the CEO. Thus, the total Delta of the option portfolio is the sum of the Delta of the current year option portfolio, plus Delta of previous year's exercisable and un-exercisable options and the sum of the Delta of the stock portfolio. Similar calculation procedure is employed to estimate the Vega of the current option grants, previous exercisable and un-exercisable options. Vega for the stock portfolio is assumed to be zero. Therefore, the total Vega is the sum of the Vega of the current year options, previous year's exercisable and previous year's un-exercisable options. Finally, we multiply the Vega and Delta with the total number of options to obtain the Vega (*CEO Total Vega*) and Delta (*CEO Total Delta*) of the entire CEO compensation portfolio. The above-mentioned procedure is used to calculate the Vega and Delta for each of the five years (2008-2012).

3.3.1.4. CEO firm stock holdings

This variable captures the total CEO stock holdings (*CEO Share Equity*) in the firm. CEOs' with high stockholdings in the firm they run, are more likely to exhibit low risk tolerance, since a large fraction of their personal wealth would be invested in the firm (Stulz, 1984), and as a result engage in more hedging. Thus, we expect the CEO stock-holdings variable to have a positive effect on hedging. Data for CEO stock holdings are collected from ExecuComp database for all the 5 years.

3.3.1.5. CEO inside debt and CEO cash compensation

Sundaram and Yermack (2007) and Edmans and Liu (2011) suggest that CEOs with higher inside debt (*CEO Inside debt*) are more likely to exhibit low risk tolerance since a large fraction of their wealth is tied to company stock performance and job security. Consequently, if inside debt deters CEO risk taking, we expect to observe a positive relation between hedging and CEO inside debt. The CEO inside debt variable is the combined value of deferred compensation and pension of the CEO. Similar with the influence of CEO inside debt holdings on hedging, CEO cash compensation (*CEO Cash Comp*) is expected to have a positive effect on hedging (i.e., incentivize CEOs to hedge more) because of the linear nature of cash compensation.

3.4. Firm level control variables

Shareholder maximization theory provides three reasons of hedging (Smith and Stulz, 1985): i) reduction in expected taxes, ii) reduction in financial distress, and iii) mitigation of the under-investment.

3.4.1. Reduction in expected taxes hedge motive:

3.4.1.1. Net Operating Loss Carry-forwards

We use the net operating loss carry-forwards, scaled by the book value of assets (*NOLs/Assets)*, to control for the reduction in expected taxes. According to the Jensen's inequality, if a firm's tax schedule is convex, hedging reduces its expected tax liabilities since the insurance (hedging) can replace the random volatile earnings with the expected earnings. Also, the more pronounced the convexity of the effective tax schedule the

greater will be the reduction in expected taxes through hedging (Mayers & Smith, 1982; Smith & Stulz, 1985). This information is obtained from the 10ks of the selected firms for all the 5 years. Most of the previous literature has used this proxy to control for tax convexity. We expect a positive relation between NOL and corporate hedging activities (Graham & Smith, 1999, Smith & Stulz, 1985)

3.4.2. Reduction in financial distress costs hedge motive:

3.4.2.1. Debt ratio

To control for financial distress cost motive for hedging, we use first the debt ratio (*Debt/Assets*), which is the variable used mostly in the previous literature (Knopf et al. 2002; Nance et. al. 1993; Coles et. al. 2006 etc.) to proxy for distress costs. Data of total debt for all five years is obtained from Compustat. Firms with higher distress costs are expected to hedge more as they face higher costs like losing relationship with suppliers and customers (Shapiro and Titman, 1986) in case of a future bankruptcy (Smith and Stulz, 1985, Rogers, 2002). Hence, we expect a positive relation between the total debt and corporate hedging activities.

3.4.2.2. Interest coverage ratio

The second ratio we use to control for financial distress costs is the interest coverage ratio (*Interest Cov ratio*), which has not been used extensively in the previous literature (Nance et al. 1993). This variable is defined as the ratio of the EBIT to the interest expenses. Data for interest expense and EBIT is obtained from Thomson Reuters' database. A negative relation between the interest coverage ratio and the hedging activities of the firm is expected.

3.4.3. Mitigation of the under-investment problem

3.4.3.1. R&D activities

As argued in Smith and Stulz (1985) and Froot et. al. (1993), hedging could be motivated by the mitigation of the under-investment problem. The under investment problem happens when a firm foregoes positive NPV projects induced by shareholders when they realize most of the gains from the investment would go to the bondholders. As a result of that, the bondholders would pay less for the firm's bonds. Thus preventing the different situations when the firm can default on its bond payments would solve the underinvestment problem and it is achieved by hedging as it smoothens the cash flows that the firm receives and reduces volatility. To control for that, we use R&D expenses divided by the total assets (*R&D/Assets*) and expect a positive relation between R&D expenses and hedging activities. Data on R&D activities for all 5 years are obtained from Thomson Reuters' database.

3.4.3.2 Market/Book value of equity

The second ratio that is used for the mitigation of underinvestment costs is the M/B ratio (*M/B ratio*). It is defined as the ratio of market value of firm to the book value of equity and we expect to observe a positive association between M/B ratio and derivative hedging consistent with previous theories (Geczy et al. 1997) that hedging increases with firm value increases. Data for this variable is obtained from Compustat database.

3.4.3.3. Capital expenditures scaled by total assets

Even though the M/B ratio and the R&D expenditures are used to proxy for the future growth opportunities, they still are affected by the firm's current spending. Therefore, we use the capital expenditures/assets (*Capex/Assets*) ratio to measure firm's future growth opportunities since this variable contains only the capital spending which is more likely to accurately capture the future long-term growth potential of the firm (Graham & Rogers, 2002, Geczy et. al. 1997).

3.5. Firm risk and hedging

3.5.1. Idiosyncratic risk

To account for firm risk, we use firm's idiosyncratic risk (*Idiosrisk*). This is calculated by estimating the standard deviation of excess returns, using daily excess returns data from Crisp/Compustat database (Shen & Zhang, 2013; Rogers, 2002). We expect a negative relation between idiosyncratic risk and hedging activities since higher risk firms would want to take more risks and hedge less with derivatives.

3.5.2. Dividend yield

Some firms use alternatives to hedging strategies like paying dividends to shareholders. To the extent that dividend-paying firms are considered to be conservative we expect a positive association between dividend yield (*Dividend yield*) and hedging (Nance et. al. 1993). Data for the dividend yield is obtained from the COMPUSTAT database.

3.6. Other control variables

3.6.1. Foreign sales to total sales ratio

The effect of foreign sales to total sales (*Foreign/Total sales*) on hedging activities is expected to be positive since more foreign sales correspond to more foreign exchange risk. Fok et. al., (1997) and Allayannis and Ofek (2001) suggest that companies with foreign sales have also foreign denominated debt that makes them exposed to interest rate (IR) risk as well which, in turn, motivates them to use IR derivatives.

3.6.2. Firm size

Using the logarithm of the total assets (*Log Assets*) to proxy firm size, the relationship between firm size and hedging could be positive or negative (Nance et. al., 1993). A positive relationship between hedging and the book value of assets can be expected since bigger firms hedge more compared to smaller firms as there are costs associated with setting up a risk management program and bigger firms benefit from economies of scale. On the other hand, a negative relation between hedging and firm size is expected if bankruptcy costs are high since these direct costs are likely to be higher for smaller firms compared to larger firms causing the former to hedge more (Warner, 1977). Also, a negative relation is conjectured if firms are subject to high information asymmetries because they will be compelled to take more risks and consequently engage in less hedging (O'Brien & Bhushan, 1990).

3.6.3. Insider ownership

Firms that have higher information asymmetry between managers and shareholders tend to hedge more (Breeden and Vishwanathan (1998); DeMarzo & Duffie, 1991). Thus firms with higher insider ownership (*Insider own*) should hedge less and as a result we expect a negative link between insider ownership and derivative hedging. We use the logarithm of the insider ownership percentage to measure its impact on hedging.

3.6.4. Quick ratio

Quick ratio (*Quick ratio*) is a proxy for the liquidity of the firm. We expect a negative relation between Quick ratio and hedging since firms which are more liquid have low hedging incentives and thus they are expected to make lower use of derivatives (Opler, 1999, Nance et. al., 1993).

3.7. CEO characteristics variables

3.7.1. Financial education and technical education

Financial and technical education variables (*Fin education & Tech education*) are binary variables and are set equal to 1 if a CEO has any financial/technical educational background (or technical education), and 0 if he does not have finance/technical background. Hence, we expect CEOs with past finance/technical background to be more cognizant of the risk of not hedging against volatility in interest rates, foreign exchange and commodity positions, and so favor more hedging.

3.7.2. CEO tenure

CEOs with greater tenure (*CEO Tenure*) are more likely to hedge, as they would be reluctant to take more risk to attain higher returns in contrast to CEOs who just joined the company and want to pursue riskier initiatives in an attempt to impress the board and shareholders. CEO tenure is measured by the total number of years the CEO is in the current position.

3.7.3. Military experience

The effect of military experience on hedging can be positive or negative. Kilgore et al., (2008) show that combat exposure increases risky behavior and, therefore, a negative relation between CEO military experience (*Military*) and hedging is expected. On the other hand, Benmelech and Frydman (2015) report that military experience is associated with risk-averse corporate policies and so a positive relation between hedging and military experience is expected. The military experience is a dummy variable that is set equal to 1 if a CEO has military experience and 0 otherwise.

3.7.4. Job tenure

The total number of years the CEO worked in a company (*Job Tenure*) has also the potential to affect the hedging decisions of the firm. CEOs with higher employment in a company they run are expected to engage in greater hedging, since the need to build their reputation by taking more risk is less (Gibbons and Murphy, 1992).

3.7.5. Chairmanceo

This is a binary variable whose value is set equal to 1 if a CEO is also the chairman of the board (*Chairman/CEO*) and 0 otherwise. CEOs who are also serving as the chairman of the board would be more conservative and less inclined to take risks as they have to answer to the board members if the risks did not pay off and so they are expected to hedge more. On the other hand, combining the CEO and Chairman roles implies a higher concentration of power and, therefore, these CEOs are likely to take more risks as they do not have to consult with the Chairman and/or respond to the board members therefore they are anticipated to hedge less. Consequently, the sign of Chairman/CEO could be positive or negative.

3.7.6. Age

We include age of the CEO (*CEO age*) as an explanatory variable to investigate its effects on hedging. The sign on the hedging variable could be positive or negative. Holmstrom (1999), Hirshleifer and Thakor (1992) among others find a negative relation between age and hedging while Serfling (2014), Prendergast and Stole (1996), Hambrick and Mason (1984) among others, show that younger CEOs take more risk. In line with the CEO life cycle literature, Pan et al. (2016) argues that an inverse U-shaped relationship could also emerge.

3.7.7. Finance career and technical career

Both these variables are dummy variables (*Finance career & Technical career*) and set equal to 1 if a CEO has worked in a financial/technical firm before joining the current firm and 0 otherwise. Therefore, CEOs with financial or technical experience, in accord with the prediction of the model of Gervais and Odean (2001), are expected to be more risk tolerant and overconfident. Therefore, they are expected to hedge less.

3.7.8. MBA Education

This variable is set equal to 1 if the CEO has a MBA degree (*MBA*) and 0 otherwise. Similar with the above variable, acquiring a MBA degree makes a CEO overconfident and so they are expected to hedge less and take more risks (Gervais and Odean, 2001). Beber and Fabbri (2012) find the MBA degree variable to be mildly significant and negative in line with the overconfident model of Gervais and Odean (2001).

3.7.9. Previous number of companies worked before current company

This variable denotes the number of companies the CEO has worked before joining the current firm (*No of Comps*). Beber and Fabbri (2012) use this variable and find it to be negative and mildly significant in predicting currency hedging, since overconfident CEOs are less risk averse (Gervais and Odean, 2001) On the other hand, greater experience acquired through working in many firms would make the CEOs cognizant about the different types of risk (IR, CP and FX) and so they are expected to hedge more. Therefore, the sign of this variable could be positive or negative.

4. Empirical results

4.1. Descriptive statistics

Looking at the summary statistics in Table 1, the average total Delta for the CEO option portfolio is 10.39 million while average total Vega is 4.768 million. Both the Delta and Vega values are large compared to the previous literature (Knopf et al. 2002, Beber and Fabbri, 2012, Rogers, 2002). This could be because in this study we are using large Fortune 500 firms which have significant exposure to various kinds of risks. The average total CEO cash compensation (salary plus bonus) is 1.49 million while inside debt is 7.9 million. The reason for the large inside debt could be because the average CEO in our sample is 56 years old and so he is associated with the firm over a longer period. The average CEO stock equity for our sample is $543.99 million which is expected since my sample set is the Fortune 500 firms. The debt to assets ratio is 0.46 which is comparatively high compared to the previous literature (Knopf et al. 2002), which is around 0.2-0.3. The reason for this can be that the firms in our sample are large and we have used a different time setting. An average firm in our sample has foreign sales of about 29% of total sales suggesting that firms in our sample generate a significant part of their revenues overseas. The average CEO age is 56 years old and has worked in the company for about 18 years. This implies that most of the CEOs in our sample are experienced and are in the firm for a long period of time. Average CEO- tenure is 7 years. An average CEO in our sample has worked in about 2 firms before joining the current firm. This implies that CEOs have previous risk management experience and are expected to be more conservative (Sundaram and Yermack, 2007). Also, the derivatives to total assets ratio equals 0.10 implying that an average firm in our sample hedges 10% of its total assets. This low value is consistent with the evidence from Guay & Kothari (2003) who found that derivatives hedging are only a small part of the non-financial firms' risk profile.

Table 2 shows the total average derivatives broken down by year. The total notional derivatives usage has increased from 2008 to 2012 suggesting that firms have increased their hedging in recent years. A similar trend can be seen for hedging with Foreign exchange (FX) and Interest Rate (IR) derivatives while no such trend is observed in commodity derivatives. The total interest rate (IR) derivatives represent 50.7% of the total derivatives while foreign exchange derivatives correspond to 41.25% of the total derivatives. This further validates the inclusion of interest rate derivatives in our analysis rather than just focusing on foreign exchange derivatives or commodity derivatives as has been the case in most of the previous studies (Beber & Fabbri, 2012; Tufano, 1996). The use of IR derivatives into the analysis of hedging provides an additional element of differentiation between this paper and previous studies. Thus, the inclusion of IR derivatives, a significant component of corporate hedging activity ignored in previous studies, recognizes the importance of interest rate risk arising from the exposure of firms to debt motivating them to employ different debt derivative instruments such as interest rate swaps, forwards swaps, and interest rate futures, etc. to hedge their exposure to interest rate risk.

[Insert Tables 1 and 2 about here]

4.2. Managerial compensation and hedging

Table 3, Panel A, presents regression results based on five different specifications. First, we test the individual effect of Delta, Vega and Delta & Vega jointly in the first three baseline specifications. In Panel B, we replicate the analysis using Delta, Vega and Delta & Vega in logs. Then, we add the control variables to test the three theories of Smith & Stulz (1985), and control for firm size, liquidity, alternatives to hedging, and managerial

entrenchment, including variables to account for CEO characteristics, CEO education and past experiences. We did not find the CEO total Delta and Vega to be significant in any of the specifications in both Panels. This result is in contrast with the evidence of Knopf et al. (2002) and Graham and Rogers (2002) who found Delta to be statistically significant using only one year data. Also, our result contradicts the evidence of Beber and Fabbri (2012) who report Vega to be mildly significant. Jointly, these findings seem to suggest that CEO risk sensitivity measured through Delta and Vega is not a significant predictor of a CEO's hedging policies. To put it differently, most option like compensation contracts designed to motivate CEOs to hedge less do not appear to work.

The coefficients of CEO inside debt, CEO stock equity and CEO cash compensation, all proxies for CEO risk-aversion, are also statistically insignificant. Overall, these results show that none of the CEO risk preference measures are significant in any of the regression models.

4.3. Firm characteristics and hedging

Due to the previously reported mixed results of the relationship between hedging and firm characteristics, we test the hedging motives as described in Smith and Stulz (1985) in a panel data set in Model 4 of Table 3. All the previous papers with exclusion of Beber and Fabbri (2012), tested the three hedging motives, based on the reduction in financial distress, reduction in expected tax and mitigation of the under-investment problem theories, using a cross-sectional dataset. To test the financial distress hedging motive, the debt ratio and interest coverage ratio are used. Both ratios, as shown in Table 3, are not significant. Testing the reduction in expected taxes hedging motive, we use NOL carry-forwards scaled by total assets to proxy for reduction in expected taxes. This variable is also not significant

in any of the models suggesting that hedging is not motivated by expected tax considerations. Finally, the mitigation of the underinvestment problem as a hedging motive is examined using the following three variables; R&D/Assets, Market/Book ratio and Capex/Assets. None of the three variables are significant in any of the models. In sum, these results fail to provide support to any of the three hedging theories of Smith & Stulz (1985).

Looking at the control variables, firm size is statistically significant and negative consistent with previous evidence (Warner, 1977). The foreign sales is positive and statistically significant suggesting that firms with greater foreign sales tend to hedge more. The idiosyncratic firm risk is also positive and significant.

4.4. Managerial characteristics and hedging

In this section, we add CEO characteristics in the regression analysis to examine their impact on hedging. Looking again at the reported results in Table 3 (Model 5 and 6), we observe that CEO age is not significant in any of the two main regression models suggesting that CEO age is not linked with derivative hedging. Similarly, CEO tenure is not significant but CEO job-tenure is significant in both of our main regressions. This indicates that CEOs with longer job tenure tend to hedge more as their job is most likely to be safer and they do not have to take risks to impress the board of directors. Male and CEO duality are not significant implying that sex and CEO duality have no influence on total derivatives hedging.

Finally, prior CEO experience, measured by the number of companies they headed in the past, is significant but the sign is positive contradicting the results of Beber and

Fabbri (2012) who find that prior CEO experience exerts a negative effect on foreign exchange (FX) hedging. This result can be attributed to the fact that more experienced CEOs, based on having prior CEO experience in other firms, appear to be aware of the different kinds of risks and their likely impact on firm's riskiness and their own job security which, in turn, seem to motivate them to engage in more hedging. Previous CEO education measures are not significant in any of the models suggesting that corporate derivatives hedging is not affected by past financial/technical education. The CEO experience variables are also not significant in any of the regression models. In sum, our results suggest that CEO job tenure and CEO experience, in other companies before joining the current firm, are positively related to hedging.

[Insert Table 3 about here]

4.5. Addressing endogeneity

One of the problems using CEO compensation measures and firm characteristics as control variables to predict derivatives hedging is endogeneity. CEO compensation variables like CEO inside debt, CEO Delta, CEO Vega, CEO cash compensation and CEO stock compensation are all predictors of firm characteristics like firm size, R&D investment, and firm risk. In other words, since option like contracts encourage CEO risk taking, CEOs with higher option like compensation values get self-selected into firms with higher R&D investment, larger firm size, and higher idiosyncratic risk. To address this problem, we follow the method employed by Shen and Zhang (2013). First, we regress each of the CEO compensation variables (CEO inside debt, CEO cash, CEO equity, CEO Delta, and Vega) against the firm characteristics (D/E ratio, firm size, firm risk, M/B ratio, R&D investment, lagged free cash flow) and managerial characteristic variables (CEO tenure and age). Table

4 presents the results. Then, we use the residuals (excess values) of these CEO compensation variables as independent variables for the fixed effect regression, which partially removes the endogeneity problem. Using the excess compensation variables fixed-effect regressions are re-estimated and Table 5 reports these results. All the variables have the same sign and statistical significance as in Table 3.

[Insert Tables 4 and 5 about here]

Since none of the education and compensation variables are significant in our regression models, we introduce interaction terms as shown in Table 5. The interaction variables are introduced because CEOs in our sample have multiple education degrees and varied work experiences with technical and finance background. Additionally, the use of the interactive terms allows us to capture the variability in the CEO risk preference and characteristics variables in our sample. The results of the interaction terms are presented in Table 6. In Model 1, we include interaction terms between CEO education variables and the CEO work experience measures. Specifically, the interaction variables added in Model 1 are for CEOs with an MBA degree and finance job experience (*MBA*Fin career*), CEOs with MBA degree and finance education (*MBA*Fin edu*), CEOs having some technical/engineering education and financial career experience (*Tech edu*Fin career*), and CEOs with finance & technical education with some financial experience (*Fin edu*Tech edu*Fin career*). In Model 2, Total CEO Delta is interacted with the CEO characteristic variables. The interaction variables added are the CEO age and CEO total Delta (*CEO Age* Total CEO Delta*), CEO tenure and Total CEO Delta (*CEO Tenure* Total CEO Delta*) and Chairman/CEO and Total CEO Delta (*Chairmanceo*Total CEO Delta*). In Model 3, we interact the CEO characteristic variables with CEOs inside debt compensation. The

interaction variables added are the CEO Insidedebt and CEO age (*CEO Insidedebt*CEO age*), CEO Insidedebt and CEO tenure (*CEO Insidedebt*CEO tenure*) and CEO Insidedebt and Chairman/CEO (*CEO Insidedebt*Chairmanceo*). Using the interaction variables, we find the tenure*delta and chairman*delta variable to be significant and positive. This suggests that CEOs who also act as chairman and having high tenure combined with high delta tend to hedge more. The result is consistent with the notion that high tenured CEOs and dual acting CEOs (chairman & CEO) are more conservative and, as a result, they tend to hedge more. We also find the age*delta interactive term to be statistically significant and negative suggesting that older CEOs with high delta hedge less. This result suggests that CEO inside debt compensation designed to motivate CEOs to act conservatively does not appear to be effective. This result, could also attributed to the fact that the CEO inside debt compensation in our sample is less while stock equity is high (543 million) which is likely to make them to behave more as risk-seeking. The signs and significance of the other variables are consistent with the ones reported in Table 5.

[Insert Table 6 about here]

4.6. Corporate hedging by derivative instrument

We turn our focus on each of the three derivative instruments separately (interest rate derivatives, foreign exchange derivatives and commodity derivatives) and replicate the previous fixed effect regression analysis by derivative instrument, controlling for endogeneity. As noted earlier, most of the previous literature has used only foreign exchange derivatives as the main dependent variable to proxy derivative hedging (Allayannis and Weston, 2001; Beber and Fabbri, 2012) assuming currency risk is far greater and more important than other sources of risk. However, as Table 2 reveals interest

rate derivatives usage represents 50.68% while currency derivatives usage is 41.25% of total derivatives usage with commodity derivatives lagging considerably (8.4%). None of the CEO risk preference variables, as shown in Table 7, are significant for any of the FX, IR and COMM derivatives confirming our previous result with the total derivatives. Consistent with our previous evidence, based on the total derivatives hedging, we failed to find any support for the three hedging theories of Smith and Stulz (1985) for each derivative hedging instrument (FX, IR and COMM). Finally, looking at the influence of CEO characteristics and education on hedging by instrument, we find no significant association between the former and hedging at the individual derivatives level for all three derivative hedging instruments.

[Insert Table 7 about here]

4.7. Robustness tests based on single year OLS regressions from 2008-2012

In addition to the fixed effect regression analysis, we also estimate separate single year OLS regressions from 2008 to 2012 for total derivatives and the FX, IR and COMM derivatives, separately. Looking at the total derivatives first, in Table 8: Panel A, for brevity we only report the significant results, the results demonstrate that none of the CEO risk preference measures are significant for any years and as before we find no support for any of the three theories of Smith and Stulz (1985). This evidence coupled with our previous findings, using fixed effect regression, corroborates that CEO risk preference measures do not affect hedging.

We conduct additional robustness tests by using foreign exchange derivatives (FX) and interest rate (IR) derivatives as our dependent variables and undergoing single year

OLS regressions. In Table 8, Panel B, we use the foreign exchange derivatives as the dependent variable and again for brevity we report only the variables with significant coefficients. We use the excess CEO risk preference measures after controlling for endogeneity (see Table 4) and fail to find any excess CEO risk preference measures to be significant for all the 5 years for our OLS regressions.

In Table 8, Panel C and D, we use interest rate derivatives and Commodity derivatives respectively as the dependent variable and as before we report only the significant variables. Again none of the variables are consistently significant over the 5 year period. Thus, using the OLS regressions, we fail again to find statistical significance for the CEO risk preference measures. The evidence also shows no support the three hedging theories of Smith & Stulz (1985).

[Insert Table 8 about here]

5. Conclusion

Theory and previous empirical studies advocate that CEO risk preferences affect hedging. This paper questions this claim and investigates whether CEO managerial compensation and CEO characteristics affect corporate derivative hedging decisions in a 5-year time series setting in contrast to earlier studies relying on cross-sectional datasets. We find the CEO Vega and Delta to be statistically insignificant, before and after we control for endogeneity. None of the other CEO risk preference measures used (inside debt, CEO share compensation and cash compensation) are significant. Overall, our findings suggest that managerial risk preferences do not affect corporate hedging.

Regarding the role of firm characteristics on hedging, we find no support for any of the three theories of Smith and Stulz (1985). Looking at managerial characteristics, we find that the CEO job-tenure exerts significant and positive impact on hedging suggesting that CEOs with longer job tenure tend to be more conservative and hedge more. In addition, the evidence shows that CEOs with more work experience before joining the current firm prefer to hedge more as a result of being less risk-tolerant.

Overall, our findings help to understand why the results of the previous empirical literature on the relation between managerial risk preferences and derivative hedging are inconsistent. Not finding any of the managerial risk preference measures, used in our analysis over a 5-year period, to have a significant impact on hedging and not finding any of the three hedging theories of Smith & Stulz (1985) to be significant leads to the conclusion that the significant results uncovered in previous studies are more likely due to their focus on a specific year since they relied on cross-sectional data and/or focusing exclusively on currency derivatives than on all derivatives used by corporations to hedge interest rate and commodity risk.

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Table 1. Summary statistics

This table presents the descriptive statistics of the variables used in the analysis. Inside debt is the total pension and deferred compensation of CEO compensation. Total derivatives are addition of total notional values of interest rate, commodity and currency contracts. Idiosyncratic risk is the standard deviation of stock returns. Total observations are 1446. For detailed description of variables see Appendices A–F.

Variable	Mean	Std Dev	Min	Max
Inside Debt (millions)	8.878	0.1994	0	232.6
Idiosyncratic Risk	0.02	0.0122	0	0.114
Total Cash Compensation (millions)	1.494	0.022	0	0.31
Total Option comp value (Current, exercisable & un-exercisable options-in millions)	2.33	11.39	0	218
NOL Carryforwards- scaled by Assets	0.013	0.0548	0	1.412
Delta of CEO Compensation (millions)	10.39	180.9	0	5275
Vega of CEO Compensation (millions)	4.768	123.3	0	4195
CEO Age (in years)	56.18	6.255	37	85
CEO Stock Compensation (millions)	543.99	0.7444	0	1179
Debt to Assets ratio	0.468	1.920	0	47.89
Market to Book ratio	7.9	371.6	0	469
Foreign sales/Total Sales	0.287	0.284	0	1.058
Total sales (billions)	2.01	3.089	0	26.50
Total assets (billions)	2.691	5.860	0	79.78
R&D Expense-scaled by Assets	0.0144	0.0361	0	0.399
Capital Expenditures- scaled by Assets	0.0725	0.245	0	4.588
Total Derivatives- scaled by Assets	0.100	5.949	0	221.3
CEO Job Tenure (in years)	17.65	11.50	0.500	45
Previous No. of Comps worked	1.848	1.859	0	9
CEO Tenure (in years)	7.024	6.076	0.500	35.50
Dividend Yield	0.0124	0.0182	0	0.146
Interest Coverage ratio	26.91	168.3	0	4,762
Quick Ratio	0.946	0.819	0	7.568
Insider Ownership	0.0101	0.0627	0	1

Table 2: Notional values of total derivatives broken down by year

This table presents the total notional values of derivatives broken down by year (from 2008 to 2012). The three types of derivatives included here are the interest rate derivatives, commodity derivatives and foreign exchange derivatives. All average derivative values are in millions. In parentheses is the percentage of a specific derivative relative to total hedging.

Year	**No. obs.**	**Mean of the three types of derivatives (in millions)**			**Total mean derivatives (In millions)**	**Derivatives/ Assets**
		Interest rate (IR)	**Commodity (COMM)**	**Foreign exchange (FX)**		
2008	274	948.04 (58.68%)	104.62 (6.48%)	562.93 (34.84%)	1615.59	0.08
2009	293	1592.59 (51.3%)	93.68 (2.85%)	1415.22 (45.8%)	3101.49	0.1
2010	294	1702.71 (45.18)	183.75 (2.7%)	1614.23 (43.37%)	3500.7	0.11
2011	295	2186.68 (58.11%)	165.45 (9.39%)	1315.56 (32.5%)	3667.69	0.108
2012	290	1696.87 (40.23%)	399.45 (10.1%)	2087.66 (49.76%)	4183.98	0.109

Table 3: The relation between firm's derivatives usage and CEO risk preference measures

This table presents the fixed effects regression results where the dependent variable is log of derivatives/assets ratio and the main independent variables are the CEO compensation, and characteristics variables. All variable definitions are provided in detail in Appendices A, C–E.. Statistically significant variables are marked in bold. Presented in parentheses are the robust standard errors which are clustered at the firm level. The superscripts ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

Panel A: Non-log risk preferences (Delta and Vega)

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6
CEO Total Delta	2.00e-10		4.20e-10	-2.09e-09	-2.03e-09	-2.05e-09
	(3.12e-10)		(8.86e-10)	(2.27e-09)	(2.27e-09)	(2.28e-09)
CEO Total Vega		2.13e-10	-3.17e-10	-1.27e-09	-1.28e-09	-1.30e-09
		(4.21e-10)	(1.19e-09)	(1.36e-09)	(1.36e-09)	(1.36e-09)
CEO Share Equity				1.03e-10	1.02e-10	1.03e-10
				(8.27e-11)	(8.28e-11)	(8.29e-11)
CEO Cash comp				4.54e-08	4.74e-08	4.50e-08
				(4.70e-08)	(4.72e-08)	(4.73e-08)
CEO Inside debt				-1.01e-08	-9.55e-09	-1.05e-08
				(2.06e-08)	(2.06e-08)	(2.07e-08)
NOLs/Assets				-0.275	-0.109	-0.0734
				(1.360)	(1.362)	(1.364)
Debt/Assets				-0.0714	-0.0666	-0.0688
				(0.0863)	(0.0868)	(0.0870)
R&D/Assets				-1.289	-2.046	-2.013
				(4.745)	(4.766)	(4.804)
Capex/Assets				-0.0997	-0.118	-0.138
				(0.348)	(0.348)	(0.349)
Idiosrisk				84.03***	83.55***	85.00***
				(28.21)	(28.53)	(28.63)
Log (Assets)				-0.569***	-0.578***	-0.627***
				(0.178)	(0.181)	(0.183)
Quick ratio				0.0720	0.0649	0.0564
				(0.121)	(0.121)	(0.122)
Dividend yield				1.709	0.493	0.283
				(3.530)	(3.589)	(3.611)
Interest Cov ratio				-0.000996	-0.00116	-0.00108
				(0.000826)	(0.000831)	(0.000837)
Insider ownership				-0.203	-0.145	-0.159
				(0.682)	(0.685)	(0.690)
Foreign/Total sales				1.228***	1.202***	1.171***
				(0.424)	(0.426)	(0.429)
M/B ratio				0.00153	0.00139	0.00144
				(0.00186)	(0.00186)	(0.00187)
Log (Job tenure)					0.198*	0.234**
					(0.107)	(0.110)
Log (CEO tenure)					-0.0324	-0.0336
					(0.0816)	(0.0829)
Male					-0.0847	-0.105

					(0.446)	(0.478)
Military					-0.307	-0.481
					(0.421)	(0.437)
Chairman/CEO					0.0449	-0.00847
					(0.238)	(0.242)
Log (Age)					0.0684	0.409
					(0.847)	(0.867)
Log (No. of comps)					0.426**	0.475***
					(0.177)	(0.182)
Fin Education						0.0963
						(0.329)
Tech Education						-0.286
						(0.361)
Finance career						0.0984
						(0.302)
Technical career						0.594
						(0.433)
MBA						0.202
						(0.216)
Constant	-1.948***	-1.947***	-1.948***	9.169**	8.510*	7.999
	(0.0329)	(0.0329)	(0.0331)	(4.203)	(5.150)	(5.172)
Industry	Y	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y	Y
Observations	1,444	1,444	1,444	1,267	1,258	1,255
R-squared	0.000	0.000	0.000	0.036	0.044	0.049
Number of Company1	302	302	302	269	268	268

Panel B: Log risk preferences (Delta and Vega)

	(1)	(2)	(3)	(4)
VARIABLES	Model 1	Model 2	Model 3	Model 4
Log (Delta)	-0.0300			
	(0.0459)			
Log (Vega)	-0.00402			
	(0.00251)			
Vega/Delta		-0.000517	-0.000547	-0.000666
		(0.00198)	(0.00197)	(0.00198)
Log (Stock equity)	0.0163	-1.64e-05	0.000240	0.00156
	(0.0278)	(0.0170)	(0.0174)	(0.0175)
Log (cash)	0.0317	0.0335	0.0322	0.0286
	(0.0311)	(0.0311)	(0.0313)	(0.0315)
Log (inside debt)	-0.0245	-0.0236	-0.0207	-0.0119
	(0.0182)	(0.0182)	(0.0186)	(0.0193)
Controls (as in Panel A)	Y	Y	Y	Y	Y	Y
Industry	Y	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y	Y
Observations	1,444	1,444	1,444	1,267	1,258	1,255
R-squared	0.000	0.000	0.000	0.036	0.044	0.049
Number of Company1	302	302	302	269	268	268

Table 4: Determinants of CEO compensation

This table presents OLS regressions of CEO compensation (i.e., cash, inside debt, stock equity, CEO total Vega, and CEO total Delta) on firm characteristics as in Shen and Zhang (2013). Robust standard errors are presented in parentheses which are clustered at the firm level. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Variable definitions are provided in detail in Appendices A, C–E.

VARIABLES	(1) CEO Delta	(2) CEO Vega	(3) CEO Shares	(4) CEO In Debt	(5) CEO Cash
CEO Cash comp	3.612	1.915	0.115	161.0	
	(5.805)	(3.991)	(0.172)	(183.5)	
Log CEO tenure	1.382e+07	8.053e+06	328,029	5.623e+08**	28,221
	(8.420e+06)	(5.790e+06)	(251,007)	(2.662e+08)	(45,103)
Log (Sales)	-7.545e+06	-4.121e+06	-749,493**	-2.772e+08	129,440**
	(1.077e+07)	(7.406e+06)	(322,260)	(3.405e+08)	(57,566)
CEO Age	-4.471e+06***	-3.052e+06***	129,701***	-1.244e+08***	43,078***
	(1.422e+06)	(977,693)	(42,417)	(4.495e+07)	(7,499)
M/B ratio	-51,194	-30,456	-3,650	-1.803e+06	-359.2
	(197,405)	(135,737)	(6,032)	(6.241e+06)	(1,058)
Idiosrisk	1.438e+08	1.309e+08	1.467e+09***	1.639e+09	4.341e+06
	(9.199e+08)	(6.325e+08)	(2.736e+07)	(2.908e+10)	(4.927e+06)
Debt/Assets	-1.077e+06	-70,047	432,299**	-1.105e+08	3,189
	(7.106e+06)	(4.886e+06)	(204,609)	(2.247e+08)	(38,073)
Lag FCF/Asset	2.418e+07	1.313e+07	-5.110e+06***	9.276e+08	-162,240
	(6.402e+07)	(4.402e+07)	(1.859e+06)	(2.024e+09)	(342,965)
Constant	4.373e+08	2.746e+08	-1.521e+07*	1.330e+10	-3.749e+06**
	(2.958e+08)	(2.034e+08)	(8.705e+06)	(9.352e+09)	(1.581e+06)
Industry	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y
Observations	1,192	1,192	1,121	1,192	1,192
R-squared	0.101	0.086	0.887	0.164	0.781

Table 5: The effect of CEO risk preference measures on firm's derivative hedging: Addressing endogeneity

This table presents fixed effect regression after controlling for endogeneity where the dependent variable is the log of the derivative to total assets ratio. We use the Shen and Zhang (2013) method to control for endogeneity. We use the CEO compensation variables as dependent variables and run regressions as shown in table 4. The residuals of the model that are estimated in Table 3 (Excess_Vega, Excess_Delta, Excess_Shares, Excess_Cash and Excess_Indebt) are saved as excess CEO compensation and used as independent variables in this regression. Robust standard errors are presented in parentheses which are clustered at the firm level. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Variable definitions are provided in detail in Appendices A, C–E.

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6
Excess_Delta	2.27e-10		5.03e-10	-1.78e-09	-1.89e-09	-1.90e-09
	(3.16e-10)		(9.02e-10)	(2.30e-09)	(2.34e-09)	(2.34e-09)
Excess_Vega		2.38e-10	-3.97e-10	-1.23e-09	-1.31e-09	-1.33e-09
		(4.27e-10)	(1.22e-09)	(1.38e-09)	(1.40e-09)	(1.40e-09)
Excess_Shares				9.41e-11	9.94e-11	1.01e-10
				(8.32e-11)	(8.51e-11)	(8.53e-11)
Excess_Cash				1.66e-08	2.31e-08	2.08e-08
				(4.89e-08)	(4.93e-08)	(4.94e-08)
Excess_Indebt				-1.49e-08	-1.38e-08	-1.50e-08
				(2.05e-08)	(2.10e-08)	(2.10e-08)
NOLs/Assets				-1.030	-0.719	-0.630
				(2.089)	(2.094)	(2.102)
Debt/Assets				-0.105	-0.102	-0.104
				(0.0905)	(0.0910)	(0.0912)
R&D/Assets				-2.471	-3.184	-3.284
				(5.171)	(5.191)	(5.239)
Capex/Assets				-0.106	-0.122	-0.144
				(0.357)	(0.357)	(0.358)
Idiosrisk				84.71**	86.54**	86.78**
				(40.84)	(41.53)	(41.69)
Log (Assets)				-0.630***	-0.643***	-0.692***
				(0.192)	(0.195)	(0.197)
Quick ratio				0.0819	0.0712	0.0633
				(0.124)	(0.124)	(0.125)
Dividend yield				1.884	0.815	0.558
				(3.703)	(3.781)	(3.813)
Interest Cov ratio				-0.00102	-0.00117	-0.00110
				(0.000846)	(0.000850)	(0.000856)
Insider own				-0.182	-0.106	-0.128
				(0.699)	(0.701)	(0.707)
Foreign/Total sales				1.295***	1.273***	1.249***
				(0.449)	(0.450)	(0.454)
M/B ratio				0.00145	0.00127	0.00135
				(0.00209)	(0.00209)	(0.00210)
Log (Job tenure)					0.170	0.198

					(0.122)	(0.125)
Log (CEO tenure)					-0.0126	-0.0141
					(0.0895)	(0.0909)
Male					-0.138	-0.193
					(0.482)	(0.525)
Military					-0.265	-0.440
					(0.432)	(0.451)
Chairman/CEO					0.112	0.0566
					(0.254)	(0.258)
Log (Age)					-0.147	0.262
					(0.993)	(1.024)
Log (No. of comps)					0.442**	0.476**
					(0.197)	(0.201)
Fin Education						0.108
						(0.357)
Tech Education						-0.263
						(0.382)
Finance career						0.112
						(0.314)
Technical career						0.589
						(0.461)
MBA						0.203
						(0.234)
Constant	-1.905***	-1.905***	-1.905***	10.57**	10.90*	10.17*
	(0.0367)	(0.0367)	(0.0367)	(4.665)	(5.914)	(5.949)
Industry	Y	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y	Y
Observations	1,190	1,190	1,190	1,116	1,112	1,109
R-squared	0.001	0.000	0.001	0.044	0.052	0.056
Number of Company1	253	253	253	240	240	240

Table 6: Interaction of CEO characteristic/experience/education variables with CEO risk preference measures

This table presents fixed effect regression the results. The dependent variable is log of the derivatives to assets ratio. In model 1, we interacted the education variables with the work experience variables. The interaction variables added are the MBA*Fin career (CEO's holding an MBA degree and has finance job experience), MBA*Fin edu (CEO with MBA degree and finance education), Tech edu*Fin career (CEO with technical education and financial career background), and Fin edu*Tech edu*Fin career (CEO with finance & technical education and financial job experience). In model 2, Delta is interacted with the CEO characteristic variables. The interaction variables added are the CEO Age* Total CEO Delta, CEO Tenure*Total CEO Delta and Chairmanceo*Total CEO Delta. In model 3, CEO inside debt variable is interacted with the CEO characteristic variables. The interaction variables added are the CEO Age* CEO Inside Debt (CEO age with the CEO inside debt variable), CEO Tenure*CEO Inside Debt (CEO Tenure variable with the inside debt variable) and Chairmanceo*CEO Inside Debt (Chairman/CEO variable with the CEO inside debt variable).

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3
Excess_Delta	-1.91e-09	6.27e-08***	6.13e-08***
	(2.35e-09)	(2.07e-08)	(2.07e-08)
Excess_Vega	-1.33e-09	-1.65e-08***	-1.64e-08***
	(1.40e-09)	(6.09e-09)	(6.10e-09)
Excess_Shares	1.01e-10	-1.34e-09**	-1.33e-09**
	(8.54e-11)	(5.30e-10)	(5.31e-10)
Excess_Cash	2.07e-08	-2.95e-08	-3.77e-08
	(4.95e-08)	(6.09e-08)	(6.37e-08)
Excess_Indebt	-1.48e-08	-1.14e-08	-4.84e-08
	(2.10e-08)	(2.09e-08)	(1.04e-07)
NOLs/Assets	-0.670	-1.218	-1.378
	(2.107)	(2.104)	(2.107)
Debt/Assets	-0.102	-0.0300	-0.0403
	(0.0915)	(0.0977)	(0.105)
R&D/Assets	-3.029	-2.670	-2.423
	(5.269)	(5.256)	(5.264)
Capex/Assets	-0.146	-0.142	-0.143
	(0.358)	(0.358)	(0.358)
Idiosrisk	86.92**	97.17**	44.99
	(41.79)	(41.75)	(155.5)
Log (Assets)	-0.687***	-0.837***	-0.868***
	(0.198)	(0.206)	(0.206)
Quick ratio	0.0579	0.0222	0.0172
	(0.125)	(0.126)	(0.126)
Dividend yield	0.459	-5.003	-4.161
	(3.830)	(4.147)	(4.188)
Interest Cov ratio	-0.00114	-0.00119	-0.00129
	(0.000865)	(0.000862)	(0.000863)
Insider Own	-0.114	-0.248	-0.301
	(0.710)	(0.713)	(0.713)
Foreign/Total sales	1.286***	1.301***	1.324***
	(0.457)	(0.459)	(0.460)

M/B ratio	0.00137	0.00149	0.00167
	(0.00210)	(0.00211)	(0.00219)
Log (job tenure)	0.181	0.176	0.155
	(0.127)	(0.127)	(0.128)
Log (CEO tenure)	0.000661	-0.0876	0.000331
	(0.0931)	(0.138)	(0.151)
Male	-0.129	-0.109	-0.276
	(0.545)	(0.542)	(0.558)
Military	-0.374	-0.328	-0.425
	(0.457)	(0.456)	(0.464)
Chairman/CEO	0.0818	0.213	0.0279
	(0.265)	(0.268)	(0.297)
Log (Age)	0.131	-3.692**	-3.957**
	(1.048)	(1.735)	(1.841)
Log (No. of comps)	0.441**	0.364*	0.333
	(0.220)	(0.220)	(0.221)
Fin Education	0.166	0.207	0.382
	(0.516)	(0.514)	(0.526)
Tech Education	-0.546	-0.506	-0.497
	(0.497)	(0.496)	(0.496)
Finance career	0.150	0.181	0.211
	(0.538)	(0.536)	(0.538)
Technical career	0.691	0.617	0.500
	(0.494)	(0.492)	(0.499)
MBA	0.317	0.327	0.309
	(0.271)	(0.270)	(0.271)
MBA*Fincare	-0.127	-0.192	-0.0978
	(0.671)	(0.668)	(0.670)
MBA*Finedu	-0.312	-0.397	-0.477
	(0.600)	(0.598)	(0.602)
Techedu*Fincare	0.164	0.244	0.185
	(0.671)	(0.668)	(0.671)
Finedu*Techedu*Fincareer	0.532	0.305	0.293
	(1.016)	(1.014)	(1.023)
Age*Delta		-2.07e-08***	-2.03e-08***
		(6.79e-09)	(6.79e-09)
CEO Tenure*Delta		4.36e-08***	4.34e-08***
		(1.61e-08)	(1.62e-08)
Chairman/CEO*Delta		3.61e-08**	3.62e-08**
		(1.62e-08)	(1.62e-08)
Age*Inside Debt			1.20e-08
			(2.86e-08)
CEO Tenure*Inside Debt			-1.16e-08*
			(6.73e-09)
Chairman/CEO*Inside Debt			2.51e-08
			(2.57e-08)
Constant	10.55*	29.28***	31.93***
	(6.012)	(9.131)	(10.35)
Industry	Y	Y	Y
Year	Y	Y	Y
Observations	1,109	1,109	1,109
R-squared	0.058	0.071	0.075
Number of Company1	240	240	240

Table 7: Fixed effect regressions of each type of derivatives (FX, IR and COMM) on CEO risk preference measures

This table reports the fixed effect regression results. The dependent variable is the foreign exchange (FX) derivative (Model 1), interest rate (IR) derivatives (Model 2), and commodity (COMM) derivatives (Model 3). The excess risk preference variables residual Vega (Excess_Vega), residual Delta (Excess_Delta), excess shares ownership (Excess_Shares), excess CEO cash compensation (Excess_CEO Cash), and Excess inside debt (Excess_Indebt) are used after controlling for endogeneity. Robust standard errors are presented in parentheses which are clustered at the firm level. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Variable definitions are provided in detail in Appendices A, C–E.

VARIABLES	(1) FX	(2) IR	(3) COMM
Excess_Delta	-3.28e-09	-1.07e-09	3.32e-09
	(2.43e-09)	(2.58e-09)	(2.39e-09)
Excess_Vega	-1.30e-09	-9.86e-10	-3.23e-09**
	(1.45e-09)	(1.54e-09)	(1.43e-09)
Excess_Shares	1.34e-10	6.55e-11	6.11e-11
	(8.83e-11)	(9.39e-11)	(8.71e-11)
Excess_Cash	4.18e-08	5.58e-08	2.21e-08
	(5.12e-08)	(5.44e-08)	(5.04e-08)
Excess_Indebt	1.26e-08	1.61e-08	1.38e-08
	(1.92e-08)	(2.05e-08)	(1.90e-08)
NOLs/Assets	-1.466	1.830	-1.335
	(2.178)	(2.318)	(2.148)
Debt/Assets	0.00362	-0.0736	-0.0822
	(0.0943)	(0.100)	(0.0930)
R&D/Assets	-1.379	-3.165	3.420
	(5.426)	(5.773)	(5.349)
Capex/Assets	-0.0695	-0.228	-0.0106
	(0.370)	(0.394)	(0.365)
Idiosrisk	-12.18	57.79**	-0.890
	(27.38)	(29.13)	(27.00)
Log (Assets)	-0.345*	-0.619***	0.0389
	(0.202)	(0.215)	(0.199)
Quick ratio	-0.171	0.114	-0.0948
	(0.129)	(0.137)	(0.127)
Dividend Yield	-3.578	-6.656	-16.58***
	(3.898)	(4.147)	(3.843)
Interest cov ratio	0.000265	-0.00137	0.000414
	(0.000887)	(0.000944)	(0.000874)
Insider ownership	-0.372	-0.627	0.0527
	(0.733)	(0.780)	(0.723)
Foreign/Total sales	-0.134	1.209**	1.132**
	(0.471)	(0.501)	(0.464)
M/B ratio	0.00102	0.000297	0.000736
	(0.00216)	(0.00230)	(0.00213)
Log (Job Tenure)	0.0561	-0.150	-0.0153

	(0.129)	(0.138)	(0.127)
Log (CEO Tenure)	0.0464	-0.0981	-0.0875
	(0.0940)	(0.100)	(0.0927)
Male	-0.315	0.178	-0.188
	(0.544)	(0.578)	(0.536)
Military	-0.224	-0.774	-0.0916
	(0.467)	(0.497)	(0.461)
Chairman/CEO	-0.225	-0.182	0.196
	(0.267)	(0.284)	(0.263)
Log (age)	0.339	1.962*	-0.175
	(1.055)	(1.123)	(1.040)
Log (No of comps)	-0.0778	-0.0128	-0.0732
	(0.208)	(0.222)	(0.205)
Fin Education	0.0142	-0.264	-0.316
	(0.370)	(0.394)	(0.365)
Tech Education	-0.460	0.234	-0.00513
	(0.396)	(0.422)	(0.391)
Finance career	-0.115	0.430	-0.177
	(0.326)	(0.346)	(0.321)
Technical career	0.723	0.219	0.661
	(0.478)	(0.508)	(0.471)
MBA	0.112	0.201	0.319
	(0.242)	(0.257)	(0.239)
Constant	5.872	3.876	-0.719
	(5.864)	(6.239)	(5.781)
Industry	Y	Y	Y
Year	Y	Y	Y
Observations	1,111	1,111	1,111
R-squared	0.018	0.044	0.055
Number of Company1	240	240	240

Table 8: OLS single year regressions from 2008 to 2012

Panel A: Relation between total derivatives and CEO risk preference measures

Panel A reports OLS single year regression results. The log of Total derivatives/assets ratio is the dependent variable for years 2008 to 2012. Risk preference variables (CEO inside debt compensation, CEO option compensation Vega, Delta, CEO cash compensation and CEO firm shares ownership) are controlled for endogeneity and their excess values are used in the regressions (see table 4 for variables used to control for endogeneity). Only the significant variables are shown in the table. Robust standard errors are presented in parentheses which are clustered at the firm level. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Variable definitions are provided in detail in Appendices A, C–E.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	**2008**	**2009**	**2010**	**2011**	**2012**
Tech career					1.38**
					(0.56)
Excess_Delta		$-4e^{-07}$*			
		($2e^{-07}$)			
					$-3.6e^{-08}$
					($1.8e^{-08}$)
Fin Educ		1.3***			
		(0.48)			
Excess_indebt		$-4e^{-08}$*			
		($2e^{-08}$)			
Excess_shares		$4e^{-09}$**			
		($2e^{-09}$)			
Debt/Assets	-0.7*				0.35*
	(0.4)				(0.18)
Log Assets	-0.6*			0.38*	
	(0.32)			(0.19)	
Idiosrisk				49.49**	55.65***
				(20.31)	(17.93)
Tech Educ					-1.15**
					(0.53)
No of comps					0.39*
					(0.22)
Observations	1110	1118	1120	1121	1118
R-squared	0.55	0.66	0.77	0.87	0.76
Industry	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y

Panel B: Relation between Foreign exchange derivatives and CEO risk preference measures

Panel B reports OLS single year regression results. The log of foreign exchange derivatives/assets ratio is the dependent variable for years 2008 to 2012. Risk preference variables (CEO inside debt compensation, CEO option compensation Vega, Delta, CEO cash compensation and CEO firm shares ownership) are controlled for endogeneity and their excess values are used in the regressions (see table 4 for variables used to control for endogeneity). Only the significant variables are shown in the table. Robust standard errors are presented in parentheses which are clustered at the firm level. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Variable definitions are provided in detail in Appendices A, C–E.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	**2008**	**2009**	**2010**	**2011**	**2012**
Tech educ		-1.43**		-1.14*	
		(0.61)		(0.659)	
R&D/Assets					
Idiosrisk					47.21*
					(24.42)
Excess_shares		$-6.41e^{-09}$***			
		($6.57e^{-09}$)			
Excess_Delta		$-5.73e^{-07}$***			
		($1.93e^{-07}$)			
Excess_Vega		$4.63e^{-07}$***			
		($1.64e^{-07}$)			
No of Comps				0.806***	
				(0.29)	
Log Age		21.27***			
		(6.97)			
Capex/Assets		1.77*			
		(1.01)			
MB ratio		0.009**			
		(0.004)			
Excess_Indebt		$-5.7e^{-08}$**		$-5.9e^{-08}$**	$-7.2e^{-08}$**
		($2.34e^{-08}$)		($2.6e^{-08}$)	($2.5e^{-08}$)
Tech educ		-1.43**			
		(0.61)			
Observations	290	288	289	287	288
R-squared	0.59	0.49	0.66	0.79	0.63
Industry	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y

Panel C. Relation between Interest rate derivatives and CEO risk preference measures

Panel C reports OLS single year regression results. The log of foreign exchange derivatives/assets ratio is the dependent variable for years 2008 to 2012. Risk preference variables (CEO inside debt compensation, CEO option compensation Vega, Delta, CEO cash compensation and CEO firm shares ownership) are controlled for endogeneity and their excess values are used in the regressions (see table 4 for variables used to control for endogeneity). Only the significant variables are shown in the table. Robust standard errors are presented in parentheses which are clustered at the firm level. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Variable definitions are provided in detail in Appendices A, C–E.

VARIABLES	(1) 2008	(2) 2009	(3) 2010	(4) 2011	(5) 2012
Foreign/total sales			2.15***	1.33*	
			(0.76)	(0.73)	
Idiosrisk				58.44**	53.81*
				(27.5)	(28.21)
NOLs/Assets	8.69*				
	(4.73)				
Tech Educ				-1.842*	
				(0.74)	
Observations	287	290	291	288	289
R-squared	0.494	0.497	0.868	0.475	0.655
Industry	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y

Panel D. Relation between Commodity derivatives and CEO risk preference measures

Panel D reports OLS single year regression results. The log of commodity derivatives/assets ratio is the dependent variable for years 2008 to 2012. Risk preference variables (CEO inside debt compensation, CEO option compensation Vega, Delta, CEO cash compensation and CEO firm shares ownership) are controlled for endogeneity and their excess values are used in the regressions (see table 4 for variables used to control for endogeneity). Only the significant variables are shown in the table. Robust standard errors are presented in parentheses which are clustered at the firm level. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Variable definitions are provided in detail in Appendices A, C–E.

VARIABLES	(1) 2008	(2) 2009	(3) 2010	(4) 2011	(5) 2012
Male		-2.28*			
		(1.35)			
CEO Tenure		-1.01*			
		(0.54)			
Div Yield	100.88**		-18.75*		-19.93*
	(49.41)		(11.11)		(10.34)
Excess_shares		6.11e^{-09}**	-6.01e^{-09}*		-8.91e^{-09}*
		(2.83e^{-09})	(3.39 e^{-09})		(4.4e^{-09})
Excess_Delta		-6.16e^{-07}**	5.94 e^{-07}*		8.67e^{-07}*
		(2.78e^{-07})	(3.37 e^{-07})		(4.4e^{-07})
Excess_Vega		5.28e^{-07}**			-8.46e^{-07}*
		(2.37e^{-07})			(5.06e^{-07})
Idiosrisk					46.39*
					(27.15)
Log Age		27.47**			
		(12.06)			
Technical career			-1.25*		
Observations	277	281	285	280	279
R-squared	0.54	0.45	0.81	0.54	0.66
Industry	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y

Appendix A. Firm Variables

This Appendix presents company variables in which the variables we derive are italicized.

- Idiosrisk – This variable captures the idiosyncratic risk and is the standard deviation of the daily excess returns.
- NOLs/Assets- Net operating loss carry-forwards divided by the total book value of the assets.
- Debt/Assets –Total debt to total assets.
- M/B ratio- This variable is calculated by dividing the market price of the stock to the book value per share of stock (BPS). BPS is calculated by dividing the book value of assets by the total shares outstanding.
- Foreign/Total sales- International sales revenue divided by the total sales revenue.
- Capex/Assets - Logarithm of the total capital expenditure of the firm divided by the total book value of the assets.
- Quick ratio- (Current assets- Inventories)/current liabilities.
- R&D/Assets –Total Research and Development expenses of the firm.
- Insider ownership- Insider stock ownership (%) of the company shares by the CEO.
- Dividend yield- Total dividend yield of the company calculated by dividing the dividend by the current stock price
- Interest Cov ratio - Interest coverage ratio of the firm calculated by dividing the EBIT by the interest expense.
- Assets - Total book value of the assets.

Appendix B: Delta and Vega calculation using Black-Scholes Option Pricing model

In this appendix, we first present how we derive CEO stock option values, deltas, and vegas and then we define other variables.

The Black and Scholes (1973) model for valuing European call options modified for dividend payments as in Merton (1973) is as follows.

$$\text{Value} = S \exp(-d*T)*N(d_1) - X \exp(-r*T)*N(d_2) \qquad (1)$$

where,

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

$d_2 = d_1 - \sigma\sqrt{T}$

N (.) = Cumulative probability function for the normal distribution

S = share price of stock at fiscal year-end

d = Dividend yield as of fiscal year-end.

X = Exercise price of the option.

r = Risk-free rate. US T-bond yields corresponding to the option's time to maturity are used.

d= Annualized standard deviation of daily stock returns measured over 120 days prior to fiscal year-end.

T = Remaining years to maturity of option.

As in Core and Guay (2002), the "**Delta**" and "**Vega**" measures are the option values sensitivity with respect to a 1% change in stock price and a 0.01 change in standard deviation, respectively, and are expressed in equations (2) and (3) below.

$$\frac{\partial value}{\partial S} * \frac{S}{100} = \exp\{-dT\}\,N(d1) * \frac{S}{100} \qquad (2)$$

$$\frac{\partial value}{\partial S} * 0.01 = 0.01 * [\exp\{-d * T\}\,N'(d2)S\sqrt{T}] \qquad (3)$$

where N' (.)= normal probability density function.

Exact values of exercise price and time to maturity are obtained from proxy statements for current year option grants. For options granted in prior years, I use the Core and Guay (2002) algorithm. I estimate average exercise prices by subtracting the ratio of realizable value of options to the number of options (for both exercisable and un-exercisable options) from fiscal year-end stock prices. Time to maturity is set at 1 year less than the time to maturity of the current year's grant (or 9 years if no new grant is made) for un-exercisable options. Time to maturity is set at 3 years less than the time to maturity of exercisable options (or 6 years if no new grant is made). Delta and Vega values for shares of stock held are assumed to be equal to 1 and 0, respectively.

Appendix C: CEO compensation variables:

- Total CEO Delta- Total Delta of the CEO compensation portfolio (sum of Delta of CEO current options, exercisable options & un-exercisable options & Delta of CEO stock options).
- Total CEO Vega - Total Vega of the CEO compensation portfolio (sum of Vega of CEO current options, exercisable options & un-exercisable options).
- CEO Inside Debt - The inside debt is the sum of the CEO's deferred compensation and pension benefits.
- CEO Cash Comp - Total salary + bonus of the CEO's compensation portfolio.
- CEO Share Equity - Total stock equity compensation of the CEO's compensation.
- Excess_ Indebt- Excess inside debt holdings of the CEO.
- Excess_Cash- Excess cash compensation (These are the residuals after controlling for endogeneity using the Shen & Zhang, 2013 method).
- Excess_Shares- Excess stock equity compensation (These are the residuals after controlling for endogeneity using the Shen & Zhang, 2013 method).
- Excess_Delta - Excess total CEO Delta compensation (These are the residuals after controlling for endogeneity using the Shen & Zhang, 2013 method).
- Excess_Vega- - Excess total CEO Vega compensation (These are the residuals after controlling for endogeneity using the Shen & Zhang, 2013 method).

Appendix D: CEO personal characteristics variables:

- CEO Age - Age of the CEO in years.
- Job Tenure - The number of years the CEO is in the current firm.
- CEO Tenure - The tenure of the executive as the CEO of the firm.
- Male- dummy variable with value=1 if male and 0 otherwise.
- Military- dummy variable with value =1 if CEO has military experience and 0 otherwise.
- Chairman/CEO- dummy variable with value=1 if CEO is the Chairman and CEO and 0 if CEO is not the chairman.
- No of Comps- Previous number of companies worked before joining the current firm.

Appendix E: CEO education and past experience variables:

- MBA- dummy variable with value=1 if CEO has MBA and 0 otherwise.
- Tech education- dummy variable with value=1 if CEO has some sort of technical education or 0 otherwise.
- Fin education- dummy variable with value=1 if CEO has any finance education or 0 otherwise.
- Finance career- dummy variable with value=1 if CEO has some sort of finance experience in the past before joining the current firm.
- Technical career- dummy variable with value=1 if CEO has some sort of technical job experience in the past before joining the current company.

Appendix F: CEO interaction variables:

- MBA*Fincare- CEOs with MBA degree and having a Financial career.
- MBA*Finedu- CEOs with MBA degree and who have some sort of Financial education.
- Tech edu*Fincare- CEOs who have technical education and who have some kind of financial job experience before.
- Finedu*Tech edu*Fin career- CEOs having a financial as well as a technical education background and also who have a financial job experience before joining the current firm.
- Age*Delta- This variable interacts the log of the age of the CEO with the Delta of the option portfolio of the CEO.
- CEO Tenure*Delta- This variable interacts the log of the CEO tenure with the Delta of the option portfolio of the CEO.
- Chairman/CEO*Delta- This variable interacts the Chairmanceo dummy variable with the Delta of the option portfolio of the CEO.
- Chairman/CEO*Inside Debt - This variable interacts the Chairmanceo dummy variable with the Delta of the option portfolio of the CEO.
- CEO Tenure*Inside Debt - This variable interacts the CEO tenure variable with the CEO inside debt of the option portfolio of the CEO.
- Age* Inside Debt - This variable interacts the log of the age of the CEO with the inside debt of the option portfolio of the CEO.