UvA-DARE (Digital Academic Repository)

Credit ratings and CEO risk-taking incentives

Kuang, Y.F.; Qin, B.

DOI

[10.1111/1911-3846.12005](https://doi.org/10.1111/1911-3846.12005)

Publication date

2013

Published in

Contemporary Accounting Research

[Link to publication](#)

Citation for published version (APA):

Kuang, Y. F., & Qin, B. (2013). Credit ratings and CEO risk-taking incentives. *Contemporary Accounting Research*, 30(4), 1524-1559. <https://doi.org/10.1111/1911-3846.12005>

General rights

It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations

If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: <https://uba.uva.nl/en/contact>, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.

Credit Ratings and CEO Risk-Taking Incentives*

YU FLORA KUANG, *VU University Amsterdam*

BO QIN, *University of Amsterdam*

Introduction

Since their first issuance in 1909, credit ratings have been widely regarded by investors, regulators, public media, suppliers, financial counterparties, and customers as primary indicators when assessing the credit risk of firms (Kisgen 2007). A substantial impact of credit ratings on financial markets has been documented in academic research (Hand, Holthausen, and Leftwich 1992; Blume, Lim, and MacKinlay 1998; Ederington and Goh 1998; Amato and Furfine 2004; Kisgen 2006). Survey-based evidence shows that a good credit standing is ranked as the second-most important concern after financial flexibility in financing decisions (Graham and Harvey 2001).¹ However, in the wake of massive accounting irregularities in the early 2000s and the more recent worldwide credit crisis, the quality of credit ratings has come under intense criticism. For instance, in an October 2008 progress update on financial market developments, the President's Working Group on Financial Markets (PWG) argues that low-quality credit ratings contributed materially to the global market turmoil. In particular, it argues that delays in lowering the credit scores of companies that ultimately failed (e.g., Enron and Worldcom) cost investors unprecedented losses. The primary objective in this study is to examine the extent to which rating agencies incorporate forward-looking information, such as managerial compensation incentives, into risk assessments. Specifically, we investigate the sophistication of rating agencies in taking account of managerial risk-taking incentives when making their credit risk evaluation. In addition, we evaluate the significance of credit ratings in the design of CEO compensation and examine whether firms with considerable rating concerns will adjust the risk-taking incentives in managerial compensation accordingly.

Economic literature provides theoretical and empirical evidence that adding convexity into managerial payoff structure, for example with equity compensation such as stock options, potentially raises a manager's appetite for risk. When managerial personal wealth is sensitive to firm risk, managers may be motivated to choose investment policies that increase the volatility of financial reporting and firm performance, thereby increasing the firm's future default risk (see, e.g., Jensen and Meckling 1976; Brander and Poitevin 1992; John and John 1993; Guay 1999; Core and Guay 1999, 2002; Knopf, Nam, and Thornton 2002; Coles, Daniel, and Naveen 2006; Rajgopal and Shevlin 2002; Levine and Hughes

* Accepted by Joy Begley. The authors are grateful for comments from two anonymous reviewers and Joy Begley (the editor). We acknowledge helpful comments from Steven Balsam, Jochen Bigus, Henk ter Bogt, Brian Cadman, Henri Dekker, Ingolf Dittmann, Tom Groot, Abe de Jong, Robert Kolb, Laurence van Lent, Hai Lu, Jeltje van der Meer-Kooistra, Jacco Wielhouwer, and Arjen van Witteloostuijn. We also thank participants at the 2009 Accounting Research Workshop at Bern, the 2009 Risk Management & Corporate Governance Conference at Chicago, the 2010 Management Accounting Section Research and Case Conference at Seattle, and the 2010 Management Accounting Research Symposium at Groningen. An earlier version of this paper benefited from conversation with Harry Chopra at Standard & Poor's. Part of this research was undertaken while Yu Flora Kuang was a visiting scholar at Ross School of Business.

1. For example, when the credit rating of NUI Corporation was downgraded in 2003, the downgrade triggered a 37.5 basis point increase in its borrowing costs (NUI Corporation, Form 10-Q, 2003). Similarly, when AIG's credit rating was downgraded by all three major rating agencies in 2008, the downgrades triggered AIG's counterparties to call for more than \$13.3 billion of additional collateral.

2005; Brockman, Martin, and Unlu 2010). Bondholders anticipate managerial risk-taking incentives arising from compensation and rationally price the risk in the form of adverse bond price reaction to the grants of equity compensation (DeFusco, Johnson, and Zorn 1990; Billett, Mauer, and Zhang 2010), and/or higher risk premiums and more restrictive covenants in debt contracts (Begley and Feltham 1999; Daniel, Martin, and Naveen 2004; Ortiz-Molina 2007; Vasvari 2008; Kabir, Li, and Veld-Merkoulova 2013). The significance of executive compensation in incentivizing managerial risk taking has been acknowledged by rating agencies (Standard & Poor's 2002b; Moody's 2005, 2007). For instance, Standard & Poor's (2002b) states that managerial incentives to pursue short-term gains at the cost of long-term stability can impair the creditworthiness of the firm. Similarly, Moody's concludes that "a connection exists between CEO compensation and overall credit risk" (2005: 8) and "pay packages that are highly sensitive to stock price and/or operating performance may induce greater risk taking by managers, perhaps consistent with stockholders' objectives, but not necessarily consistent with bondholders' objectives" (2007: 8). Despite the credit raters' claims, it remains an empirical question regarding the quality of credit ratings in reflecting managerial risk-taking incentives derived from their wealth portfolios.

In the study, we employ two measures to capture the risk-taking incentives from executive compensation. The first measure is the sensitivity of managerial wealth to stock return volatility (*vega*). *Vega* increases the convexity of managers' payoffs on the firm value. One of the consequences of such a payoff structure is that managers may find risk more valuable and thus choose more risky investments and financing policies to increase the volatility of firm performance (Guay 1999; Rajgopal and Shevlin 2002; Coles et al. 2006). The second measure of managerial risk-taking incentives is the sensitivity of managerial wealth to stock price (*delta*). To the extent that it aligns the interests of managers with shareholders, *delta* may lead to the classic asset substitution problem where managers are inclined to substitute into riskier investments which are beneficial to shareholders while detrimental to bondholders (Fama and Miller 1972; Jensen and Meckling 1976). Our main empirical analyses are set to investigate the economic consequences of compensation policies. We find that managerial risk-taking incentives (both *vega* and *delta*) and firms' realized rating category default rates are positively related. That is, an increase in management incentives to take risk is associated with an increase in firm default, which implies that compensation policies that induce managerial risk taking can serve as a red flag in rating agencies' credit risk assessments. To the extent that credit ratings are primary indicators of a firm's creditworthiness, we expect higher managerial incentives for risk taking (both *vega* and *delta*) to be associated with worse credit risk assessments. Consistent with our hypothesis, we find a negative relationship between managerial compensation incentives (both *vega* and *delta*) and credit rating scores. In particular, for a firm in our sample, the effect of a one standard deviation increase in *vega* (*delta*) is to downgrade the firm's credit ratings by one (two) notch(es).

Next, we explore the role of credit ratings in affecting managerial compensation policies and in particular investigate whether firms with rating concerns will adjust managerial compensation incentives accordingly. We categorize firms' concerns of credit ratings based on Kishen 2006. More specifically, we use two measures to capture firms' credit rating concerns: whether the firm experienced a rating downgrade in the prior year; and/or whether the firm's rating score was downgraded to the lower edge of the investment category (i.e., BBB-) ² in the prior year, respectively. Our findings suggest that rating-troubled

2. In 1936, the U.S. Treasury Department issued a ruling (still in place today) that banks could not invest in bonds that were rated below "investment grade", that is, below a "BBB-" rating as designated by Standard & Poor's (Kishen 2007; White 2007). Thus, companies issuing bonds have to obtain threshold ratings (from nationally recognized statistical rating organizations, or NRSROs) if they want their bonds to be eligible for ownership by banks, insurance companies, and other financial institutions.

firms significantly decrease the sensitivity of top management's wealth to stock return volatility, or *vega*, but we find no evidence that firms' rating concerns significantly affect the sensitivity of managerial wealth to stock price, or *delta*. In particular, if during the prior year, a firm in our sample experiences any type of rating downgrade, assuming everything else equal, the firm is expected to reduce *vega* incentive in new option grants by approximately 18 percent, compared to firms that did not experience a downgrade. A downgrade to the lower edge of the investment category (i.e., BBB-) in the previous year is associated with a 51 percent reduction of *vega* in options granted to its CEO during the next year. In addition, we observe statistically significant differences in the reduction of *vega* across the two rating concern measures, suggesting that the greater are firms' concerns about their credit ratings, the more aggressively they will reduce managers' *vega* incentive.

The current study contributes to the literature in several ways. First, motivated by the well-documented impact of executive compensation on firm decisions (see, e.g., Berger, Ofek, and Yermack 1997; Core and Guay 1999; Rogers 2002; Coles et al. 2006), this study is among the first to systematically analyze the extent to which credit ratings incorporate managerial risk-taking incentives. It argues that rating agencies have particular positions³ that enable the acquisition of information about firms' prospects, but what rating agencies actually do in constructing their assessments of credit risk is cloaked in secrecy. Although the importance of rating agencies in the markets has been demonstrated in the literature (Ederington, Yawita, and Roberts 1987; Goh and Ederington 1993; Kliger and Sarig 2000; Coffee 2002), the quality of credit ratings has been the subject of mounting public scrutiny following a series of accounting scandals in the early 2000s and the more recent global credit crisis. Our study contributes to the increasingly heated debate on the quality of credit ratings by providing evidence on the sophistication of rating agencies in incorporating forward-looking information — in particular, risk-taking incentives derived from managerial compensation — into risk assessments. Prior literature demonstrates that credit ratings capture the relationship between issuers' default risk and capital structure, corporate governance, and information characteristics (Kisgen 2006; Ashbaugh-Skaife, Collins, and LaFond 2006; Cheng and Subramanyam 2008). The current study advances our understanding of the rating process from the perspective of managerial compensation incentives. While we do not equate sophistication in incorporating forward-looking information with high quality credit ratings per se, we expect that risk assessments that take such information into account are desirable from the perspective of rating users.

Second, built on prior research on the impact of credit ratings on firms' operational and investment policies (Ederington et al. 1987; Hand et al. 1992; Ederington and Goh 1998; Graham and Harvey 2001; Kisgen 2006), this study examines the influence of firms' ratings scores on executive pay. The results suggest that firms concerned about their credit ratings will tone down managers' risk appetite by decreasing the sensitivity of managerial wealth to the volatility of firm performance (*vega*); however, they do not loosen the interest alignment between managers and shareholders (*delta*). The findings shed new light on how rating-troubled firms adjust managerial risk-taking incentives.

In addition, this study also contributes to the growing literature on the implications of corporate governance on credit risk and credit ratings. There is a sequence of work on the association between corporate governance attributes and credit risk and/or credit spreads (see, e.g., Ashbaugh-Skaife et al. 2006; Bradley and Chen 2011). Our study is part of the

3. Rating agencies have privileged access to inside proprietary information insofar as that information is to be used to construct their assessments of the firm's default risk (see, e.g., Coffee 2002). For instance, the SEC's Regulation Fair Disclosure (FD), implemented on October 23, 2000, prohibits U.S. public companies from making selective disclosure of nonpublic information to financial professionals such as equity research analysts, but grants issuers a conditional exception for information disclosed to ratings agencies, provided that the information is used solely to prepare a credit rating.

larger literature that contains the work on executive risk-taking incentives from compensation, an important aspect of corporate governance.

One general concern in executive compensation literature is the potential endogeneity problem (Armstrong, Jagolinzer, and Larcker 2010; Coles, Lemmon, and Meschke 2012). In the current study this concern arises over the endogenous relationship between compensation, investment, and financing policies. In the main analysis, we try to mitigate this concern by including control variables and controlling for (unobservable) firm and time effects simultaneously. To check the robustness of the findings, we employ an array of empirical methodologies, including simultaneous equations estimation, change-in-variable regressions, and so forth. Our conclusions are drawn on the basis of consistent findings.

The remainder of the paper is organized as follows. Section 2 reviews prior literature and develops our hypotheses. We introduce our research design in section 3. Section 4 discusses the paper's main empirical findings on the impact of compensation incentives on credit ratings and the effect of credit rating changes on a firm's compensation policies. The results of robustness tests are reported in section 5. Section 6 concludes.

2. Related literature and hypothesis development

Related literature

Agency theory posits that one way to offset the concavity of a risk-averse manager's utility function is to make managerial compensation follow a convex payoff structure, that is, to make managerial wealth sensitive to firm performance. As a result, managers can share firm profits and "upside" gains when the firm prospers, but are protected from losses due to limited liability. One of the consequences of such a payoff structure is that managers may find risk more valuable and thus are motivated to undertake risky investments.⁴ Among empirical studies that rely on the above or similar intuition, Tufano (1996), Berger et al. (1997), and Rogers (2002), among others, explore the association between managerial stock and/or option holdings and financial policies, including leverage, repurchases, and derivatives usage. They show that top management's equity compensation is positively related to riskier financial policies. DeFusco et al. (1990) find that firms that approved stock option plans between 1978 and 1982 exhibited a stock return variance increase, and Agrawal and Mandelker (1987) find that firms with higher stock plus option ownership take on more variance-increasing acquisitions. Prior studies differentiate managerial risk-taking incentives from compensation into *vega* — the sensitivity of managerial wealth to the volatility of firm performance, and *delta* — the sensitivity of managerial wealth to firm performance. *Vega* captures the convexity of managers' payoffs on the firm value while *delta* gives managerial incentives to take risk on behalf of shareholders. Guay (1999) shows that the volatility of stock returns increases with CEO compensation scheme convexity (as measured by *vega*). Rajgopal and Shevlin (2002) find that oil exploration risk is positively related to lagged *vega*, and Knopf et al. (2002) show that the use of derivatives is negatively related to *vega*. Coles et al. (2006) investigate the causal relationship between managerial compensation and investment policy, debt policy, and firm risk. Controlling for *delta* and accounting for reverse causation in the empirical design, they show that when CEO wealth is more sensitive to performance volatility (i.e., with higher *vega*), managers have greater incentives to implement several riskier financial choices, including relatively more investment in research and development, higher leverage, and less corporate diversification. In terms of causation flowing the other way, they find that riskier policy choices generally lead to compensation structures with higher *vega* and lower *delta*.

4. However, there are mixed results on the association between managerial option compensation and risk-taking behavior (Ju, Leland, and Senbet 2002; Lewellen 2006; see Coles et al. 2006 for a review of the empirical findings).

Bondholders are mainly concerned about the downside risk of a firm's investments (Jensen and Meckling 1976); creditors prefer stable performance to risky investment policies that can increase the likelihood of business failure and financial default. In the absence of any equity-based incentives, the payoff structure of risk-averse managers is more like that of bondholders, with limited upside profits while being exposed to the downside risk when a project fails. Therefore, the risk-aversion can lead managers to choose less than optimal firm risk (see, e.g., Smith and Stulz 1985). By adding convexity into managerial payoffs with, for instance, equity compensation, a firm will motivate its managers to behave like risk seekers as increases in stock return volatility increase the managers' expected utility. Consistent with this assertion, prior studies document a significant negative reaction in the bond market to the grants of equity-based incentives (see, e.g., DeFusco et al. 1990; Billett et al. 2010) and bondholders anticipate managerial risk-taking incentives from compensation when negotiating lending contracts (Daniel et al. 2004; Vasvari 2008).

However, Stulz (1984) and Smith and Stulz (1985) argue that without convexity in their compensation package risk-averse managers with high levels of ownership will seek to diversify risk, consistent with the interests of bondholders. Furthermore, there is evidence demonstrating the trade-off between *delta* and *vega* impacts the cost of debt. Devos, Prevost, and Rao (2009) find offsetting effects of *vega* and *delta* on bond yields. Billett et al. (2010) document opposite bond market reactions to changes in *vega* and *delta* of managerial compensation. Brockman et al. (2010) report different impacts of *delta* and *vega* on maturity structure of corporate debt.

In respect of credit ratings, prior studies document the information content of credit ratings. For instance, evidence suggests that rating assessments efficiently predict the yield to maturity beyond the publicly available information that would predict spreads (see, e.g., Ederington et al. 1987; Kliger and Sarig 2000; Odders-White and Ready 2006). Prior studies also show that credit rating downgrades are accompanied by significantly negative reactions from the bond market as well as the stock market (Hand et al. 1992; Ederington and Goh 1998), whereas firms receive benefits from maintaining a particular rating level. Consistent with anecdotal evidence (Graham and Harvey 2001), prior research shows that the benefits of upgrades and costs of downgrades directly influence firms' financing decisions (Kisgen 2006, 2007). For instance, firms with larger credit rating concerns will issue less debt relative to their peers with less credit rating concerns. Further evidence shows the stability of ratings, suggesting that rating agencies focus on firms' default risk over long investment horizons (Altman and Rijken 2004).

Notwithstanding the above research, credit ratings are a less explored area in the accounting literature (Frost 2007). Studies investigate the sophistication of rating agencies in incorporating complex accounting information (such as disclosures of employee stock options) in risk assessments (Lee 2008), the effects of corporate governance quality on credit rating evaluation (Ashbaugh-Skaife et al. 2006; Bradley and Chen 2011), and the interaction between securities analysts and credit risk analysts in monitoring and supervision (Cheng and Subramanyam 2008). The evidence suggests that credit risk analysts include value-relevant accounting information in risk assessments, that weak corporate governance impairs firms' creditworthiness, leading to lower rating results, and that the rating agencies play an important role in monitoring and deterring managerial misbehavior. Our study falls into the theme of research that examines the value of credit ratings, the sophistication of credit raters in incorporating complex information into their assessments, and the effect credit ratings have on engineering top management's compensation contracts.

Shaw (2012) examines the impact of managerial equity compensation on the cost of debt, where credit ratings on individual new bond issues are employed as a proxy for the

cost of debt. Our study differs in three aspects. First, the purpose of our study is to analyze the extent to which rating agencies incorporate CEO risk-taking incentives into the assessments of creditworthiness. Second, the current study focuses on corporate overall creditworthiness. Third, we investigate the effect of rating concerns on the design of CEO compensation. The combined empirical results provide new insights on the risk evaluation process of rating agencies.

Hypothesis development

Rewarding managers with a convex payoff structure and aligning their wealth portfolios with shareholders' potentially increases top management's preference to undertake risky investments and motivates them to transfer bondholders' wealth to shareholders⁵ (e.g., Jensen and Meckling 1976; John and John 1993; Ortiz-Molina 2007). Because risky investment policies increase the probability of business failure and financial default, such policies have an adverse impact on firms' repayment capability and thus jeopardize bondholders' interests. Furthermore, managerial incentives to expropriate bondholders' wealth for the benefits of shareholders are anticipated by rational bondholders and thus generate higher borrowing costs (e.g., Begley and Feltham 1999; Vasvari 2008).

Theoretical studies model the existence of credit rating agencies based on information asymmetries and show the role of rating agencies in "information gathering and screening" and certifying the creditworthiness of firms (Millon and Thakor 1985; Boot, Milbourn, and Schmeits 2006). Empirical studies provide consistent evidence on the efficiency of rating agencies in processing information and assessing firm risk (Ederington et al. 1987; Elton, Gruber, Agrawal, and Mann 2001). Evidence suggests that credit ratings exhibit significant power in incorporating complex information, such as capital structure, corporate governance features, and so forth, into risk assessments (Blume et al. 1998; Amato and Furfine 2004; Kishen 2006, 2007; Ashbaugh-Skaife et al. 2006; Lee 2008; Cheng and Subramanyam 2008). We therefore expect that to the extent that credit ratings are primary indicators of a firm's creditworthiness and executive compensation steers a manager's risk appetite, greater managerial compensation incentives for risk taking are associated with higher default risk and in turn with worse credit ratings. Based upon the above discussion, our first hypothesis is stated as follows:

HYPOTHESIS 1. Credit rating agencies incorporate managerial risk-taking incentives derived from compensation into their risk evaluation and larger managerial incentives for risk taking are associated with higher default risk assessed by rating agencies.

Rating agencies normally make the results of their analysis widely available to investors, portfolio managers, regulators, and investment parties. Credit ratings have a significant impact in the marketplace. For instance, large financial institutions are prohibited from owning corporate bonds with low credit ratings, that is, below BBB-. Private contracts such as long-term contracts with suppliers or customers, bond covenants, and other financial agreements usually result in the firm being obligated to maintain a particular credit rating (Cantor 2001; Moody's 2003; Kishen 2007). Furthermore, rating agencies are considered to possess not only public information but also private information to evaluate the credit quality of the firm. A credit rating can therefore act as a signal of a firm's overall quality (Kishen 2007) and rating downgrades can have an adverse impact on firms' financial positions and operations (Hand et al.

5. Studies suggest that when managerial interests are better aligned with those of shareholders, managers have greater incentives to shift risk from shareholders to debtholders by, for example, increasing dividend payouts before default, and thus debtholders perceive their investments in the firm as facing higher risk (Mehran 1992; Berger et al. 1997). However, excessive interest alignment and managerial overexposure to risk may reduce managers' incentives to take risk (Brick, Palmon, and Wald 2012).

1992; Ederington and Goh 1998; Graham and Harvey 2001).⁶ In addition, prior studies show that concerns regarding credit ratings directly influence firms' reporting and financing decisions (Kisgen 2006, 2007; Ali and Zhang 2008). For instance, in order to favorably influence their rating records, firms may cut back dividend payouts, reduce R&D spending, aggressively manage earnings, and/or decrease the proportion of debt in their capital structure.

Executive compensation has been acknowledged by rating agencies as an important factor they use in ascertaining credit risk. Credit raters state that the structure and focus of incentives from managerial compensation are analyzed and incorporated into their risk assessments. Pay packages highly sensitive to firm performance are deemed to induce greater managerial risk-taking behavior not necessarily consistent with bondholders' interest (Standard & Poor's 2002b; Moody's Investor Service, 2005). These claims are supported by the evidence that top management's risk-taking incentives are positively associated with higher bond spreads and more restrictive covenants in loan contracts (Daniel et al. 2004; Vasvari 2008). Adjusting managerial compensation incentives may efficiently steer managerial preferences away from risky investments (Guay 1999; Rajgopal and Shevlin 2002; Coles et al. 2006; Kabir et al. 2013) and in turn decrease firms' default risk as desired by creditors. Therefore adjusting the design of executive compensation policy and reducing managerial risk-taking incentives is expected to have a positive influence on rating agencies' risk evaluations and help to alleviate firms' rating concerns. The above argument leads to the following hypothesis:

HYPOTHESIS 2. Firms' rating concerns influence the design of managerial compensation and rating-troubled firms will decrease managerial risk-taking incentives by adjusting executive compensation.

3. Research design

Variable description

Dependent variable: Credit ratings

We follow prior literature (e.g., Francis, LaFond, Olsson, and Schipper 2005; Ashbaugh-Skaife et al. 2006; Cheng and Subramanyam 2008) and focus on Standard & Poor's Long-Term Domestic Issuer Credit Rating (COMPUSTAT Item #280). As explained by Standard & Poor's, a rating represents the rating agency's current opinion on an issuer's overall capacity to meet its financial obligations (Standard & Poor's 2002a). We assign Standard & Poor's ratings a value from 1 to 20, where higher rating codes correspond to higher default risk, following Francis et al. 2005 and Cheng and Subramanyam 2008.⁷

Independent variable: Managerial risk-taking incentives

Incentivized by the degree of convexity in their payoff portfolios, managers may find it beneficial to undertake more risky investments and financing policies and increase firm risk. Prior literature shows that the convexity of managerial payoff increases with their stock option holdings and managers are incentivized by their stock option compensation to increase the volatility of firm performance (Guay 1999). We therefore measure managerial risk-taking incentives first by option *vega*, which captures the sensitivity of the value

-
6. Hand et al. (1992) find both security market and bond market react negatively upon the announcements of downgrades of straight debt. Ederington and Goh (1998) show that credit rating downgrades result in significantly negative equity returns and that equity analysts tend to revise earnings forecasts "sharply downward" following the downgrades. Furthermore, they show that the market response is a result of the "downgrade itself — not to earlier negative information or contemporaneous earnings numbers."
 7. Our recoding method distinguishes rating notches, such as BBB+, BBB, and BBB-. Our results are robust to combining ratings of the letter grade and using fewer rating classes.

of managerial option holdings to the volatility of a firm's stock returns. Another incentive for managers to take risk stems from the degree of interest alignment between executives and shareholders, that is, pay-performance sensitivity. Shareholders may design managerial compensation in a way to motivate managers to promote shareholder value, even at the expense of debtholders (Berger et al. 1997; Ortiz-Molina 2007; Vasvari 2008). We measure a manager's risk-taking incentives on behalf of shareholders by equity *delta*, which gives the sensitivity of managerial wealth (including stock and stock option holdings) to stock price.⁸ We estimate *vega* and *delta* following Core and Guay 2002. Further details are presented in Appendix 1.

Empirical models

Our first hypothesis posits that rating agencies incorporate managerial risk-taking incentives in their assessments of credit risk. Accordingly, we fit the following regression model:

$$RATING_{i,t} = \alpha_0 + \alpha_1 INC_{i,t} + \gamma CONTROLI_{i,t} + \varepsilon_{i,t} \quad (1),$$

where, suppressing subscripts, *RATING* proxies for the credit risk assessment of firm *i* in year *t*, and *INC* proxies for the managerial risk-taking incentives of firm *i* in year *t* (either *LNVEGA*, *LNDELTA*, $\Delta LNVEGA$, $\Delta LNDELTA$, *RESLNVEGA* or *RESLNDELTA*). *CONTROLI* is a vector of control variables and ε is an error term. Standard errors cluster simultaneously on the firm and year dimensions. Appendix 2 summarizes the variable definitions.

We employ three sets of variant derived from *vega* and *delta* to measure managerial risk-taking incentives. First, we take the natural logarithms of *vega* and *delta*, respectively (i.e., *LNVEGA* and *LNDELTA*), as the base-line measures of risk-taking incentives. In the prior literature, *vega* and *delta* exhibit significant impacts on investment strategy and financing policy, and in turn affect credit risk (e.g., Guay 1999; Rajgopal and Shevlin 2002; Coles et al. 2006). Given that rating evaluations already incorporate the influence of a firm's financial policies on credit risk, we need to measure the additional power of *vega* and *delta* beyond current investment and financing policies in explaining the variation of credit ratings. We take the first-order differences of *LNVEGA* and *LNDELTA* (i.e., $\Delta LNVEGA$ and $\Delta LNDELTA$), assuming that firms are expected to maintain the same levels of *vega* and *delta* in the current year as in the previous year so as to implement the existing investment strategy and financing policy. Then the current *vega* and *delta* exceeding (or falling short of) the prior year's levels give additional information beyond the existing financial policies on the firm's default risk. Furthermore, in the spirit of Core and Guay 1999, Guay 1999, and Coles et al. 2006, we construct regressions based on the current financial policy proxies to predict the levels of *vega* and *delta* that are required to implement the existing investment strategy and financing policy.⁹ Then the residuals from the predictive regressions (i.e.,

8. Given the well-demonstrated effects of option compensation in motivating managerial risk taking (Core and Guay 1999; Coles et al. 2006), we focus on new option grants in examining the second hypothesis.

9. The determinants in the predictive regression of *vega* include sales of the current year, standard deviation of stock returns over prior 60 months for the firm by the end of the year, book-to-market ratio measured as book value of equity divided by market value of equity for the firm at the end of the year, cash compensation as the sum of salary plus cash bonus paid during the year, book leverage, R&D expenditure scaled by assets, and net capital expenditure to assets. To predict the level of *delta*, we include sales of the current year, standard deviation of stock returns over prior 60 months for the firm by the end of the year, book-to-market ratio measured as book value of equity divided by market value of equity for the firm at the end of the year, surplus cash measured as cash from assets-in-place to total assets (Coles et al. 2006), CEO tenure, book leverage, R&D expenditure scaled by assets, and net capital expenditure to assets. Furthermore, industry and year dummies are included to control for industry- and year-level fixed effects.

RESLNVEGA and *RESLNDELTA*) capture the “forward” part in the current *vega* (*delta*) which is not echoed by the current financial policies.¹⁰ In the hypothesis, we expect rating agencies to incorporate managerial risk-taking incentives into their rating assessments. Because higher rating codes (*RATING*) correspond to higher default risk, α_1 is expected to be positive.¹¹

The choice of control variables is based on prior literature on the determinants of bond ratings (e.g., Ashbaugh-Skaife et al. 2006; Cheng and Subramanyam 2008). Higher return-on-assets (*ROA*), higher interest coverage (*COVER*), or a lower leverage ratio (*LEV*) often represent lower default risk. We therefore expect a negative relationship between *RATING* and *ROA* as well as *COVER*, and a positive relationship between *RATING* and *LEV*. Larger firms (*MV*) and firms in the financial industry (*FIN*) tend to face lower risk, and thus we expect a negative relationship between *RATING* and *MV* as well as between *RATING* and *FIN*. Firms experiencing a loss (*LOSS*) have greater likelihood of default, leading to a predicted positive association between *RATING* and *LOSS*. We also control for earnings quality using the transparency measure (*TRANS*) proposed by Gu 2007 and the absolute value of abnormal accruals (*ABSACC*); following prior literature, we expect a negative relation between *RATING* and *TRANS*, but a positive association between *RATING* and *ABSACC*. Several market-based measures of financial risk are also included, such as stock returns (*RET*), volatility of net income (*SDNI*), beta (*BETA*), volatility of monthly returns (*SDRET*), and book-to-market ratio (*BTM*). We expect a positive association between *RATING* and *SDNI*, *BETA*, and *SDRET*. We make no predictions regarding the association between *RATING* and *RET* or between *RATING* and *BTM*, because prior literature shows that these measures of financial risk may also capture increased growth opportunities, which indicates decreased default risk (Bhojraj and Sengupta 2003). Similarly, we make no prediction on the association between *RATING* and investment in intangible assets (*INTAN*), as higher investment in intangible assets may increase the risk of default or positively influence the firm’s future profitability. Finally, no predictions are made on new equity capital raised during the year (ΔEQ),¹² as equity financing can mitigate agency problems between shareholders and debtholders and thus work to decrease credit risk, but it can also indicate difficulty in raising debt capital, which would exhibit different implications for credit risk.

In the second hypothesis, we expect that firms with rating concerns will reduce managerial risk-taking incentives in compensation design. Given the significance of stock option compensation in inducing managers to choose risky investment projects (Jensen

-
10. Literature shows that current risk-taking incentives may motivate change of investment policies in future periods (Rajgopal and Shevlin 2002). Furthermore, firms may design compensation in such a way to attract and retain certain types of managers. A compensation contract with high levels of *vega* and/or *delta* may fit the profile of the top managers whose actions are expected to bring the best interest to the shareholders.
 11. Due to the high multicollinearity between *LNVEGA* and *LNDELTA* (with a correlation of 0.75), *LNVEGA* and *LNDELTA* are not simultaneously included in the model, neither are $\Delta LNVEGA$ and $\Delta LNDELTA$ (with a correlation of 0.70) for the same reason. However, Coles et al. (2006) demonstrate the importance of investigating the incentive effects of *vega* after controlling for *delta* incentive and vice versa. In response, we include both *RESLNVEGA* and *RESLNDELTA* in (1) and we regress *RATING* on both *LNVEGA* and *LNDELTA* in simultaneous equations estimation as shown in Section 5. We find that the relationship between managerial compensation incentives and credit ratings stays robust after we control for the other dimension of managerial risk-taking incentives.
 12. We use cash flows from new equity issues to indicate whether the firm has raised equity capital during the year. The employment of this measure is based on prior literature (see Cheng and Subramanyam 2008). The correlation between ΔEQ and *LNDELTA* (*LNVEGA*) and their variant is below 0.10 (with *p*-value < 0.01), which suggests that it is less likely that the potential mechanic association between equity capital change and executive equity compensation may bias the estimates.

and Murphy 1990; Core and Guay 1999, 2002; Coles et al. 2006), our analysis focuses on whether rating-troubled firms will adjust option grants so as to reduce top management's incentives to take risk.¹³ We employ the following model:

$$NEWOPTINC_{i,t} = \beta_0 + \beta_1 RCON_{i,t} + \varphi CONTROL2_{i,t} + \varepsilon_{i,t} \quad (2),$$

where, suppressing subscripts, *NEWOPTINC* proxies for managerial incentives from newly granted stock options (either *LNNEWVEGA* or *LNNEWDELTA*), *RCON* proxies for one of our measures of credit rating concerns (either *DOWN* or *DOWNBBB-*), *CONTROL2* is a vector of control variables, and ε is an error term. Standard errors cluster simultaneously on the firm and year dimensions. Appendix 2 summarizes the variable definitions.

The dependent variable is left-censored and thus OLS will lead to biased and inconsistent estimates. We therefore fit a tobit model in order to account for the censoring at zero incentive grants. Furthermore, firms may simultaneously decide whether to grant options and the magnitude of the option grant conditional on making a grant. In effect, we follow Core and Guay 1999 and use tobit models to jointly estimate the probability of a grant and the size of a grant for the grant and nongrant observations.

We employ two measures to capture firms' credit rating concerns. Our first measure is *DOWN*, which is coded one if the firm experienced a rating downgrade in the prior year and zero otherwise. We expect that firms are more concerned about their credit ratings if they have recently experienced a rating downgrade, and that such concerns will trigger changes in corporate governance devices, such as risk-taking incentives from option grants. Our second measure of rating concerns is *DOWNBBB-*, which indicates whether the firm's ratings have been downgraded to the lower edge of the investment category (i.e., *BBB-*). This measure is based on Kisgen 2006, who argues that firms having been downgraded to the lower edge of the investment category will be most concerned about their ratings. Following this argument, we expect firms' concerns to rise when their ratings have been downgraded to the lower edge of the investment category. Note that the two measures of rating concerns are nested such that they reflect increasing concerns. Given the significance of credit ratings on firms' financial positions and operations, we expect that firms with substantial rating concerns will reduce managerial incentives for risk taking with the view of restoring or at least maintaining their rating scores. We therefore expect a negative association between *NEWOPTINC* and *RCON*, that is, a negative β_1 .

The choice of control variables is drawn on Guay 1999 and Core and Guay 1999. We first control for the possibility that firms may grant options to adjust portfolio incentives to the level required to implement previous year's financial policies. Following prior literature, we estimate the levels of *vega* and *delta* using previous year's investment strategy and financing policy as determinant variables¹⁴ and the residuals from the regressions give the deviation of the actual incentive from the predicted level of the incentive in year $t - 1$ (i.e., *RESLNVEGA* _{$t-1$} and *RESLNDELTA* _{$t-1$}). The predicted level for last period would be the norm for a firm with those characteristics, and that departures from that predicted level would motivate a response by the firm to adjust the incentives with new grants. We expect that when managerial incentive is above (below) the predicted level in year $t - 1$, a smaller (larger) incentive grant will be made in year t . In the regression with *vega* in new option grants as the dependent variable, we include *R&D* and *CAPEX* to control for the impact of investment policies

13. Following prior literature (e.g., Core and Guay 1999), we predict that new option grants represent the primary way to adjust managerial option holdings and in addition may alleviate rating concerns of a firm.

14. The required levels of *vega* and *delta* in year $t - 1$ are estimated based on a vector of determinants measured in year $t - 1$. Refer to footnote 10 for the definitions of these determinants. Following Core and Guay 1999, we estimate *RESLNVEGA* _{$t-1$} and *RESLNDELTA* _{$t-1$} on the basis of individual annual regressions.

on option grants; in the model with *delta* in new option grants as the dependent variable, *BTM* captures firms' investment and growth opportunities, and *COVER* controls for firms' cash flow situation. In both models, the financial risk measures *BETA* and *RET* are included. *EMPL* proxies for firm size. Further, following Core and Guay 1999, we control for the impact of CEO risk aversion by adding *TENURE* into both models.

Prior literature and anecdotal evidence suggest the presence of firm and time effects on credit ratings. In the spirit of Cameron, Gelbach, and Miller 2011 and Thompson 2011, we address firm and time effects by estimating the models with standard errors clustering on firm and year dimensions simultaneously. In contrast to conventional fixed effect models, our approach does not assume constant firm or year effect. The assumption of constant firm or time effect may not fully remove the dependence between observations and therefore will produce biased standard errors if the firm or time effect is indeed not fixed (Petersen 2009; Gow, Ormazabal, and Taylor 2010). Because our approach does not assume constant effects, the results are not subject to the related estimation bias.

Sample distribution and summary statistics

Our sample consists of all firm-year observations from 1992 to 2006 with available data for the analyses. The data are retrieved from several sources. We obtain accounting data from COMPUSTAT Industrial Annual. Market return data are acquired from CRSP. Data on CEO compensation come from Execucomp. All continuous variables are winsorized at the 1 percent and 99 percent levels to mitigate the influence of extreme values on the analyses. The final sample consists of 8,189 firm-year observations from 1992 until 2006. Firms incorporated in our sample all have rating records issued by Standard & Poor's. Compared with COMPUSTAT full sample, they are larger in size as measured by total assets (*t*-statistics = 42.12, with *p*-value < 0.01), with higher book value of equity (*t*-statistics = 76.55, with *p*-value < 0.01), and use more long-term debt to assets (*t*-statistics = 37.80, with *p*-value < 0). But no significant differences have been identified in book-to-market ratio and profitability as measured by *ROA* between our sample firms and COMPUSTAT universe companies.

Table 1 reports the distribution of recoded ratings, including both number of observations and relative percentage. The distribution is qualitatively similar to that in prior studies (e.g., Ashbaugh-Skaife et al. 2006; Cheng and Subramanyam 2008): the broad BBB category has the largest weight in the sample (i.e., 33.8 percent of the sample firm-years). Investment grade ratings (i.e., BBB–and above) account for 74.1 percent of all the observations.

Table 2 presents summary statistics. In Panel A we find that the distribution of *RATING* is comparable to prior findings (e.g., Cheng and Subramanyam 2008), with a mean (median) *RATING* of 8.49 (8.00), which approximately corresponds to an average credit rating of BBB or BBB+ at the median. Turning to *LNVEGA* and *LNDELTA*, natural logarithms address the skewness of our incentive variables in the sense that the means of *LNVEGA* and *LNDELTA* do not significantly differ from their medians. Regarding the incidence of rating downgrades, *DOWN* occurs in 13 percent of cases and *DOWNBBB–* occurs in 1 percent of cases in the sample. Consistent with evidence documented in prior literature (e.g., Lee 2008), rating downgrades are not commonly observed in our sample. Stable rating scores imply that there might be a substantial impact of rating downgrades on issuers and related parties. Stable ratings also imply that it might be difficult for issuers to predict a rating downgrade ex ante,¹⁵ but once

15. Before raters downgrade an issuer's ratings, there might be a negotiation process, during which the issuer could adjust strategies ex ante so as to avoid a rating downgrade. However, such negotiation is not guaranteed and we can hardly empirically ascertain whether a negotiation process or the resulting strategy adjustment exists.

TABLE 1
Coding credit ratings and sample frequency

S&P debt rating	COMPUSTAT Item #280 code(s)	Credit rating score (<i>RATING</i>)	Full sample frequency	Full sample percentage
AAA	2	1	147	1.8
AA+	4	2	48	0.6
AA	5	3	234	2.9
AA–	6	4	272	3.3
A+	7	5	639	7.8
A	8	6	1,166	14.2
A–	9	7	794	9.7
BBB+	10	8	908	11.1
BBB	11	9	1,103	13.5
BBB–	12	10	750	9.2
BB+	13	11	523	6.4
BB	14	12	566	6.9
BB–	15	13	436	5.3
B+	16	14	357	4.4
B	17	15	147	1.8
B–	18	16	68	0.8
CCC+	19	17	17	0.2
CCC or CC	20, 23	18	6	0.1
C	21, 24	19	2	<0.0
D or SD	27, 29, 90	20	6	0.1
Total			8,189	100.0

it happens, the issuers would try hard to turn the downgrade around or at least prevent further rating deterioration. The descriptive statistics for the control variables are also comparable to those reported in prior studies (e.g., Ashbaugh-Skaife et al. 2006; Cheng and Subramanyam 2008).

Panel B of Table 2 presents the time-series evolution of *RATING*, *VEGA*, and *DELTA*. The magnitude of *vega* and *delta* is generally consistent with the evidence documented in the extant literature (Core and Guay 1999; Coles et al. 2006). In line with Brick et al. 2012, we observe an increase in CEO risk-taking incentives (both *vega* and *delta*) over time. *RATING* also increases over the study period, indicating a deterioration of credit ratings over time, as documented in prior research (e.g., Blume et al. 1998). In particular, we find that rating agencies appear to tighten up their evaluation criteria and provide less optimistic assessments after the Enron-era accounting scandals.

4. Discussion of empirical results

CEOs' risk-taking incentives and realized rating category default rates

Prior literature argues that introducing a convex payoff structure, such as stock options, into managerial compensation can offset the concavity in risk-averse managers' utility function, increasing their preference for risky projects (e.g., Rajgopal and Shevlin 2002; Coles et al. 2006). However, some evidence suggests that the validity of this argument may be a function of factors such as the shape of managers' utility function (e.g., Carpenter 2000; Ju et al. 2002; Lewellen 2006). In this section we investigate the association between realized rating category default rates and our measures of risk-taking incentives (*LNVEGA*, *LNDELTA* and the variant). Firms' historical default rate records are

TABLE 2
Descriptive statistics

Panel A: Descriptive statistics

Variable	Mean	Std dev	25th percentile	50th percentile	75th percentile
<i>RATING</i>	8.49	3.22	6.00	8.00	11.00
<i>DRATE</i>	0.62%	1.57%	0	0	0.54%
<i>VEGA</i>	192.73	280.61	36.67	90.89	219.39
<i>DELTA</i>	762.21	1,708.01	103.48	252.52	655.39
<i>LNVEGA</i>	4.48	1.30	3.60	4.51	5.39
<i>LNDELTA</i>	5.56	1.44	4.64	5.53	6.49
Δ <i>LNVEGA</i>	0.08	1.10	-0.15	0.18	0.52
Δ <i>LNDELTA</i>	0.05	1.06	-0.17	0.20	0.50
<i>RESLNVEGA</i>	0.00	1.01	-0.64	0.03	0.69
<i>RESLNDELTA</i>	0.00	1.10	-0.71	-0.06	0.60
<i>LNNEWVEGA</i>	3.10	1.32	2.21	3.14	4.03
<i>LNNEWDELTA</i>	3.15	1.34	2.27	3.18	4.07
<i>DOWN</i>	0.13	0.33	0	0	0
<i>DOWNBBB-</i>	0.01	0.12	0	0	0
<i>ROA</i>	0.04	0.06	0.01	0.04	0.07
<i>LEV</i>	0.29	0.16	0.18	0.28	0.38
<i>SDNI</i>	0.03	0.04	0.01	0.02	0.03
Δ <i>EQ</i>	0.47	0.50	0	0	1
<i>INTAN</i>	0.01	0.04	0	0	0
<i>COVER</i>	10.70	18.28	3.00	5.96	11.22
<i>BTM</i>	0.48	0.33	0.27	0.43	0.63
<i>MV</i>	8.09	1.54	7.07	8.04	9.11
<i>SDRET</i>	0.36	0.16	0.25	0.32	0.42
<i>LOSS</i>	0.12	0.32	0	0	0
<i>FIN</i>	0.25	0.43	0	0	0
<i>RET</i>	0.06	0.40	-0.19	0.03	0.26
<i>BETA</i>	0.97	0.52	0.61	0.92	1.27
<i>ABSACC</i>	0.04	0.08	0.00	0.02	0.05
<i>TRANS</i>	-0.12	0.55	-0.62	-0.09	-0.02
<i>TENURE</i>	1.26	1.02	0	1.39	2.08
<i>EMPL</i>	2.45	1.47	1.54	2.48	3.47
<i>R&D</i>	0.02	0.03	0	0	0.02
<i>CAPEX</i>	0.05	0.06	0.01	0.04	0.07

Panel B: *RATING*, *VEGA*, and *DELTA* over years

Year	<i>RATING</i>		<i>VEGA</i> (\$ 000s)		<i>DELTA</i> (\$ 000s)	
	Mean	Median	Mean	Median	Mean	Median
1992	7.23	7.00	56.28	35.64	243.51	91.59
1993	7.66	7.00	61.58	42.15	248.26	121.35
1994	8.01	8.00	65.44	37.33	266.15	120.96
1995	8.03	8.00	81.61	45.55	422.60	147.35
1996	8.18	8.00	85.29	45.36	532.60	186.87
1997	8.24	8.00	117.39	55.15	674.11	237.59

(The table is continued on the next page.)

TABLE 2 (Continued)

Panel B: *RATING*, *VEGA*, and *DELTA* over years

Year	<i>RATING</i>		<i>VEGA</i> (\$ 000s)		<i>DELTA</i> (\$ 000s)	
	Mean	Median	Mean	Median	Mean	Median
1998	8.27	8.00	157.53	86.86	838.86	235.60
1999	8.26	8.00	168.77	89.80	882.56	242.72
2000	8.77	9.00	224.49	98.11	1,031.68	278.58
2001	8.76	9.00	271.51	143.80	909.19	319.91
2002	8.91	9.00	274.78	154.60	660.25	265.34
2003	9.01	9.00	282.51	162.20	908.70	354.05
2004	9.05	9.00	304.24	183.88	1,056.52	474.35
2005	8.91	9.00	311.75	182.89	1,185.33	558.64
2006	9.01	10.00	241.20	139.01	1,224.76	518.90

Note:

Appendix 2 provides variable definitions.

retrieved from Standard & Poor's (2009).¹⁶ Appendix 3 lists Standard & Poor's one-year corporate default rates by rating category during the 15-year period from 1992 to 2006. One can see from this appendix that realized rating category default rates can vary significantly from one year to the next, and that the observed rate for any given year can vary significantly from the average. The realized rating category default rates thus differ from the estimated default rate embedded in different rating categories. Panel A of Table 2 presents the descriptive statistics of the realized rating category default rates, or *DRATE*. The mean is 0.62 percent while the median is 0, which suggests that realized default is not frequently observed and there is a high frequency of zero default rate in our sample.

We take *DRATE* into (1) as the dependent variable and estimate how it is associated with *vega* and *delta*. Because *DRATE* is left-truncated, we employ a tobit model. Standard errors cluster on both the firm and year dimensions. The empirical findings are presented in Table 3. Columns 1 and 4 report the results using *LNVEGA* and *LNDELTA* to measure managerial risk-taking incentives. In columns 2 and 5, Δ *LNVEGA* and Δ *LNDELTA* are employed to capture the incentives. When using *RESLNVEGA* and *RESLNDELTA* to measure the compensation incentives, the results are exhibited in columns 3, 6, and 7. In columns 1 and 4, the coefficients on both *LNVEGA* and *LNDELTA* are positive and significant (p -value < 0.01), suggesting that compensation policies that induce executives to undertake risky projects and implement aggressive financial policies are associated with rating categories with higher default rates. Δ *LNVEGA* (Δ *LNDELTA*) and *RESLNVEGA* (*RESLNDELTA*) capture the incremental explanatory power of the current *vega* and *delta* beyond the existing investment strategy and financing policy in explaining realized rating category default rates. The positive and significant (p -value < 0.01) coefficients on Δ *LNVEGA* (Δ *LNDELTA*) and *RESLNVEGA* (*RESLNDELTA*) suggest that our findings on the positive relationship between compensation incentives and default rates remain.

16. The realized rating category default rates are computed based on the default of all the firms rated by Standard & Poor's. It is likely that the firms included in our analysis do not fully represent the entire pool of rated firms. The purpose of the analysis is to provide empirical evidence on the assertion that managerial risk-taking incentives from compensation are positively associated with the actual default of the firm. An analysis based on firm-specific default information would yield additional insights.

TABLE 3
Tobit estimation of the relationship between CEO risk-taking incentives and realized rating category default rates

Dependent variable is default rate of each bond's rating category								
Variable	Predicted sign	Column (1) <i>D RATE</i>	Column (2) <i>D RATE</i>	Column (3) <i>D RATE</i>	Column (4) <i>D RATE</i>	Column (5) <i>D RATE</i>	Column (6) <i>D RATE</i>	Column (7) <i>D RATE</i>
<i>LNVEGA</i>	H1: +	0.097*** (4.28)						
Δ <i>LNVEGA</i>	H1: +		0.072*** (2.91)					
<i>RESLNVEGA</i>	H1: +			0.172*** (6.11)				0.096*** (3.08)
<i>LNDELTA</i>	H1: +				0.091*** (4.31)			
Δ <i>LNDELTA</i>	H1: +					0.048** (2.05)		
<i>RESLNDELTA</i>	H1: +						0.195*** (8.64)	0.154*** (6.18)
<i>ROA</i>		-3.387*** (-3.17)	-3.418*** (-5.82)	-4.351*** (-3.24)	-3.482*** (-3.21)	-3.427*** (-5.83)	-4.288*** (-3.10)	-4.352*** (-3.23)
<i>LEV</i>		1.909*** (5.37)	1.952*** (11.27)	2.038*** (4.80)	1.933*** (5.51)	1.962*** (11.34)	1.927*** (4.68)	1.918*** (4.65)
<i>SDNI</i>		4.976*** (3.12)	4.884*** (6.86)	5.443*** (2.88)	5.088*** (3.15)	4.839*** (6.80)	5.677*** (3.01)	5.705*** (3.03)
Δ <i>EQ</i>		0.033 (0.38)	0.032 (0.64)	0.067*** (4.61)	0.026 (0.30)	0.029 (0.58)	0.041*** (3.06)	0.047*** (3.54)
<i>INTAN</i>		-0.025 (-0.02)	0.107 (0.14)	0.894 (0.75)	0.027 (0.03)	0.099 (0.13)	0.692 (0.59)	0.704 (0.59)
<i>COVER</i>		-0.005*** (-5.90)	-0.005*** (-2.34)	-0.005*** (-4.24)	-0.005*** (-6.31)	-0.005*** (-2.32)	-0.005*** (-5.11)	-0.005*** (-5.32)
<i>BTM</i>		-0.150* (-1.81)	-0.149* (-1.93)	-0.160* (-1.80)	-0.101 (-1.27)	-0.149* (-1.89)	-0.197** (-2.23)	-0.209** (-2.35)

(The table is continued on the next page.)

TABLE 3 (Continued)

Variable	Predicted sign	Dependent variable is default rate of each bond's rating category						
		Column (1) <i>DRA</i> <i>T</i> <i>E</i>	Column (2) <i>DRA</i> <i>T</i> <i>E</i>	Column (3) <i>DRA</i> <i>T</i> <i>E</i>	Column (4) <i>DRA</i> <i>T</i> <i>E</i>	Column (5) <i>DRA</i> <i>T</i> <i>E</i>	Column (6) <i>DRA</i> <i>T</i> <i>E</i>	Column (7) <i>DRA</i> <i>T</i> <i>E</i>
<i>MV</i>		-0.357*** (-12.18)	-0.311*** (-15.73)	-0.344*** (-12.61)	-0.348*** (-12.46)	-0.308*** (-15.63)	-0.351*** (-13.09)	-0.360*** (-13.13)
<i>SDRET</i>		7.596*** (24.89)	7.642*** (37.97)	8.002*** (21.24)	7.533*** (24.29)	7.640*** (37.96)	7.965*** (20.76)	7.967*** (20.93)
<i>LOSS</i>		0.223*** (5.68)	0.226** (2.30)	0.210 (1.31)	0.236*** (6.01)	0.227** (2.30)	0.252*** (5.67)	0.239*** (5.66)
<i>FIN</i>		-1.081*** (-3.10)	-1.131*** (-4.47)	-0.885* (-1.87)	-1.115*** (-3.42)	-1.125*** (-4.45)	-0.964** (-2.17)	-0.936** (-2.08)
<i>BETA</i>		0.596*** (4.98)	0.589*** (11.77)	0.599*** (4.72)	0.602*** (4.96)	0.591*** (11.81)	0.620*** (4.82)	0.614*** (11.60)
<i>ABSACC</i>		-0.230 (-0.36)	-0.280 (-0.98)	-0.474 (-0.67)	-0.255 (-0.39)	-0.287 (-1.01)	-0.571 (-0.81)	-0.527 (-0.76)
<i>TRANS</i>		-0.005*** (-2.65)	-0.005* (-1.85)	-0.005*** (-4.37)	-0.005*** (-2.66)	-0.005* (-1.83)	-0.005*** (-4.44)	-0.005*** (-4.38)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations		8,138	5,208	8,138	8,138	5,208	8,138	8,138
Pseudo <i>R</i> ²		0.19	0.20	0.19	0.19	0.20	0.19	0.19

Notes:

The *t*-statistics shown in parentheses are based on standard errors clustered at both firm and year levels (see Petersen 2009 and Gow et al. 2010 for a description). ***, **, * indicate significance at 0.01, 0.05, and 0.10 levels (two-tailed), respectively. Appendix 2 provides variable definitions.

The coefficients on the control variables are consistent with the findings reported in prior research. Financial risk measures such as *SDNI*, *SDRET*, and *BETA* are loaded with positive and significant coefficients (p -value < 0.01), suggesting the higher financial risks the higher realized rating category default rates. Firms with heavier debt burden face higher default rates. In contrast, firms with better performance, better interest coverage, larger size, and greater financial reporting transparency, as well as firms in the financial industry, are associated with lower default rates.

Impact of CEOs' risk-taking incentives on credit ratings

Table 4 presents the regression results for (1). Recall that in this model the dependent variable is *RATING*, which increases with the default risk of issuers as evaluated by credit risk analysts. F -statistics show that the model has statistically significant power in explaining the cross-sectional variation of *RATING*. The explanatory variable of interest in column 1 is *LNVEGA*, which measures the sensitivity of managerial wealth to stock return volatility. In column 4, the variable of interest is *LNDELTA*, which captures the sensitivity of managerial wealth to stock price. Both of them capture managerial appetite for risky investments. Furthermore, the variables of interest are Δ *LNVEGA* (Δ *LNDELTA*) in column 2 (5) and *RESLNVEGA* (*RESLNDELTA*) in column 3 (6). In column 7 both *RESLNVEGA* and *RESLNDELTA* are included to proxy managerial risk-taking incentives from compensation.¹⁷

The regression results suggest that CEO risk-taking incentives are positively related to rating agencies' evaluation of firms' default risk. In particular, in columns 1 and 4 we find that the coefficients on *LNVEGA* and *LNDELTA* are significantly positive (p -value < 0.10 and p -value < 0.01 , respectively). The results imply that managerial compensation incentives increase the issuer's credit risk in the eyes of the credit raters. Furthermore, we consider the potential influence of current compensation schemes on a firm's existing investment strategy and financing policy. Δ *LNVEGA* (Δ *LNDELTA*) and *RESLNVEGA* (*RESLNDELTA*) measure the additional power of *vega* (*delta*) beyond the existing financial policies in explaining the variation of credit ratings. In columns 2 and 5, the coefficients on Δ *LNVEGA* and Δ *LNDELTA* are significant and positive (p -value < 0.01). In columns 3, 6, and 7, *RESLNVEGA* and *RESLNDELTA* are loaded with significantly positive coefficients (p -value < 0.01). Therefore, the change in *vega* (*delta*) and the unexplained portion of *vega* (*delta*) beyond the concurrent investment and financing policies exhibit significant power in explaining rating agencies' risk evaluation outcomes. In summary, the findings support our first hypothesis that rating agencies evaluate firms' default risk in a forward-looking manner, assessing the impact of top management's compensation incentives on credit risk. In particular, the coefficient on *LNDELTA* is 0.227 in column 4 of Table 4, implying that assuming everything else equal if a firm upscales the *delta* in the CEO's equity holdings by one standard deviation, the firm's *RATING* score will increase by 1.7 (indicating increased default risk). Given *RATING* an intuitive measure of default risk, the amount of increase in *RATING* will in effect translate into a two-notch rating downgrade. Similarly, we gauge the economic significance of changes on *vega* on a firm's rating score and find that a one standard deviation increase in *vega* from the median leads to an approximately 0.8 increase in *RATING* score, in effect, nearly a one-notch rating downgrade. Turning to the control variables, the results are consistent with both our predictions and prior findings.

17. We also include the residual term of the equity incentive and its expected level simultaneously (i.e., *RESLNVEGA* and the estimated *LNVEGA*; *RESLNDELTA* and the estimated *LNDELTA*) into (1). The idea is that the estimated value (to some extent) releases the endogeneity part from the original level of *LNVEGA* (*LNDELTA*), leaving the residual term as an experimental shock that could affect the credit ratings. Untabulated results show that our prior findings on *RESLNVEGA* and *RESLNDELTA* stay robust.

TABLE 4
OLS estimation of the relationship between CEO risk-taking incentives and credit ratings
 $RATING_{i,t} = \alpha_0 + \alpha_1 INC_{i,t} + \gamma CONTROL_{i,t} + \epsilon_{i,t}$
(1)

Variable	Predicted sign	Dependent variable defined as				
		Column (1) RATING	Column (2) RATING	Column (3) RATING	Column (4) RATING	Column (5) RATING
Intercept		12.934*** (22.56)	12.985*** (23.60)	13.648*** (22.26)	12.578*** (22.61)	13.015*** (24.04)
<i>LNVEGA</i>	H1: +	0.147* (1.94)				13.987*** (22.41)
$\Delta LNVEGA$	H1: +		0.126*** (3.43)			
<i>RESLNVEGA</i>	H1: +			0.209*** (3.38)		0.062*** (10.30)
<i>LNDELTA</i>	H1: +				0.227*** (3.88)	
$\Delta LNDELTA$	H1: +					0.166*** (6.77)
<i>RESLNDELTA</i>	H1: +					0.332*** (5.50)
<i>ROA</i>		-2.139** (-2.09)	-2.178** (-2.09)	-1.919 (-1.61)	-2.385** (-2.33)	-1.905 (-1.61)
<i>LEV</i>		1.679*** (3.88)	1.734*** (4.01)	1.688*** (3.36)	1.676*** (3.90)	1.439*** (2.89)
<i>SDNI</i>		4.326*** (3.18)	4.204*** (3.06)	4.211*** (3.05)	4.788*** (3.54)	4.727*** (3.50)
ΔEQ		0.058 (0.73)	0.060 (0.73)	0.085 (1.02)	0.043 (0.54)	0.044 (0.55)

(The table is continued on the next page.)

TABLE 4 (Continued)

Variable	Predicted sign	Dependent variable defined as						
		Column (1) RATING	Column (2) RATING	Column (3) RATING	Column (4) RATING	Column (5) RATING	Column (6) RATING	Column (7) RATING
<i>INTAN</i>		-1.668 (-1.18)	-1.513 (-1.06)	-1.045 (-0.75)	-1.611 (-1.15)	-1.465 (-1.03)	-1.350 (-0.98)	-1.348 (-0.99)
<i>COVER</i>		-0.011*** (-3.02)	-0.011*** (-2.94)	-0.010*** (-2.58)	-0.011*** (-3.25)	-0.011*** (-2.90)	-0.011*** (-2.89)	-0.011*** (-2.88)
<i>BTM</i>		0.169 (0.88)	0.169 (0.88)	0.080 (0.40)	0.297 (1.58)	0.188 (1.00)	-0.011 (-0.06)	-0.015 (-0.08)
<i>MV</i>		-0.999*** (-13.94)	-0.931*** (-18.69)	-0.996*** (-17.75)	-1.029*** (-16.60)	-0.935*** (-19.10)	-1.020*** (-17.90)	-1.025*** (-17.80)
<i>SDRET</i>		7.847*** (13.50)	7.982*** (13.14)	7.737*** (12.04)	7.645*** (13.03)	7.988*** (13.17)	7.680*** (12.48)	7.653*** (12.59)
<i>LOSS</i>		0.199* (1.68)	0.200* (1.68)	0.052 (0.38)	0.221* (1.85)	0.205* (1.73)	0.097 (0.75)	0.094 (0.72)
<i>FIN</i>		-0.108 (-0.21)	-0.169 (-0.34)	0.259 (0.51)	-0.120 (-0.25)	-0.136 (-0.28)	0.145 (0.32)	0.160 (0.35)
<i>RET</i>		0.756*** (7.22)	0.724*** (7.10)	0.756*** (8.46)	0.708*** (7.28)	0.653*** (6.55)	0.690*** (8.35)	0.708*** (8.62)
<i>BETA</i>		0.086 (0.51)	0.093 (0.54)	-0.035 (-0.20)	0.057 (0.35)	0.084 (0.50)	-0.069 (-0.43)	-0.063 (-0.39)
<i>ABSACC</i>		0.108 (0.24)	0.033 (0.07)	0.028 (0.07)	0.085 (0.19)	0.003 (0.01)	-0.084 (-0.20)	-0.054 (-0.13)
<i>TRANS</i>		0.001 (0.32)	0.001 (0.23)	0.001 (0.33)	0.001 (0.39)	0.001 (0.29)	0.001 (0.39)	0.001 (0.43)

(The table is continued on the next page.)

TABLE 4 (Continued)

Variable	Predicted sign	Dependent variable defined as						
		Column (1) <i>RATING</i>	Column (2) <i>RATING</i>	Column (3) <i>RATING</i>	Column (4) <i>RATING</i>	Column (5) <i>RATING</i>	Column (6) <i>RATING</i>	Column (7) <i>RATING</i>
Industry dummies		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations		8,189	5,284	8,189	8,189	5,284	8,189	8,189
R^2		0.66	0.66	0.68	0.67	0.66	0.69	0.69
F -statistics		486.28***	486.01***	372.07***	486.33***	485.14***	375.18***	363.88***

Notes:

The t -statistics shown in parentheses are based on standard errors clustered at both firm and year levels.***, **, * indicate significance at 0.01, 0.05, and 0.10 levels (two-tailed), respectively. Appendix 2 provides variable definitions.

Effect of rating concerns on compensation policy

The second hypothesis focuses on the effect of firms' rating concerns on the design of managerial compensation. Table 5 shows the tobit regression results of (2). *LNNEWVEGA* is the dependent variable in columns 1 and 2 while *LNNEWDELTA* is the dependent variable in columns 3 and 4. The results suggest that credit ratings have a significant impact on firms' compensation policy in the sense that firms concerned about their credit ratings tend to adjust option grants so as to gear down CEOs' *vega* incentive. In column 1, the significantly negative coefficient on *DOWN* (p -value < 0.01) suggests that firms with a rating downgrade in the prior year reduce *vega* derived from stock option grants in the current year.¹⁸ Firms with larger rating concerns, that is, firms having experienced a rating downgrade to the lower edge of the investment grade status, also downscale *vega* incentive, as suggested by the significantly negative coefficient on *DOWNBBB-* (p -value < 0.01) in column 2. However, in the model specifications in which *LNNEWDELTA* is the dependent variable, the coefficients on both the rating-concern measures are statistically insignificant, suggesting that when confronted with rating concerns, firms would reduce the sensitivity of managerial wealth to the volatility of firm performance (*vega*) rather than loosen the interest alignment between shareholders and managers (*delta*). All in all, our findings provide evidence on the economic significance of credit ratings in managerial compensation practices. More specifically, firms with credit rating concerns will adjust the manager's equity incentives for risk taking to prevent rating deterioration, but in doing so they prefer adjusting manager's *vega* rather than *delta* incentive.

In respect of the economic significance of the results, we estimate the marginal effects of *DOWN* and *DOWNBBB-* on *LNNEWVEGA*, which are -0.180 and -0.513 , respectively. The results indicate that a firm will reduce *vega* incentive in new option grants by approximately 18 percent (i.e., 0.180×100 percent) when the firm has experienced a rating downgrade in the immediate prior year, compared to firms that did not experience a downgrade. A downgrade to the lower edge of the investment category (i.e., *BBB-*) in the previous year will lead to an approximately 51 percent reduction of *vega* in the current year's option grants. In addition, we observe that the absolute value of the coefficient on *DOWNBBB-* is larger than that on *DOWN*, implying that the greater are firms' concerns about their credit ratings, the more aggressively they will reduce managers' *vega* incentive.¹⁹

Turning to the control variables, consistent with prior literature (Core and Guay 1999), the significant and negative coefficients (p -value < 0.01) on *RESLNVEGA_{t-1}* and *RESLNDELTA_{t-1}* suggest that firms further from their expected level of *vega* and *delta* utilize option grants to adjust the level of managerial equity holdings back toward a more normal level.

5. Robustness analyses

Simultaneous equations estimation

As with other empirical studies that examine the relationship between credit ratings and firm characteristics, our study is possibly subject to endogeneity bias as ratings and managerial risk-taking incentives may be determined simultaneously by unobservable factors. Therefore OLS estimation can lead to biased results. Above we try to mitigate this problem by including control variables that can influence a firm's risk profile. However, there

18. When replacing *DOWN* with *DOWNEDGE-*, an indicator if a firm has been downgraded to the lower edge of a broad rating category (i.e., *AA-* of the broad *AA* rating category), the results are not significantly different.

19. The results of Hausman tests show that the coefficient on *DOWNBBB-* is significantly different from that on *DOWN* with chi-square being 9.94 and p -value < 0.01 .

TABLE 5
Tobit estimation of the relationship between credit rating concerns and new stock option grants
 $NEWOPTINC_{i,t} = \beta_0 + \beta_1 RCON_{i,t} + \varphi CONTROL_{i,t} + \varepsilon_{i,t}$ (2)

Variable	Predicted sign	Dependent variable defined as			
		Column (1) <i>LNNNEWVEGA</i>	Column (2) <i>LNNNEWVEGA</i>	Column (3) <i>LNNNEWDELTA</i>	Column (4) <i>LNNNEWDELTA</i>
<i>DOWN</i>	H2: −	−0.180*** (−3.01)		−0.037 (−0.56)	
<i>DOWNBBB−</i>	H2: −		−0.513*** (−4.19)		−0.111 (−0.79)
<i>RET</i>		0.064 (0.75)	0.058 (0.68)	0.206* (1.75)	0.204* (1.70)
<i>BETA</i>		−0.079 (−1.07)	−0.080 (−1.06)	0.221*** (3.03)	0.221*** (3.02)
<i>TENURE</i>		0.032 (1.37)	0.033 (1.38)	0.169*** (6.36)	0.169*** (6.37)
<i>EMPL</i>		0.101*** (3.80)	0.100*** (3.74)	0.289*** (10.63)	0.289*** (10.55)
<i>R&D</i>		−0.012 (−0.02)	−0.050 (−0.06)		
<i>CAPEX</i>		−0.444 (−1.22)	−0.383 (−1.03)		
<i>COVER</i>				0.004*** (2.82)	0.004*** (2.88)
<i>BTM</i>				−1.301*** (−7.77)	−1.302*** (−7.79)
<i>RESLNVEGA_{t−1}</i>		−0.444*** (−13.61)	−0.445*** (−13.60)		
<i>RESLNDELTA_{t−1}</i>				−0.237*** (−7.54)	−0.238*** (−7.55)
Industry dummies	Yes	Yes	Yes	Yes	Yes
Number of observations		5,550	5,550	5,756	5,756
Pseudo <i>R</i> ²		0.20	0.20	0.19	0.19

Notes:

The *t*-statistics shown in parentheses are based on standard errors clustered at both firm and year levels.***, **, * indicate significance at 0.01, 0.05, and 0.10 levels (two-tailed), respectively. Appendix 2 provides variable definitions.

has been a concern as regards the effectiveness of econometric remedies such as proxy variables, fixed effects, instrumental variables in providing reliable solutions to the simultaneity bias (Coles et al. 2012). In this section, we estimate a system where rating scores and managerial risk-taking incentives are assumed to be codetermined. In addition, prior literature shows that managerial compensation has a significant impact on a firm's investment strategy and financing policy. We follow the framework in Coles et al. 2006 and Brockman et al. 2010 and investigate the relationships among credit ratings, managerial compensation incentives, financing policy, and investment strategy in the system. Prior research suggests that investment and growth opportunities are fundamental determinants of compensation, financing, and investment policies. Following Brockman et al. 2010, we view book-to-market ratio (*BTM*) as exogenous and include *BTM* in all six equations. The choice of other instrument variables relies on prior literature.²⁰

The results reported in column 1 of Table 6 are in line with our first hypothesis. After controlling for the simultaneity between credit ratings, managerial compensation incentives, and financial policies, the coefficients on *LNVEGA* and *LNDELTA* are positive and significant (p -value < 0.01) in relation to *RATING*, corroborating our prior findings that rating agencies assign lower credit ratings to the firms that give their CEOs larger risk-taking incentives from equity compensation. Column 4 reports the results on the association between compensation incentives and financing policies. We observe that the coefficient on *LNVEGA* is positive and significant (p -value < 0.01) while the coefficient on *LNDELTA* is negative and significant (p -value < 0.01); the findings are consistent with prior literature (e.g., Coles et al. 2006; Brockman et al. 2010). Columns 5 and 6 present our findings on the relationship between compensation incentives and investing strategies. The results on the *vega* dimension are in line with those reported in Coles et al. 2006 and Brockman et al. 2010 that managers incentivized by *vega* opt for high-risk investments in R&D expenditures but invest less in low-risk fixed-asset capital expenditures. Consistent with Brockman et al. 2010, the coefficient on *LNDELTA* is negative and significant (p -value < 0.01) in column 5 in relation to *R&D* while insignificant in column 6 of *CAPEX*.

Other sensitivity tests

In addition, we investigate the robustness of prior results based on (1) on multiple dimensions. First, we estimate (1) in a first-difference form. Table 7 panel A presents the results of (1) with change specifications. By taking first differences, we control for the effects of unobservable time-invariant firm-specific factors on our prior findings and thus reduce the possibility of bias from correlated omitted variables. *F*-statistics suggest that the change specifications exhibit significant power in explaining the variation of the dependent variable ($\Delta RATING$). The variables of interest ($\Delta LNVEGA$ and $\Delta LNDELTA$) are loaded with significantly positive coefficients (p -value < 0.01), in line with our conjecture that higher risk-taking incentives from CEO compensation are associated with higher issuer default risk assessed by the credit rater. Results on the control variables also corroborate our prior findings.

Second, prior research documents the effects of corporate governance quality on credit rating evaluations (e.g., Ashbaugh-Skaife et al. 2006; Standard & Poor's 2002b) and compensation policies (e.g., Core, Holthausen, and Larcker 1999; Denis 2001; Bebchuk and Fried 2003). The findings on the effect of equity incentives on credit ratings could be a reflection of a relation between governance quality and credit ratings. To control for the

20. As with prior studies, we assume these instrumental variables are independent of the error terms in the equations. A violation of the assumption will lead to biased estimates.

TABLE 6
Simultaneous equations: the relationship between CEO risk-taking incentives, credit ratings, leverage, R&D, and capital expenditure

Variable	Dependent variable defined as					
	Column (1) <i>RATING</i>	Column (2) <i>LNVEGA</i>	Column (3) <i>LNDELTA</i>	Column (4) <i>LEV</i>	Column (5) <i>R&D</i>	Column (6) <i>CAPEX</i>
<i>RATING</i>		-0.231*** (-11.38)	-0.012 (-0.55)	0.024*** (6.72)	0.004*** (12.66)	0.001 (0.006)
<i>LNVEGA</i>	0.490*** (8.41)		0.751*** (27.28)	0.068*** (13.78)	0.003** (2.35)	-0.027*** (-13.62)
<i>LNDELTA</i>	0.284*** (5.73)	0.580*** (26.66)		-0.031*** (-7.37)	-0.008*** (-8.25)	0.001 (0.26)
<i>LEV</i>	1.276* (1.80)	3.137*** (13.52)	-1.423*** (-5.99)		-0.084*** (-12.86)	0.090*** (7.39)
<i>R&D</i>	-3.799 (-1.56)	7.895*** (8.91)	-6.527*** (-7.57)	-1.265*** (-6.99)		
<i>CAPEX</i>	-4.361*** (-4.08)	-8.905*** (-17.21)	0.224 (0.43)	0.018 (0.07)		
<i>BTM</i>	0.100 (0.93)	0.325*** (5.98)	-0.836*** (-18.54)	-0.102*** (-12.20)	-0.020*** (-13.42)	-0.017*** (-6.18)
<i>SDRET</i>	7.602*** (34.73)	1.665*** (7.65)	0.836*** (3.73)	-0.117*** (-3.64)		
<i>MV</i>	-0.830*** (-24.09)			-0.008* (-1.85)	0.007*** (7.96)	0.011*** (7.40)
<i>ROA</i>	-3.645*** (-5.97)			-0.346*** (-7.57)	-0.224*** (-26.30)	0.016 (1.01)
<i>CASHCOMP</i>		0.030*** (3.30)			0.001*** (3.51)	0.001** (2.14)
<i>TENURE</i>			0.246*** (19.18)		0.003*** (6.74)	0.007*** (7.32)
<i>SURCASH</i>			0.929*** (4.37)		0.172*** (28.29)	0.136*** (12.19)
<i>SDNI</i>	5.747*** (8.25)			-0.038 (-0.65)		

(The table is continued on the next page.)

TABLE 6 (Continued)

Variable	Dependent variable defined as					
	Column (1) <i>RATING</i>	Column (2) <i>LNVEGA</i>	Column (3) <i>LNDELTA</i>	Column (4) <i>LEV</i>	Column (5) <i>R&D</i>	Column (6) <i>CAPEX</i>
<i>LOSS</i>	0.110 (1.38)			0.009 (1.12)		
<i>RET</i>	0.588*** (11.32)				-0.003*** (-3.50)	-0.014*** (-7.61)
<i>BETA</i>	-0.005 (-0.13)					
<i>SALES</i>		0.065*** (3.57)	0.033* (1.71)			
<i>SALESGROW</i>					0.001 (0.31)	0.001*** (3.92)
<i>ΔEQ</i>	0.018 (0.50)					
<i>INTAN</i>	1.582*** (2.59)					
<i>COVER</i>	-0.013*** (-6.62)					
<i>FIN</i>	0.241 (1.09)					
<i>NETPPE</i>				0.136*** (3.40)		
<i>ZSCORE</i>				-0.003*** (-17.53)		
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	5,484	5,484	5,484	5,484	5,484	5,484
<i>R</i> ²	0.66	0.38	0.64	0.17	0.49	0.19

Notes:

t-statistics are shown in parentheses. ***, **, * indicate significance at 0.01, 0.05, and 0.10 levels (two-tailed), respectively. Appendix 2 provides variable definitions.

TABLE 7

Robustness check on the effect of CEO risk-taking incentives on credit ratings

Panel A: Regression with first differences

$$\Delta RATING_{i,t} = \alpha'_0 + \alpha'_1 INC_{i,t} + \gamma' CONTROL_{i,t} + \varepsilon_{i,t}$$

Variable	Predicted sign	Dependent variable defined as	
		Column (1) $\Delta RATING$	Column (2) $\Delta RATING$
Intercept		-0.058 (-0.58)	-0.056 (-0.57)
$\Delta LNVEGA$	H1: +	0.155*** (2.55)	
$\Delta LNDELTA$	H1: +		0.170*** (3.83)
ΔROA		-0.569 (-1.21)	-0.617 (-1.27)
ΔLEV		1.870*** (5.94)	1.885*** (5.98)
$\Delta SDNI$		6.384*** (6.11)	6.421*** (6.00)
$\Delta \Delta EQ$		0.094*** (2.89)	0.080** (2.63)
$\Delta INTAN$		-1.749 (-1.23)	-1.778 (-1.23)
$\Delta COVER$		-0.006* (-1.65)	-0.005* (-1.66)
ΔBTM		-0.205 (-1.05)	-0.169 (-0.83)
ΔMV		-0.819*** (-10.71)	-0.825*** (-11.02)
$\Delta SDRET$		7.535*** (12.03)	7.555*** (11.91)
$\Delta LOSS$		0.168** (1.98)	0.175** (1.99)
ΔRET		0.405*** (4.91)	0.381*** (4.60)
$\Delta BETA$		0.171** (1.98)	0.156** (1.97)
$\Delta ABSACC$		0.715* (1.82)	0.656* (1.71)
$\Delta TRANS$		0.002 (1.39)	0.001 (1.48)
Number of observations		5,108	5,108
R^2		0.56	0.56
F-statistics		153.21***	152.18***

Panel B: Rating regression adding corporate governance measures

$$RATING_{i,t} = \alpha_0 + \alpha_1 INC_{i,t} + \gamma CONTROL_{i,t} + \beta GOV_{i,t} + \varepsilon_{i,t} \quad (3)$$

Variable	Predicted sign	Dependent variable defined as	
		Column (1) $RATING$	Column (2) $RATING$
Intercept		14.581*** (14.45)	14.061*** (14.69)

(The table is continued on the next page.)

TABLE 7 (Continued)

Panel B: Rating regression adding corporate governance measures

$$RATING_{i,t} = \alpha_0 + \alpha_1 INC_{i,t} + \gamma CONTROL_{i,t} + \beta GOV_{i,t} + \varepsilon_{i,t} \quad (3)$$

Variable	Predicted sign	Dependent variable defined as	
		Column (1) <i>RATING</i>	Column (2) <i>RATING</i>
<i>LNVEGA</i>	H1: +	0.176*** (2.91)	
<i>LNDELTA</i>	H1: +		0.270*** (4.08)
<i>ROA</i>		-3.124*** (-2.68)	-3.260*** (-2.79)
<i>LEV</i>		1.315** (2.19)	1.443** (2.45)
<i>SDNI</i>		3.184 (1.49)	3.313 (1.58)
ΔEQ		0.134 (1.54)	0.117 (1.36)
<i>INTAN</i>		-1.513 (-1.00)	-1.495 (-0.98)
<i>COVER</i>		-0.010** (-2.40)	-0.010** (-2.46)
<i>BTM</i>		-0.108 (-0.52)	0.027 (0.13)
<i>MV</i>		-1.130*** (-14.03)	-1.177*** (-14.21)
<i>SDRET</i>		6.618*** (9.57)	6.500*** (9.30)
<i>LOSS</i>		0.097 (0.82)	0.126 (1.05)
<i>FIN</i>		0.402 (0.52)	0.338 (0.47)
<i>RET</i>		0.770*** (4.85)	0.713*** (4.63)
<i>BETA</i>		0.196 (0.96)	0.159 (0.85)
<i>ABSACC</i>		0.170 (0.23)	0.127 (0.17)
<i>TRANS</i>		0.001 (0.50)	0.001 (0.52)
<i>DUAL</i>		-0.222 (-0.37)	-0.233 (-0.40)
<i>CEOCOMP</i>		-0.069 (-0.91)	-0.027 (-0.38)
<i>PCTIND</i>		0.161 (0.45)	0.362 (0.99)
<i>CEOVOTE</i>		0.023*** (3.76)	0.014*** (2.74)
Industry dummies		Yes	Yes
Number of observations		3,779	3,779
R^2		0.67	0.68
F -statistics		214.20***	215.73***

Notes:

The t -statistics shown in parentheses are based on standard errors clustered at both firm and year levels. ***, **, * indicate significance at 0.01, 0.05, and 0.10 levels (two-tailed), respectively.

Appendix 2 provides variable definitions.

influence of firms' corporate governance structures on our prior findings, we incorporate measures for corporate governance in the following analysis:

$$RATING_{i,t} = \alpha_0 + \alpha_1 INC_{i,t} + \gamma CONTROL_{i,t} + \beta GOV_{i,t} + \varepsilon_{i,t} \quad (3),$$

where, suppressing subscripts, *RATING* proxies for credit ratings, *INC* proxies for managerial risk-taking incentives (*LNVEGA* and *LNDELTA*), *CONTROL* is a vector of control variables, *GOV* is a vector of governance measures based on Ashbaugh-Skaife et al. 2006, and ε is an error term. Standard errors cluster simultaneously on the firm and year dimensions. Appendix 2 summarizes the variable definitions. Information on corporate governance is retrieved from RiskMetrics governance database.

Panel B in Table 7 summarizes the regression results for (3).²¹ The results show that managerial risk-taking incentives continue to have a significant impact on credit ratings after controlling for corporate governance structures. In particular, in columns 1 and 2, the coefficients on both *LNVEGA* and *LNDELTA* are positive and significant (p -value < 0.01). *CEOVOTE*, which represents the voting power held by the CEO, is significantly positively related to *RATING* (p -value < 0.01). This result is consistent with the evidence in Ashbaugh-Skaife et al. 2006 that in firms where the CEO has more voting power (suggesting management entrenchment), there is an increased likelihood of default, resulting in lower credit ratings. The relationships between other governance variables and *RATING* are not significant.

Third, note that *RATING* is a discrete variable with integer scoring, which assumes that the 20 rating categories are equally spaced. The assumption of uniform differences between categories may be crude, and thus in untabulated analysis we employ ordered logit models. The results corroborate our prior findings. Finally, financial sectors may be subject to special rating criteria (e.g., Ashbaugh-Skaife et al. 2006); we therefore replicate our prior analysis excluding financial firms from our sample and the results remain qualitatively unchanged.²²

6. Conclusions

This study examines the association between credit ratings and managerial compensation incentives for risk taking. We measure risk-taking incentives in two ways. First, we use the sensitivity of managerial wealth to the volatility of firm performance (*vega*) to capture managers' risk appetite. Second, we use the sensitivity of managerial wealth to firm performance (*delta*) to capture the degree of interest alignment between managers and shareholders and in turn measure managers' incentives to choose risky investment policies on behalf of shareholders. Using a large sample of 8,189 firm-year observations during the 15-year period from 1992 to 2006, we provide evidence that rating agencies impound managerial risk-taking incentives (both *vega* and *delta*) in their risk assessments. Further, we examine whether firms with considerable rating concerns, such as having experienced a rating downgrade in the prior year, will tune down the risk-taking incentives in new option grants. Our results show that rating-troubled firms decrease managers' risk-taking

21. The decline in the number of observations is due to the merging with the corporate governance information from RiskMetrics governance database.

22. In addition, we perform propensity score matching analysis in the spirit of Rosenbaum and Rubin 1983 to examine whether a firm's rating concern will trigger any significant adjustments in the new option grants. The results are supportive of our prior findings. The model on which the matching is based has a pseudo R^2 of 28 percent (25 percent) when *Down* (*DownBBB*–) is used as the dependent variable. Also note that there are a number of observations in the control group that have been used for multiple times in the across-group comparisons. We recognize the limitation that matching with replacement will overstate the weight put on a single control observation that is matched with multiple treatment observations.

incentives as measured by *vega*, but not with respect to *delta*. These results are robust to allowing for the endogenous relationship between compensation, investment, and financing policies.

By explicitly investigating the extent to which rating agencies incorporate complex and forward-looking information in their risk evaluations, our results are consistent with the view that credit ratings are informative about issuers' overall credit risk. Our findings are thus supportive of the value of rating agencies in the marketplace, in line with prior literature (e.g., Anderson, Mansi, and Reeb 2003; Lee 2008). Furthermore, consistent with prior research (e.g., Coffee 2002), the results suggest that credit raters perform a monitoring role, deterring firms from excessively inducing top management to pursue risky investments. Our findings can be of use to regulators or other practitioners who are concerned about the quality of credit ratings, following the accounting scandals of the early 2000s and the more recent global credit crisis.

Our findings however should be generalized with due caution. First, while care has been taken to address potential endogeneity problem in our estimations, the effectiveness of these approaches in addressing omitted variable and simultaneity problems is still open to debate. In addition, our measures of firms' credit rating concerns may be subject to measurement errors because in an empirical setting we cannot fully mimic corporate concerns about credit ratings. However, we attempt to mitigate this concern by measuring rating concerns from different perspectives and our empirical results remain largely consistent. Furthermore, compared with COMPUSTAT full sample, our sample tends to include larger firms and firms deeper in debt. The potential sample selection issue may hamper the generalization of the results. In addition, although our results suggest that firms with severe rating concerns will largely reduce risk-taking incentives in executive compensation design, excessive underinvestment is not necessarily consistent with shareholders' best interest (Acharya, Amihud, and Litov 2011).

Appendix 1

Estimating *vega* and *delta*

Option *vega* is estimated as follows: $vega = \exp(-dT)N'(d_1) * PT^{(1/2)} * num$, where $d_1 = [\log(P/X) + T(r - d + \sigma^2/2)]/(\sigma T^{(1/2)})$, N is the cumulative probability function for the normal distribution, N' is the normal density function, P is the price of the underlying stock at the end of the year, X is the exercise price of the option, σ is the expected stock return volatility over the life of the option, r is the risk-free interest rate, T is time-to-maturity of the option in years, d is the expected dividend rate over the life of the option, num is the number of options.

Following Core and Guay 2002, we estimate the sensitivity of option value to changes in prices, option *delta*. The *delta* of stock options newly granted in current year is expressed as $Option_delta = \exp(-dT) N(d_1) * P * num * 0.01$.

We also calculate the *delta* of options granted before current year. Following Core and Guay 2002, the maturity of exercisable options granted before is assumed to be three years less than the average maturity of the current options grants. Further, the maturity of unexercisable options is assumed to be one year less than the average maturity of the current options grants. The average exercise price for the unexercised but exercisable options is the current stock price minus the ratio of the intrinsic value of unexercised but exercisable previously granted options to the number of unexercised but exercisable options. In contrast, the average exercise price for the unexercised and unexercisable options is the current stock price minus the ratio of the intrinsic value of unexercised and unexercisable options less the intrinsic value of current option grants to the number of unexercised and unexercisable options less the number of options granted during the current year.

The aggregate equity *delta* is the sum of option *delta* and the sensitivity of stocks held by CEOs to changes in prices. Thus $Equity_delta = Option_delta + P * num_stock * 0.01$, where *num_stock* is the number of stocks, including stocks, restricted stocks, and performance-based stocks, held by CEOs at the end of the year.

Appendix 2

Variable definitions

Variable	Description
<i>RATING</i>	<i>RATING</i> is recoded Standard & Poor's long-term domestic issuer credit rating for firm <i>i</i> in the end of year <i>t</i> (COMPUSTAT Item#280) in the range of 1–20, where 1 represents AAA and 20 stands for default.
<i>DRATE</i>	One-year corporate realized rating category default rates defined by each rating category.
<i>DOWN</i>	A dummy variable equals one if the rating for the firm was downgraded in the prior year, zero otherwise.
<i>DOWNBBB–</i>	A dummy equals one if the firm was downgraded to the edge of the investment category (i.e., BBB–) in the prior year, zero otherwise.
<i>LNVEGA</i>	Natural logarithm of option <i>vega</i> , the change in the value of the CEO's option holdings for a 0.01 change in the standard deviation of stock returns.
<i>LNDELTA</i>	Natural logarithm of equity <i>delta</i> , the change in the dollar value of the CEO's stock and option holdings for 1 percent change in the stock price.
$\Delta LNVEGA$	<i>LNVEGA</i> minus its one-year-prior value, that is, $LNVEGA_t - LNVEGA_{t-1}$.
$\Delta LNDELTA$	<i>LNDELTA</i> minus its one-year-prior value, that is, $LNDELTA_t - LNDELTA_{t-1}$.
<i>RESLNVEGA</i>	Residual <i>vega</i> from a prediction model that regresses <i>LNVEGA</i> on several measures of existing investment and financing policies and a vector of control variables at the end of year <i>t</i> .
<i>RESLNDELTA</i>	Residual <i>delta</i> from a prediction model that regresses <i>LNDELTA</i> on several measures of existing investment and financing policies and a vector of control variables at the end of year <i>t</i> .
$RESLNVEGA_{t-1}$	Residual <i>vega</i> from a prediction model that regresses <i>LNVEGA</i> on several measures of existing investment and financing policies and a vector of control variables at the end of year <i>t</i> – 1.
$RESLNDELTA_{t-1}$	Residual <i>delta</i> from a prediction model that regresses <i>LNDELTA</i> on several measures of existing investment and financing policies and a vector of control variables at the end of year <i>t</i> – 1.
<i>LNNEWVEGA</i>	<i>Vega</i> incentive from stock options newly granted during the current year, measured as the natural logarithm of the change in the value of stock options newly granted to the CEO during year <i>t</i> for a 0.01 change in the standard deviation of stock returns.
<i>LNNEWDELTA</i>	<i>Delta</i> incentive from stock options newly granted during the current year, measured as the natural logarithm of the change in the value of stock options newly granted to the CEO during year <i>t</i> for 1 percent change in the stock price.
<i>ROA</i>	Return on assets, measured as income before extraordinary items (Item #18) divided by total assets (Item #6) for the firm at the end of year.
<i>LEV</i>	Leverage ratio, measured as the sum of long-term debt (Item #9) and short-term debt (Item #34) divided by total assets (Item #6) for the firm at the end of year.

(The table is continued on the next page.)

Appendix 2 (Continued)

Variable	Description
<i>SDNI</i>	Standard deviation of income before special items (Item #18) scaled by total assets (Item #6) at the end of year t over prior four years.
ΔEQ	A dummy equaling to one if the firm has raised equity capital (Item #108) during the current year, zero otherwise.
<i>INTAN</i>	The ratio of the sum of R&D expense (Item #46) and advertising expense (Item #45) to total assets (Item #6) for the firm at the end of year.
<i>COVER</i>	Interest coverage, estimated as the ratio of operating income before depreciation (Item #13) to interest expense (Item #15) for the firm at the end of year.
<i>BTM</i>	Book-to-market ratio measured as book value of equity (Item #60) divided by market value of equity for the firm at the end of year.
<i>MV</i>	Natural logarithm of market value of equity (Item #199 $\times$ Item #54) at the end of year.
<i>SDRET</i>	Standard deviation of stock returns over prior 60 months for the firm by the end of year.
<i>LOSS</i>	A dummy equaling one if net income before special items (Item #18) is negative, zero otherwise.
<i>FIN</i>	A dummy equaling one if the firm belongs to financial industry (i.e, SIC 6000–6999), zero otherwise.
<i>RET</i>	Stock return over prior 12 months for the firm at the end of year = (Item #199 $_t$ - Item #199 $_{t-1}$)/Item #199 $_{t-1}$.
<i>BETA</i> ²³	Market beta measured according to the CAPM model using the current year's daily stock returns for the firm at the end of year.
<i>ABSACC</i> ²⁴	Absolute value of abnormal accruals and the abnormal accruals are estimated by the cross-sectional version of Jones model for the firm at the end of year.
<i>TRANS</i>	The level of financial transparency measured as negative one multiplied by the squared residual from the cross-sectional regression suggested by Gu 2007.
<i>TENURE</i>	Natural logarithm of CEO tenure measured in years at the end of year.
<i>EMPL</i>	Natural logarithm of number of employees for the firm at the end of year.
<i>R&D</i>	Research and development expenditure to assets = Max(0, Item #46)/Item #6.
<i>CAPEX</i>	Net capital expenditure to assets = (Item #128 –Item #107)/Item #6.
<i>CASHCOMP</i>	CEO's cash compensation (in millions), defined as the sum of salary plus cash bonus paid during the year).
<i>SURCASH</i>	Cash from assets-in-place to assets = (Item #308 –Item #125 + Item #46)/Item #6.
<i>SALES</i>	Sales to assets = Item #12/Item # 6.
<i>SALESGROW</i>	Sales growth rate = $\ln$ (Item #12 $_t$ /Item #12 $_{t-1}$).
<i>NETPPE</i>	Net property, plant, and equipment to assets = Item #8/Item #6.

(The table is continued on the next page.)

23. Annual betas are estimated using the methods developed by Scholes and Williams 1977.

24. Abnormal accruals are estimated using the cross-sectional Jones model (DeFond and Jambalvo 1994), which is estimated each year for each three-, two-, and one-digit SIC code conditional on having at least 10 firms in each group, and comprise the residuals from the following intercept-suppressed regression $ACC/LTA = a_0*(1/LTA) + a_1*(PPE/LTA) + a_2*(\Delta REV/LTA) + \varepsilon$, where ACC is total accruals, defined as the change in current assets (Item #4) minus the change in current liabilities (Item #5) minus the change in cash (Item #1) plus the change in short-term debt (Item #34) less depreciation expense (Item #14); PPE is property, plant, and equipment (Item #7); ΔREV is change in sales revenue (Item #12); and LTA is total assets (Item #6) in the end of prior year.

Appendix 2 (Continued)

Variable	Description
<i>ZSCORE</i>	Altman's Z-score = $3.3 \times \text{Item \#178} / \text{Item \#6} + 1.2 \times (\text{Item \#4} - \text{Item \#5}) / \text{Item \#6} + \text{Item \#12} / \text{Item \#6} + 0.6 \times \text{Item \#199} \times \text{Item \#25} / (\text{Item \#9} + \text{Item \#34}) + 1.4 \times \text{Item \#36} / \text{Item \#6}$
<i>DUAL</i>	A dummy equaling one if the focal CEO being the chairman of the board, zero otherwise.
<i>CEOCOMP</i>	A dummy equaling one if the focal CEO sits on compensation committee, zero otherwise.
<i>PCTIND</i>	The proportion of independent directors among all board members for the firm. Independent director refers to any member of a company's board who has never been employed by the company and sits on that company's board.
<i>CEOVOTE</i>	Voting power held by the focal CEO.
Industry Dummies	Identified on the basis of Fama-French industry classification (12 industry portfolios).

Appendix 3

Standard & Poor's one-year global corporate default rates by rating category (in percentage)

	AAA	AA+	AA	AA–	A+	A	A–	BBB+	BBB	BBB–
1992	—	—	—	—	—	—	—	—	—	—
1993	—	—	—	—	—	—	—	—	—	—
1994	—	—	—	—	0.45	—	—	—	—	—
1995	—	—	—	—	—	—	—	—	—	0.63
1996	—	—	—	—	—	—	—	—	—	—
1997	—	—	—	—	—	—	—	0.36	0.34	—
1998	—	—	—	—	—	—	—	0.54	0.70	1.29
1999	—	—	—	0.36	—	0.24	0.27	—	0.28	0.30
2000	—	—	—	—	—	0.24	0.56	—	0.26	0.88
2001	—	—	—	—	0.57	0.49	—	0.24	0.48	0.27
2002	—	—	—	—	—	—	—	1.11	0.65	1.31
2003	—	—	—	—	—	—	—	—	0.19	0.52
2004	—	—	—	—	—	0.23	—	—	—	—
2005	—	—	—	—	—	—	—	—	0.17	—
2006	—	—	—	—	—	—	—	—	—	—
	BB+	BB	BB–	B+	B	B–	CCC to C			
1992	—	—	—	0.72	14.93	20.83	30.19			
1993	—	1.92	—	1.30	5.99	4.17	13.33			
1994	—	0.86	—	1.83	6.58	3.23	16.67			
1995	—	1.55	1.11	2.76	8.00	7.69	28.00			
1996	0.86	0.65	0.55	2.33	3.74	3.92	4.17			
1997	—	—	0.41	0.72	5.19	14.58	12.00			
1998	1.29	1.06	0.72	2.57	7.47	9.46	42.86			

(The table is continued on the next page.)

Appendix 3 (Continued)

	BB+	BB	BB–	B+	B	B–	CCC to C
1999	0.54	1.33	0.90	4.20	10.55	15.45	32.35
2000	—	0.80	2.29	5.60	10.66	11.50	34.12
2001	0.49	1.19	6.27	5.94	15.74	23.31	44.55
2002	1.50	1.74	4.62	3.69	9.63	19.53	44.12
2003	0.48	0.94	0.27	1.70	5.16	9.23	33.13
2004	—	0.64	0.76	0.46	2.68	2.82	15.11
2005	0.36	—	0.25	0.78	2.59	2.98	8.87
2006	0.36	—	0.48	0.54	0.78	1.58	13.08

Notes:

“—” means zero. Source: Standard & Poor’s 2009.

References

- Acharya, V. V., Y. Amihud, and L. Litov. 2011. Creditor rights and corporate risk-taking. *Journal of Financial Economics* 102 (1): 150–66.
- Agrawal, A., and G. N. Mandelker. 1987. Managerial incentives and corporate investment and financing decisions. *The Journal of Finance* 42 (4): 823–37.
- Ali, A., and W. Zhang. 2008. Proximity to broad credit rating change and earnings management. Working paper, University of Texas at Dallas and Cheung Kong Graduate School of Business.
- Altman, E. I., and H. A. Rijken. 2004. How rating agencies achieve rating stability. *Journal of Banking and Finance* 28 (11): 2679–714.
- Amato, J. D., and C. H. Furfine. 2004. Are credit ratings procyclical? *Journal of Banking and Finance* 28 (11): 2641–77.
- Anderson, R. C., S. A. Mansi, and D. M. Reeb. 2003. Founding family ownership and the agency costs of debt. *Journal of Financial Economics* 68 (2): 263–85.
- Armstrong, C. S., A. D. Jagolinzer, and D. F. Larcker. 2010. Chief executive officer equity incentives and accounting irregularities. *Journal of Accounting Research* 48 (2): 225–71.
- Ashbaugh-Skaife, H., D. W. Collins, and R. LaFond. 2006. The effects of corporate governance on firms’ credit ratings. *Journal of Accounting and Economics* 42 (1-2): 203–43.
- Bebchuk, L. A., and J. M. Fried. 2003. Executive compensation as an agency problem. *Journal of Economic Perspectives* 17 (3): 71–92.
- Begley, J., and G. A. Feltham. 1999. An empirical examination of the relation between debt contracts and management incentives. *Journal of Accounting and Economics* 27 (2): 229–59.
- Berger, P. G., E. Ofek, and D. L. Yermack. 1997. Managerial entrenchment and capital structure decisions. *The Journal of Finance* 52 (4): 1411–38.
- Bhojraj, S., and P. Sengupta. 2003. Effect of corporate governance on bond ratings and yields: The role of institutional investors and outside directors. *Journal of Business* 76 (3): 455–75.
- Billett, M. T., D. C. Mauer, and Y. Zhang. 2010. Stockholder and bondholder wealth effects of CEO incentive grants. *Financial Management* 39 (2): 463–87.
- Blume, M. E., F. Lim, and A. C. MacKinlay. 1998. The declining credit quality of US corporate debt: Myth and reality? *The Journal of Finance* 53 (4): 1389–413.
- Boot, A. W. A., T. T. Milbourn, and A. Schmeits. 2006. Credit ratings as coordination mechanisms. *The Review of Financial Studies* 19 (1): 81–118.
- Bradley, M., and D. Chen. 2011. Corporate governance and the cost of debt: Evidence from director limited liability and indemnification provisions. *Journal of Corporate Finance* 17 (1): 83–107.

- Brander, J. A., and M. Poitevin. 1992. Managerial compensation and the agency costs of debt finance. *Managerial and Decision Economics* 13 (1): 55–64.
- Brick, I. E., O. Palmon, and J. K. Wald. 2012. Too much pay performance sensitivity? *The Review of Economics and Statistics* 94 (1): 287–303.
- Brockman, P., X. Martin, and E. Unlu. 2010. Executive compensation and the maturity structure of corporate debt. *The Journal of Finance* 65 (3): 1123–61.
- Cameron, A. C., J. B. Gelbach, and D. L. Miller. 2011. Robust inference with multi-way clustering. *Journal of Business and Economic Statistics* 29 (2): 238–49.
- Cantor, R. 2001. Moody's investors service response to the consultative paper issued by the Basel Committee on Bank Supervision "A new capital adequacy framework." *Journal of Banking and Finance* 25 (1): 171–85.
- Carpenter, J. N. 2000. Does option compensation increase managerial risk appetite? *The Journal of Finance* 55 (5): 2311–31.
- Cheng, M., and K. R. Subramanyam. 2008. Analyst following and credit ratings. *Contemporary Accounting Research* 25 (4): 1007–43.
- Coffee Jr., J. C. 2002. Understanding Enron: It's about the gatekeepers, stupid. Working paper, Columbia Law School.
- Coles, J. L., N. D. Daniel, and L. Naveen. 2006. Managerial incentives and risk-taking. *Journal of Financial Economics* 79 (2): 431–68.
- Coles, J. L., M. L. Lemmon, and J. F. Meschke. 2012. Structural models and endogeneity in corporate finance: The link between managerial ownership and corporate performance. *Journal of Financial Economics* 103 (1): 149–68.
- Core, J. E., and W. R. Guay. 1999. The use of equity grants to manage optimal equity incentive levels. *Journal of Accounting and Economics* 28 (2): 151–84.
- Core, J. E., and W. R. Guay. 2002. Estimating the value of employee stock option portfolios and their sensitivities to price and volatility. *Journal of Accounting Research* 40 (3): 613–30.
- Core, J. E., R. W. Holthausen, and D. F. Larcker. 1999. Corporate governance, chief executive officer compensation, and firm performance. *Journal of Financial Economics* 51 (3): 371–406.
- Daniel, N. D., J. S. Martin, and L. Naveen. 2004. The hidden cost of managerial incentives: Evidence from the bond and stock markets. Working paper, Drexel University, University of Melbourne, and Temple University.
- DeFond, M. L., and J. Jiambalvo. 1994. Debt covenant violation and manipulation of accruals. *Journal of Accounting and Economics* 17 (1-2): 145–76.
- DeFusco, R. A., R. R. Johnson, and T. S. Zorn. 1990. The effect of executive stock option plans on stockholders and bondholders. *The Journal of Finance* 45 (2): 617–27.
- Denis, D. K. 2001. Twenty-five years of corporate governance research . . . and counting. *Review of Financial Economics* 10 (3): 191–212.
- Devos, E., A. K. Prevost, and R. P. Rao. 2009. The structure of executive stock option compensation and the cost of debt. Working paper, University of Texas, Ohio University, and Oklahoma State University.
- Ederington, L. H., and J. C. Goh. 1998. Bond rating agencies and stock analysts: Who knows what when? *Journal of Financial and Quantitative Analysis* 33 (4): 569–85.
- Ederington, L. H., J. B. Yawita, and B. E. Roberts. 1987. The informational content of bond ratings. *Journal of Financial Research* 10 (3): 211–26.
- Elton, E. J., M. J. Gruber, D. Agrawal, and C. Mann. 2001. Explaining the rate spread on corporate bonds. *The Journal of Finance* 56 (1): 247–77.
- Fama, E. F., and M. H. Miller. 1972. *The theory of finance*. New York: Holt Rinehart & Winston.
- Francis, J., R. LaFond, P. Olsson, and K. Schipper. 2005. The market pricing of accruals quality. *Journal of Accounting and Economics* 39 (2): 295–327.
- Frost, C. A. 2007. Credit rating agencies in capital markets: A review of research evidence on selected criticisms of the agencies. *Journal of Accounting, Auditing, and Finance* 22 (3): 469–92.

- Goh, J. C., and L. H. Ederington. 1993. Is a bond rating downgrade bad news, good news, or no news for stockholders? *The Journal of Finance* 48 (5): 2001–08.
- Gow, I. D., G. Ormazabal, and D. J. Taylor. 2010. Correcting for cross-sectional and time-series dependence in accounting research. *The Accounting Review* 85 (2): 483–512.
- Graham, J. R., and C. R. Harvey. 2001. The theory and practice of corporate finance: Evidence from the field. *Journal of Financial Economics* 60 (2-3): 187–243.
- Gu, Z. 2007. Cross-sample incomparability of R^2 s and additional evidence on value relevance changes over time. *Journal of Business Finance and Accounting* 34 (78): 1073–98.
- Guay, W. R. 1999. The sensitivity of CEO wealth to equity risk: An analysis of the magnitude and determinants. *Journal of Financial Economics* 53 (1): 43–71.
- Hand, J. R. M., R. W. Holthausen, and R. W. Leftwich. 1992. The effect of bond rating agency announcement on bond and stock prices. *The Journal of Finance* 47 (2): 733–52.
- Jensen, M. C., and W. H. Meckling. 1976. Theory of the firm: Managerial behavior, agency costs, and ownership structure. *Journal of Financial Economics* 3 (4): 305–60.
- Jensen, M. C., and K. J. Murphy. 1990. Performance pay and top-management incentives. *Journal of Political Economy* 98 (2): 225–64.
- John, T. A., and K. John. 1993. Top-management compensation and capital structure. *The Journal of Finance* 48 (3): 949–74.
- Ju, N., H. E. Leland, and L. W. Senbet. 2002. Options, option repricing and severance packages in managerial compensation: Their effects on corporate risk. Working paper, Hong Kong University of Science & Technology, University of California, Berkeley, and University of Maryland.
- Kabir, R., H. Li, and Y. V. Veld-Merkoulova. 2013. Executive compensation and the cost of debt. Working paper, University of Twente and University of Stirling.
- Kisgen, D. J. 2006. Credit ratings and capital structure. *The Journal of Finance* 61 (3): 1035–72.
- Kisgen, D. J. 2007. The influence of credit ratings on corporate capital structure decisions. *Journal of Applied Corporate Finance* 19 (3): 65–73.
- Kliger, D., and O. Sarig. 2000. The information value of bond ratings. *The Journal of Finance* 55 (6): 2879–902.
- Knopf, J. D., J. Nam, and J. H. Thornton, Jr. 2002. The volatility and price sensitivities of managerial stock option portfolios and corporate hedging. *The Journal of Finance* 57 (2): 801–13.
- Lee, Y.-J. 2008. The effects of employee stock options on credit ratings. *The Accounting Review* 83 (5): 1273–314.
- Levine, C. B., and J. S. Hughes. 2005. Management compensation and earnings-based covenants as signaling devices in credit markets. *Journal of Corporate Finance* 11 (5): 832–50.
- Lewellen, K. 2006. Financing decisions when managers are risk averse. *Journal of Financial Economics* 82 (3): 551–89.
- Mehran, H. 1992. Executive incentive plans, corporate control, and capital structure. *Journal of Financial and Quantitative Analysis* 27 (4): 539–60.
- Millon, M. H., and A. V. Thakor. 1985. Moral hazard and information sharing: A model of financial information gathering agencies. *The Journal of Finance* 40 (5): 1403–22.
- Moody's Investor Service. 2003. Special comment: Measuring the performance of corporate bond ratings. April: 1–28.
- Moody's Investor Service. 2005. Special comment: CEO compensation and credit risk. July: 1–10.
- Moody's Investor Service. 2007. Special comment: A user's guide to the SEC's new rules for reporting executive pay. April: 1–14.
- Odders-White, E. R., and M. J. Ready. 2006. Credit ratings and stock liquidity. *The Review of Financial Studies* 19 (1): 119–57.
- Ortiz-Molina, H. 2007. Executive compensation and capital structure: The effects of convertible debt and straight debt on CEO pay. *Journal of Accounting and Economics* 43 (1): 69–93.
- Petersen, M. A. 2009. Estimating standard errors in finance panel data sets: Comparing approaches. *The Review of Financial Studies* 22 (1): 435–80.

- Rajgopal, S., and T. Shevlin. 2002. Empirical evidence on the relation between stock option compensation and risk taking. *Journal of Accounting and Economics* 33 (2): 145–71.
- Rogers, D. A. 2002. Does executive portfolio structure affect risk management? CEO risk-taking incentives and corporate derivatives usage. *Journal of Banking and Finance* 26 (2-3): 271–95.
- Rosenbaum, P. R., and D. B. Rubin. 1983. The central role of the propensity score in observational studies for causal effects. *Biometrika* 70 (1): 41–55.
- Scholes, M., and J. Williams. 1977. Estimating betas from nonsynchronous data. *Journal of Financial Economics* 5 (3): 309–27.
- Shaw, K. W. 2012. CEO incentives and the cost of debt. *Review of Quantitative Finance and Accounting* 38 (3): 323–46.
- Smith, C. W., and R. M. Stulz. 1985. The determinants of firms' hedging policies. *Journal of Financial and Quantitative Analysis* 20 (4): 391–405.
- Standard & Poor's. 2002a. Understanding credit ratings. January: 1–4.
- Standard & Poor's. 2002b. The evolving role of corporate governance in credit rating analysis. Ratings Direct, Standard & Poor's Web-based credit analysis system. October.
- Standard & Poor's. 2009. Understanding Standard & Poor's rating definitions. June: 1–18.
- Stulz, R. M. 1984. Optimal hedging policies. *Journal of Financial and Quantitative Analysis* 19 (2): 127–40.
- Thompson, S. B. 2011. Simple formulas for standard errors that cluster by both firm and time. *Journal of Financial Economics* 99 (1): 1–10.
- Tufano, P. 1996. Who manages risk? An empirical examination of risk management practices in the gold mining industry. *The Journal of Finance* 51 (4): 1097–137.
- Vasvari, F. P. 2008. Equity compensation and the pricing of syndicated loans. Working paper, London Business School.
- White, L. J. 2007. A new law for the bond rating industry. *Regulation* 30 (1): 48–52.