Guess Who's Also Minding Your Business? The Effect of Credit Ratings Changes on CEO Incentives*

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Abstract

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JEL Classification: G14, G34, D80, J33
Keywords: credit ratings changes, CEO incentives, corporate governance

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Abstract

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1 Introduction

Much of our understanding of corporation is built on the idea that mangers, if not properly motivated and closely monitored, may pursue goals that are not in shareholders' interests (e.g., Jensen and Meckling, 1976). The existing literature emphasizes the role of equity-based incentives in aligning the interests of *managers and shareholders*(e.g., see Murphy, 1999). While the use of stock grants, options, and other forms of equity-related incentive pay are believed to be able to align managers' interests with those of shareholders, the effectiveness of equity-based incentive and how these incentives interact with other stake-holders (e.g., bondholders) remain open issues. [1]

In this study, we hypothesize that the changes in credit ratings have significant impact on the CEO incentives. Our conjecture is motivated by anecdotal evidence and roots its origin in various theoretical corporate finance models. At the anecdotal level, Graham and Harvey (2001), in their survey of the American CFOs, find that credit rating is an executive's second most important concern when determining financing policy. Corporate executives enjoys "quiet" life (see, for example, Bertand and Mullainathan, 2003). Credit ratings changes, especially downgrades, disturb such "quiet" life, which may severely affect CEO incentive level. Take as an example. The recent downgrades of U.S. auto giant General Motors(GM) credit ratings to speculative grade sent a shudder to the financial market, triggering a major overhaul of GM's corporate strategies and operational efficiencies. This downgrade rocked the American automobile industry and had it repercussion felt throughout the the whole global market.[2]

On the theory front, various corporate finance models have implications for the effect of credit ratings changes on CEO incentives as well. First, the standard principal-agent models predict that managerial incentives decline with firm risk. Credit downgrades or upgrades reflect changes in a firm's risk exposure, which, according to the standard risk-incentive tradeoff argument, either increase or decrease managerial incentives. Second, credit ratings changes reflect rating agencies' assessment about a firm's future cash flow. Credit downgrades/upgrades elicit valuable information to the capital markets. The information can be leveraged by the principals to better structure managerial incentive contract. Third, credit ratings changes affect the likelihood that a CEO

[1]The previous research has identified firm size, return volatility, growth opportunity, CEO tenure, ownership structure, industry, and stock price informativeness to be important determinants of equity-based incentives.

[2]See, e.g., 'Black Thursday' for corporate bonds after S&P cuts GM, Ford to junk, Associated Press Online, May 5, 2005.

loses his job and firm-specific human capital investment, more importantly, his reputation in the managerial market. In order to retain those private benefits derived from the control of the firm, the CEO may adjust his incentive levels accordingly. Last but not the least, rating agencies' monitoring complement incentive pay and other corporate governance mechanisms to discipline the CEOs. Changes in credit ratings change the configuration of various governance mechanisms in place. Credit downgrade may trigger a more effective use of corporate governance mechanisms such as incentive pay. Credit upgrades however signal good CEO performance and likely less severe agency conflicts, and may lead to a reduced dependence on the incentive pays to resolve agency problems. In addition, credit ratings changes may also increase or decrease a CEO's bargaining power, which leads to either an increased or decreased CEO total pay level, and as a consequence, a change in CEO incentives.

Although both anecdotes and existing corporate finance theories suggest that credit ratings changes affect CEO incentives, the statistical and economical magnitude of such effect, especially the channels through which credit ratings affect CEO incentives, remain unaddressed. In this paper, we examine the dynamics between credit ratings changes and the changes in CEO incentives. Specifically, we analyze the extent to which credit rating changes affect CEO incentives. We also examine how credit rating affect CEO incentives.

Modeling credit ratings changes and changes in CEO incentives as jointly endogenous variables and using different model specifications to cope with the endogeneity of credit ratings changes, our analysis yields several key findings. First of all, we find that credit ratings changes has significant effect on CEO incentives, measured as pay-performance sensitivity. We document that credit downgrades significantly improve CEO incentives while credit upgrades significantly reduce CEO incentives. To disentangle the effects of different channels, we conduct several cross-sectional analysis. We find that the effect of credit ratings changes on CEO incentives are most significant for firms with investment grades debts. Such effect tends to be stronger for large firm and firms with large presence of institutional investors. Interestingly, we also find that when firms operate in an environment in which their investors have less access to valuable information, credit ratings changes affect more on CEO incentives. Finally, although the standard principal-agency theory predicts that CEO compensations are optimally designed to resolve the agency conflicts, various studies have shown that such contracting is never optimal either due to errors in observations of

CEO performance, or because CEO themselves can exert their influence on the boards to obtain better pays.[3] Therefore, CEOs are either over-compensated or under-compensated. We find in our cross-sectional analysis that the impact of credit ratings changes on CEO incentives is more significant for firms whose CEOs have been previously mis-compensated. Our finding thus suggests that rating agencies' monitoring helps firms to manage the optimal level of equity incentives.

Our empirical findings are not consistent with the theoretical agency theory prediction that managerial equity ownership shares (measure of the managerial incentive level) decline with risk. However, they provide partial support for the information dissemination, CEO private benefit based, and corporate governance based arguments. These theories collectively explain the roles of credit ratings changes in determining CEO incentive levels, and specify respectively the different channels through which such effect occurs. Our results suggest that the monitoring of rating agencies, or more generally, that of bondholders, complement equity based incentives, and other corporate governance mechanisms as resolutions of various agency conflicts.

This study introduces a new element to the traditional principal agent model. We argue and demonstrate empirical evidence that introducing the role of rating agencies (or bondholders) twist the principal-manager dynamics, and have important implications for equity-based incentive being one important corporate governance mechanism. Our findings add new insights to the understanding of the effectiveness of incentive pay, and the risk-incentive relation. The paper also relates to an extensive literature that emphasizes the roles of debts in alleviating manger-shareholder agency conflicts. This literature has shown that the choice of capital structure and bond maturity structure can be effective tool to monitor management and boost firm performance (see, e.g., Jensen and Meckling, 1977; Myers, 1977; Rajan and Winton, 1995, and Stulz, 2000). The paper is also related to a body of research on the delegated monitoring, which concerns the role of institution activism by pension funds and other financial intermediaries. Our findings add to this line of research by showing that rating agencies facilitate external monitoring of debt-holders, especially at firms where agency costs of managerial discretion and the benefits of bond monitoring are greater.

The rest of the paper proceeds as follows. In Section 2, we discuss various corporate fiance theories at the confluence of the credit rating literature and CEO compensation literature. We

[3]See, e.g., Bertrand and Mullainathan (2001); Bebchuk and Fried (2003).

then develop main predictions which map out the dynamics between credit ratings changes and CEO incentives. Section 3 discuss the sample construction and data used in our empirical analysis. We also discuss our empirical strategy and explain in detail how we cope with the endogeneity problem. Section 4 presents the main empirical findings. In Section 5, we carry out various cross-sectional analyses to better understand the channels through which credit ratings changes affect CEO incentives. We summarize our results and conclude in Section 6.

2 Credit Ratings Changes and CEO Incentives

2.1 Why credit ratings changes may affect CEO incentives?

Firms' overall credit ratings reflect a rating agency's opinion of an firm's overall creditworthiness and its capacity to satisfy its financial obligations. They are determined by rating agencies' assessment of the probability distribution of future cash flows to bondholders, which in turn, depends on the future cash flows to firms. Thus, changes in credit ratings reflect changes in firms' fundamentals, especially their future cash flow distributions, and they are common and well-disseminated information events (Dichev and Piotroski, 2001). Although facing heavy criticism in recent year,[4] credit ratings have been embraced by financial markets because they mostly predict the likelihood of defaults. As rating agencies largely represent the interest of debt-holders, it is believed that credit ratings changes, like debts, help to resolve the agency problems.[5]

Incentive pay is another mechanism that has been widely used to align managerial interest with that of shareholders. The effectiveness of incentive pay, including the use of pay-performance sensitivity as a proxy for incentive level, has been the subject of a large and growing literature. While many firm or industry specific characteristics have to identifer to be important determinants of equity-based incentives, the CEO incentives, to the best of our knowledge, have never been examined at the confluence of executive compensation and credit rating literature.

Both traditional principal-agent models and more recent corporate governance theories predict that credit ratings changes affect CEO incentives. Various channels exist. First, as predicted by the

[4]Rating agencies have been criticized for missing the crises at firms such as Enron, Worldcom, and Parmalat.

[5]As far as debt is concerned, the literature so far has extensively examined the role of debt in resolving agency problems. E.g., Easterbrook (1984) argues that debt forces managers to be accountable to the external capital market. Lang et al. (1996) document evidence that debt curtails investment by firms with poor prospects. Maloney et al. (1993) find that leverage improves managerial decision-making on key issues such as acquisitions.

standard principal-agent models, there is a trade-off between risk and managerial incentives — firms are less likely to adopt equity-based incentives to motivate managers when the uncertainty level in the environment is high. Although the empirical support for this prediction is still inconclusive,[6] most economists believe that a certain correlation exists between risk and incentive. Credit ratings changes signal changes in firms' risk profiles. E.g., a downgrade predicts an increase in the likelihood of default, while an upgrade predicts the converse. Therefore, we expect CEO incentives to change after credit ratings downgrades/upgrades. We call this line of reasoning the risk-incentive tradeoff based argument.

Second, the standard principal-agent models also predict that the principals are able to leverage all relevant information to optimally design managerial compensation contracts (see e.g., Holmstrom, 1979; and Holmstrom and Milgrom, 1987). New batch of information released through either downgrades or upgrades helps refine the contracting environment and boost CEOs' equity-based incentives. We call it the information dissemination based argument.

Third, credit ratings reflect bondholders' assessment of firm bankruptcy probability. In the case of bankruptcy, the CEO may lose his private control benefits and firm-specific human capital investment (see, e.g., Eckbo and Thorburn, 2003). The CEO may also find his reputation in the managerial market to be crippled (Fama and Jensen, 1983a, b). The CEO's incentives, subsequent to credit ratings changes, especially downgrades, therefore will adjust accordingly. This channel, although having been studied in previous literature in different settings,[7] has not been rigorously examined in our setting. We label it the CEO private benefit based argument.

Fourth, credit ratings complement equity-based incentives as effective corporate governance mechanisms to discipline managers and resolve agency problems. Although CEOs enjoy the quiet life, credit rating changes (especially downgrades) disturb or even terminate CEOs' quiet life, triggering more effective use of various corporate governance mechanisms. The credit ratings changes also alter the configuration of corporate governance mechanisms in place. In the case of downgrades, more effective monitoring of CEOs emerges as an urgent need. Thus downgrades may trigger public attentions and more effective use of other corporate governance mechanisms

[6] For example, Aggarwal and Samwick (1999) document a negative correlation between CEO incentives and firm risk measure. Core and Guay (2002) find exactly the opposite.

[7] E.g., Eckbo and Thorburn (2003) find that CEO private benefits of control, together with managerial reputation concerns, impose self-disciplines on CEOs in Swedish firms' bankruptcy auctions.

such as equity-based incentives. In the case of upgrades, we expect the demand for more effective monitoring gets weaker due to good firm performance. A firm's reliance on CEO incentives thus may be reduced.[8] We call it the corporate governance based argument in our context.

2.2 Testable predictions

The different arguments discussed above, although generating conflicting predictions in several cases, collectively offer a complete description of the dynamics between credit ratings changes and CEO incentives. The risk-incentive tradeoff based argument predicts that CEO incentives attenuate when risk increases (e.g., downgrades of credit ratings). However, the default risk actually decreases following credit ratings upgrades, which should lead to improved CEO incentives. The other three arguments, on the contrary, all suggest an improved CEO incentives following credit ratings downgrades, although their implications derived from the credit upgrading cases differ. For example, the information dissemination based argument predicts that credit ratings changes elicit valuable information for principals to better structure managerial incentives. The magnitude of such impact hinges on the amount of information released through downgrades/upgrades. It has been found that downgrades of credit ratings contain more information than upgrades do.[9] We therefore expect an improved CEO incentives following bond downgrades but a less significant change in CEO incentives following upgrades.

Both the CEO private benefit based argument and the corporate governance based argument predict that credit downgrades may disturb CEOs' quiet lives, exposing them to more thorough scrutiny and higher likelihood of losing job and reputation. We thus expect improved CEO incentives following credit downgrades. While CEO private benefit based argument does not have any particular prediction on upgrading cases, the corporate governance based argument suggests that CEO incentives might decrease following upgrades, because the firm's reliance on CEO equity based incentives may decrease after upgrades. On the balance, we formulate our first prediction:

Prediction 1: The CEO incentives, measured as the pay performance sensitivities (PPS),

[8] In the case of upgrades, CEO incentives may decrease for two different reasons. First, it may be caused by lax monitoring subsequent to good operating performance; second, it is also possible that CEOs of upgrading firms can negotiated higher pays, which increases the risk of holding stocks or options. The CEOs thus may sell shares to balance the risk exposure.

[9] Studying the stock market reactions to all Moody's bond ratings changes, Dichev and Piotroski (2001) do not find significant abnormal returns following upgrades. However, they find that the markets react negatively to downgrades.

increase following downgrades; but decrease following upgrades.

As we discussed in Section (2.1), the above four theories collectively suggest the important role of credit ratings changes in explaining CEO incentive level. However, each of them has different focus. To better understand the potential channels through which credit ratings changes eventually impact on CEO incentives, we need to carry out a series of cross-sectional analysis. The private benefit based theory suggests that CEOs of large firms and firms with investment grade debts likely care more about their career, reputation, and loss of control benefits. Therefore, they should be more responsive to credit ratings changes. Meanwhile, it is expected that credit ratings changes among large firms and investment grade firms trigger more urgent demand for effective corporate governance mechanisms. We therefore have:

Prediction 2: The impact of credit ratings changes on CEO incentives is larger for firms with investment grade debts.

Prediction 3: The impact of credit ratings changes on CEO incentives is more significant for large firms

The corporate governance based argument predicts that credit ratings changes disturb CEOs' quiet life, which lead to changes in CEO incentives. Many large institutional investors, particularly those governed by prudent investor rules, have pre-specified contracts that they cannot hold stocks of firms with below investment grade debts. In the meantime, invitational investors can better exert their monitoring on CEOs subsequent to corporate news (i.e., downgrades or upgrades here). We thus expect the impact of credit ratings changes to be more significant for firms with more significant presence of institutional investors. We have:

Prediction 4: The impact of credit ratings changes on CEO incentives tend to larger for firms with more significant presence of institutional investors.

It is has been well-documented that managerial contracting process is sub-optimal because powerful CEOs can extract a large amount of rents from dysfunctional boards.[10] In addition, an inefficient contracting environment due to information asymmetry, and/or costs of renegotiating incentive contracts may only generate sub-optimal CEO incentive levels. Core and Guay (1999) document evidence that firms use equity grants to manage optimal equity-based incentive levels. We

[10]Such managerial self-dealings are extensively discussed in Shleifer and Vishny , 1997. Also see Bertrand and Mullainathan, 2001; and Bebchuk and Fried, 2003).

expect that CEO incentives will adjust as a response to credit ratings changes, and such adjustments will be more pronounced among firms whose CEOs have been sub-optimally compensated (either overpaid or underpaid). We thus have

Prediction 5: The effect of credit ratings changes on CEO incentives is much larger form firms whose CEO incentive levels have previously deviated from the optimal levels the most.

Now consider the importance of the information environment in which the incentive contract is designed. If credit ratings changes affect CEOs' incentives through information dissemination channel, we would expect their impact to be more significant for firms with less transparent information environments. Put it another way, such impact is larger for firms whose investors have less accessible pubic information. We have

Prediction 6: The impact of credit ratings changes on CEO incentives is larger for firms whose investors have less accessible public information.

To sum up, we expect the impact of credit ratings changes to be more significant when the agency costs of managerial discretion and the benefits from rating agencies' monitoring are the largest. Based on the different theories, Predictions 2-5 map out the potential channels through which credit ratings changes may affect CEO incentives.

3 Data and Empirical Strategy

3.1 Data, sample and variables

In this subsection we first explain sources of the data and construction of the sample for our empirical study, then we define variables and present summary statistics of the variables.

3.1.1 Data and sample construction

Data for this study comes from five sources. We retrieve executive compensation data from Standard and Poor's ExecuComp database. The database reports annual compensation flows as well as information related to changes in the value of stock and stock option holdings for the five top-paid executives, including the CEO, for each firm appearing in the S&P500 Index, S&P MidCap 400 Index, and the S&P SmallCap 600 Index for the period 1992-2003. We obtain firms's annual accounting information and credit ratings data from Standard and Poor's Compustat database.

We use S&P historical long-term domestic issuer credit ratings (data 280) in our study. We obtain stock return data from the Center for Research in Security Prices (CRSP) Monthly Stock File. We compute a firm's probability of informed trading (PIN) in a given year by using intraday trading data extracted from the Trade and Quote (TAQ) database. We obtain institutional equity holdings from the CDA/Spectrum 13f Institutional Holdings database. For our empirical study, we measure all monetary terms in 1992 constant dollars, and we adjust nominal stock returns by the Consumer Price Index (CPI) from the Bureau of Labor Statistics to obtain real stock returns.

Merging Compustat and Execucomp databases, we obtain a sample of 10,301 firm-year observations with credit ratings. Table 1, Panel A reports the distribution of credit ratings of firms (excluding unrated firms). For brevity we report the distribution based on the broad rating measure which includes the minus, middle, and plus specifications for a particular rating. That is, a broad rating of "AA" refers to firms with ratings of "AA+", "AA", and "AA-"; and similar to the other broad rating measures. The panel shows that the bulk of firms in our sample have ratings between "A" and "BB", comprising 82.57% of our sample. A-rated, BBB-rated and BB-rated firms account for 29.62%, 33.43%, and 19.52% of the sample, respectively. In contrast, only 167 firms (1.62%) are AAA-rated, 704 firms (6.83%) are AA-rated, 801 firms (7.78%) are B-rated over the twelve-year period. Overall, 71.86% of our observations have investment-grade ratings (i.e., have broad rating categoeis "BBB" or above). The panel also shows a shift of the firm ratings distribution over time. The number of speculative-rated firms tend to increase steadily and the number of A-or-above-rated firms tend to decrease steadily over time. This trend becomes more conspicuous after the year of 1999, probably reflecting the lasting impact of the stock market crash and the ensuing economic recession in 2001.

Table 1, Panel B reports the distribution of credit rating changes. We convert firms' credit rating into the following cardinal scales: 1 for "AAA", 2 for "AA+", 3 for "AA", 4 for "AA-", and so on until 22 for the default category "D". We calculate the change in credit ratings in a year as the credit rating level at the year-end minus the credit rating level at the last year-end. Thus a positive change means downgrading and a negative change implies upgrading. Because it requires two consecutive observations to calculate credit rating changes, the sample reduces to 8,967 firm-year observations. Among them there are 1,174 downgrades, 795 upgrades, and 7,007 observations without rating changes. Again, the panel shows that the number of downgrades increases rapidly and exceeds

the number of upgrades over time, consistent with the well-documented downward trend in US corporate debt ratings in the past three decades (see, e.g., Blume, Lim, and MacKinlay (1998)). This is particularly the case after the year of 1999, corroborating the evidence displayed in Panel A that the rating quality seems to decline as a result of the worsening business conditions in the post-1999 period.

In this study we create a matched sample and apply the difference-in-difference-type (DD) estimation method to evaluate the impact of rating changes on CEO incentives (see details on the DD-type estimation in Section 3.2). We view each rating change as one treatment received by a firm and define the event date by t. The treated firms (or the subjects) are the firms experiencing rating changes, and the untreated firms (i.e., firms without receiving rating changes) serve as a pool of potential control firms. By matching on the pre-treatment firm characteristics of no-rating-change firms and rating-change firms, we form a comparison group that are comparable to the subjects. Specifically, for each subject, we first identity all possible candidates from the pool of no-rating-change firms if the subject and the candidates have the same credit ratings and are in the same three-digit industry in the year immediately prior to rating changes, i.e., $t-1$.[11] We then randomly pick, for each subject, one comparison firm from the group of possible candidates as a control if the group contains more than one matched firms. Our results remain qualitatively similar if we use as a control the average characteristics of the group of matched candidates for the subject. Consequently, we obtain a sample of 1,523 pairs of matched observations containing both the subjects and their corresponding controls. As shown in Table 1, Panel C, there are 925 pairs of downgrades and 598 pairs of upgrades in the sample. Also, the number of downgrades exceeds the number of upgrades in most of the years.

The DD-type estimation compares the difference in outcomes after and before the treatment for groups affected by the treatment to the same difference for unaffected groups. This requires that each chosen subject (and each control as well) has consecutive credit ratings from the year before rating changes (i.e., $t-1$) through the year immediately after the rating changes (i.e., $t+1$). This restriction further filters observations from the sample and reduces the sample size to 1,197

[11] We essentially treat the credit rating as a sufficient statistic for firm characteristics and a score for matching. Standard & Poor's corporate rating methodology provides a framework that ensures all salient issues are considered. The credit analysis concerns both business risk and financial risk. The business analysis covers industry characteristics, competitive position and management. The financial analysis includes accounting quality, financial characteristics, financial policy, profitability, capital structure, cash flow protection, and financial flexibility, etc.

firm-year observations with 723 downgrades and 474 upgrades. We conduct our empirical analysis using this refined sample.

3.1.2 Variables

We define the credit ratings change variable, *Change*, as the difference of a firm's numerical credit ratings in any two consecutive years.[12] We control for firm characteristics such as size, stock return volatility, market-to-book ratio, aggregate institutional holding and concentrated institutional ownership. The empirical compensation literature has identified these variables to be important determinants of cross-section variations in CEO incentives (see, e.g., Jensen and Murphy, 1990; Murphy, 1999; Aggarwal and Samwick, 2001; and Hartzell and Starks, 2003). We calculate firm size ($SIZE$) as the logarithm value of the market capitalization of common equity (data 25 times data 199) at fiscal year-end. We compute the annualized percentage volatility of stock returns (VOL) using the past five years of monthly stock return data. We obtain the market-to-book ratio (MTB) as the market value of assets divided by the book value of assets. The market value of assets is equal to the book value of assets (data 6) plus the market value of common equity less the book value of common equity (data 60) and balance sheet deferred taxes (data 74). We respectively calculate aggregate institutional holding ($INSTH$) as the total institutional share holdings in percentage of the total number of shares outstanding, and the concentrated institutional holding ($INSTC$) as the top-five institutional share holdings in percentage of the total institutional share holdings. We use three proxies, two accounting and one market, for firm performance. The accounting measures are profit margin ($Profit$) and return on assets (ROA), which are respectively derived as the ratio of net income (data 172) to sales (data 12) and the ratio of net income to total assets (data 6). The market measure is the real stock return (RET), which is the annualized percentage nominal returns adjusted by the annual CPI. We measure CEO incentives by Jensen and Murphy's (1990) pay-performance sensitivity. We focus on stock-based incentives as various studies document that the equity-based incentive simply swamps incentive provisions due to changes in other compensation components like salary and bonus (Hall and Liebman, 1998; and Murphy, 1999). We define the stock-based incentive (PPS) as the dollar value change in the CEO

[12]Throughout our analysis, we winsorize the absolute value of *Change* at 5, because firms with magnitude of rating changes larger than 5 notches are normally involving mergers & acquisitions, CEO turnovers, or other extreme corporate events.

stock and stock option holdings per $1,000 change in shareholder value. Also, we report the CEO ownership (OWN) as the CEO's shareholdings (excluding options) in percentage of the company's outstanding shares.

Table 2 presents summary statistics of the above variables for credit-rating-change firms (subjects) and their matched non-rating-change firms (controls) in the period from one year before rating changes (i.e. at t-1), which is the benchmark year, to one year after rating changes (i.e. at t+1), with the rating change date (event year) denoted by t. Panel A reports the mean, standard deviation and number of non-missing observations of the variables for downgrading firms and their controls. From the benchmark year $t-1$ to the event year t, firm size, market-to-book ratio, profit margin and return on assets all decline, and firm risk measured by stock return volatility increases. Even though the stock return increases in the same period, the average stock returns are significantly negative at -6.256% in year $t-1$ and -2.472% in year t. As stated in the S&P documents on credit ratings, these variables belong to the set of factors considered by the rating agency to adjust the ratings. Overall, these variables combined signal why a downgrading occurs in year t. Both CEO pay-performance sensitivity and stock ownership decrease slightly from year $t-1$ to year t. After the downgrading, i.e, from the event year t to the post-treatment year $t+1$, firm risk continues to rise and firm size does not change significantly. There is a slight increase in market-to-book ratio and significant improvements in profit margin, return on assets, and stock return. In particular, the average stock returns turn from negative returns before or on the rating change date to positive returns (19.229%) after the downgrading and far exceeds the average stock returns before the downgrading. In contrast, the profit margin and return on assets remain negative at -0.268% and -0.197% and still below their before-rating-change levels, respectively. After the downgrading, the pay-performance sensitivity continues to decline slightly but the stock ownership increases and exceeds the ownership in the benchmark year $t-1$. Both aggregate institutional holding and concentrated institutional ownership increase from the benchmark year to the event year, but they virtually remain unchanged from the event year to the post-treatment year $t+1$.

In the same period from the benchmark year $t-1$ through the post-treatment year $t+1$, the matched controls of downgrading firms experience similar patterns as the subjects in terms of stock return volatility, aggregate institutional holding, concentrated institutional ownership, profit margin, return on assets and stock return; firm size remains virtually unchanged across

time; and both CEO incentive and CEO stock ownership of controls decrease steadily. Note that, dramatically different from the subjects, the two accounting measures and the market measure of firm performance for the controls stay at positive levels in each year, and there are no significant differences in these three performance measures between the benchmark year $t-1$ and the post-treatment year $t+1$. Also note that the decline in CEO incentives for subjects have a significantly smaller magnitude than the decline in CEO incentives for controls from year $t-1$ through year $t+1$.

Table 2, Panel B reports the mean, standard deviation and number of non-missing observations of the variables for upgrading firms and their controls. Both firm size and firm risk rise steadily from the benchmark year $t-1$ to the post-treatment year $t+1$. Market-to-book ratio, aggregate institutional holding, profit margin and return on assets all increase first from years $t-1$ to t and then decline from t to $t+1$. Concentrated institutional ownership declines from $t-1$ to t and increases from t to $t+1$. Stock return, CEO incentives and CEO stock ownership decline uniformly from $t-1$ through $t+1$. Specifically, stock returns average at 41.751% before upgrading, 30.620% in the upgrading year and 15.212% after upgrading, respectively; CEO pay-performance sensitivities drop from 30.167 in $t-1$ to 26.712 in t and further down to 24.725 in $t+1$; CEO stock ownership falls from 2.128% before upgrading to 1.929% in the event year and further to 1.867% in the year immediately after upgrading. In the same period from the benchmark year $t-1$ through the post-treatment year $t+1$, the matched controls of upgrading firms experience similar patterns as the subjects do in terms of firm size and stock return volatility. The controls see a general trend of declines in market-to-book ratio, concentrated institutional ownership, profit margin, return on assets, CEO incentives and CEO stock ownership over the period. Note that the decline in CEO incentives for subjects has a significantly larger magnitude than the decline in CEO incentives for controls from year $t-1$ through year $t+1$.

Comparing upgrading firms with downgrading firms, we find that upgrading firms have higher levels of size, market-to-book ratio, aggregate institutional holding, profit margin, return on assets, stock return, CEO incentive and CEO stock ownership but lower concentrated institutional ownership than downgrading firms in almost every year of the period. The upgrading firms have slightly higher stock return volatility in year $t-1$ but lower stock return volatility in years t and $t+1$ than downgrading firms, reflecting the fact that firm risk increases as a result of downgrading.

There are significant differences in performance measures and CEO incentives between the two groups of firms. For example, the profit margins of downgrading firms are negative in years t and $t+1$ and only 1.189% in year $t-1$ while the profit margins of upgrading firms hover above 6% in all of the three years; the CEO incentives of of downgrading firms are no more than 18.10 each year while the CEO incentives are at least 24.70 each year. More importantly, there is a conspicuous difference between downgrading firms and upgrading firms in the pattern of changes in performance measures. The stock returns of downgrading firms increase sharply from -6.256% in the benchmark year $t-1$ to 19.229% in the post-treatment year $t+1$ while the stock returns of upgrading firms decrease sharply from 41.751% in the benchmark year $t-1$ to 15.212% in the post-treatment year $t+1$. The profit margin and return on assets of downgrading firms increase significantly from the event year t to the post-treatment year $t+1$ while the two performance measures for upgrading firms slightly decrease from years t to $t+1$. Furthermore, there is a not-so-trivial difference between downgrading firms and upgrading firms in the pattern of changes in CEO stock ownership and CEO incentive measures. The CEO stock ownership of downgrading firms increases slightly from 1.378% in year $t-1$ to 1.420% in year $t+1$ while the CEO stock ownership of upgrading firms decreases in a relatively larger magnitude from 2.218% in year $t-1$ to 1.867% in year $t+1$. CEO incentives of downgrading firms decrease by 1.509 from 18.012 in year $t-1$ to 16.503 in year $t+1$ while the CEO incentives of upgrading firms decrease in a much larger magnitude (by 5.442) from 30.167 in year $t-1$ to 24.725 in year $t+1$. If we take into account the reductions in CEO incentives over the same period for both controls of the two groups of subjects, we find that CEO incentives of downgrading firms actually gain by 2.454 *relative to their controls* and CEO incentives of upgrading firms actually lose by 2.150 *relative to their controls*. All in all, the above univariate summary statics indicate that credit downgrading improves firm performance (absolutely) and CEO incentives (relatively) while credit upgrading hurts firm performance and CEO incentives both absolutely and relatively.

Table 3 reports summary statistics of changes in firm/CEO-specific characteristics in the one-year, two-year, three-year and four-year periods after the credit ratings changes relative to the benchmarks in the year immediately prior to the rating changes, with Panels A and B designated for downgrading firms and upgrading firms, respectively. The table characterizes patterns of firm/CEO characteristics changes similar to what we have discussed based on Table 2. Moreover, Table 3 shows that the patterns of changes remain prevalent well beyond the first post-treatment year $t+1$.

That is, the impacts of rating changes are not transitory but rather persistent, and the impacts in the first post-treatment year contribute most to the overall lasting impacts in the post-treatment years to come. Specifically, firm size, stock return volatility and aggregate institutional holding steadily rise from years $t+1$ to $t+4$ for both downgrading firms and upgrading firms; downgrading (upgrading) firms experience a general trend of increases (decreases) in market-to-book ratio, profit margin, return on assets, stock return and CEO incentives and a general trend of decline (increase) in concentrated institutional ownership in the post-treatment period of $t+1$ to $t+4$. The lasting improvements (reductions) in CEO incentives for downgrading (upgrading) firms gain additional significance relative to their respective controls. These observations on intertemporal changes in firm/CEO characteristics reinforce the evidence based on Table 2 that firm performance and CEO incentives seem to receive a boost following credit downgrading and a hit following credit upgrading.

3.2 Empirical strategy

A predominant specification in the literature to evaluate treatment effects is firm-year panel regressions, with which we assume that the *levels* of CEO compensations/incentives are driven by a variety of firm and industry characteristics (see, e.g., Aggarwal and Samwick, 1999; and Hartzell and Starks, 2003) and we examine the incremental effect of credit ratings changes in a panel regression of firm-years. This approach suffers two weaknesses, though. Bertrand, Duflo, and Mullainathan (2004) point out that such panel regressions overstate the significance of the treatment effects. They demonstrate that the overstatement arises from the presence of serial correlation in the indicator variables measuring the shock (i.e., credit rating change in our study) and that conventional parametric methods to solve the serial correlation problem do not work well. In our setting, indicator variables for credit rating changes are consecutively zero for several years (indicating the pre-treatment periods) and then consecutively 1 for several years (indicating the post-treatment periods). In the presence of such autocorrelation, each firm-year observation provides little new information, so a typical panel regression obtains significant results by overstating the number of observations. Another issue associated with the firm-year panel regression is that the credit rating change is an endogenous variable, which is not easy to tackle with in the panel regression setting.

Instead, in this empirical study we build on the DD-type estimation method and use the *changes*

specification at firm-level. That is, we compare the changes in CEO incentives for treated firms to the changes in CEO incentives for comparable untreated firms controlling for the changes in firm characteristics that affect CEO incentives, where the changes are measured relative to the pre-treatment benchmark year $t-1$. This approach results in one pairs of observations (treated firm and control firm included) per firm event. Note that, as explained earlier, for each treated firm under observation we identify a control firm which comes from the same three-digit industry and has the same credit rating as the treated firm in year $t-1$. We conjecture that credit ratings changes have both an immediate impact and a lasting impact on CEO incentives, so we examine the impacts in two different horizons. We study the immediate treatment effects by focusing on the changes in CEO incentives in the year immediately after the rating change (i.e. $t+1$) relative to the benchmark year. To study the lasting impact of rating changes on CEO incentives, we follow Bertrand, Duflo, and Mullainathan's (2004) proposal to collapse the multi-year post-treatment observations for each firm into a single observation by focusing on the average changes in CEO incentives in the post-treatment period relative to the benchmark year.

We measure CEO incentives by pay-performance sensitivities (PPS) and define ΔPPS as the average change in PPS in the one-year, two-year, three-year, and four-year periods after the credit ratings change minus PPS in year $t-1$. We follow an analogous approach to calculate changes in firm characteristics as covariates for ΔPPS and lag these covariates by one year to be consistent with the empirical compensation literature. We specify our basic model as

$$\begin{aligned} \Delta PPS_i &= \beta_0 + \beta_1 change_i + \beta_2 \Delta size_i + \beta_3 \Delta vol_i + \beta_4 \Delta mtb_i + \beta_5 \Delta insth_i \\ &\quad + \beta_6 \Delta instc_i + \varepsilon_i. \end{aligned} \tag{1}$$

Here, we control for changes in such firm characteristics as size ($size$), stock return volatility (vol), market-to-book ratio (mtb), aggregate institutional holding ($insth$) and concentrated institutional ownership ($instc$). These variables have been found to be important determinants of cross-section variations in CEO incentives.[13] In equation (1), the variable *change* measures the credit ratings

[13]See, e.g., Schaefer (1998) for research on firm size, Garen (1994), Aggarwal and Samwick (1999), and Jin (2002) for research on return volatility (risk), Smith and Watts (1992) and Gaver and Gaver (1993) for research on growth opportunity, and Hartzell and Starks (2003) for institutional ownership. Industry and year effects are important determinants of CEO incentives as well. Our firm-level changes specification controls for both effects in that the industry effect is differenced out across time and the year effect enters equation (1) as one component of the intercept.

change and is our variable of interest. The estimated coefficient β_1 is the primary coefficient of interest, capturing the impact of credit ratings changes on CEO incentives. We test our hypotheses by examining the sign and significance of the estimated coefficient.

This econometric specification has two appealing features to our research questions. First, a changes specification cancels out any fixed and time-invariant firm-specific effects and allows for time-invariant unobservable differences between treatment and comparison group individuals, thus alleviating concerns that such effects might be driving our results. Consequently, equation (1) is a parsimonious way to implicitly control for the endogeneity of *change*. Second, Bertrand, Duflo, and Mullainathan (2004) propose that collapsing the multiple observations for each firm into a single observation yields more reliable inference than other specifications in DD-type estimations. We therefore stick to this basic specification throughout our empirical analysis. We carry out analyses using other model specifications and discuss them in the section of robustness check.

The specification in equation (1), to a certain extent, controls for the endogeneity of rating changes. One may still wonder whether such a control is enough given that a large empirical literature finds credit ratings changes to be endogenously driven by a variety of factors. Therefore, explicitly and systematically controlling for the endogeneity of *change* may be necessary. Towards this objective, we take both *change* and ΔPPS as endogenous variables and form a system of simultaneous equations. We perform the two-stage least-square regression (2SLS) on the system. In our 2SLS regressions, the equation for ΔPPS follows equation (1), and we use instrument variables to specify the equation for *change* as:

$$\begin{aligned} Change_i &= \theta_0 + \theta_1 \Delta size_i + \theta_2 \Delta vol_i + \theta_3 \Delta mtb_i + \theta_4 \Delta insth_i + \theta_5 \Delta instc_i \\ &\quad + \tau z + \delta, \end{aligned} \tag{2}$$

where the variable z refers to a set of instruments, including the firm's characteristics in the benchmark year $t-1$: credit rating ($Lrate$), firm size ($Lsize$), stock volatility ($Lvol$), the market-to-book ratio ($Lmtb$), the ratio of debt (long-term plus short-term) to total assets ($Ldebt$), the ratio of net income to interest expenses ($Lfcov$), and the ratio of net income to total sales ($Lprofit$); and the corresponding changes in the above firm characteristics from the benchmark year $t-1$ to

the event year t: $\Delta Size0$, $\Delta vol0$, $\Delta mtb0$, $\Delta debt0$, $\Delta fcov0$, and $\Delta profit0$.[14]

4 Empirical Results

4.1 Do credit ratings changes affect the CEO incentives?

We perform the 2SLS estimation on the the set of equations comprised of equations (1) and (2). The first-stage regression is on equation (2) for the endogenous credit ratings change variable *Change* using a set of instrumental variables. The second-stage regression is on equation (1) replacing the variable *change* with its fitted value from the first-stage regression. To increase the efficiency of the estimations we estimate the two stages jointly and this is done by using the Stata command "ivreg". We adjust for hetereoscedasticity and clustering of firms when calculating robust standard errors of the estimates. For brevity, we report only the second-stage regression results in Table 4.[15]

We examine the immediate impact of rating changes on CEO incentives. Table 4, Column (1) reports the result of CEO incentive changes (δPPS) one year after the credit ratings changes. We find that *Change* is significantly and positively related to change in CEO incentives (ΔPPS), with a coefficient of 2.941 and an associated t-statistic of 1.82. One notch decrease in a firm's credit rating ($Change = 1$) causes a \$2.941 increase in its CEO's incentive level. The positive sign of the coefficient of *Change* also implies that an upgrade of credit rating leads to decreased CEO incentives. Note that the economic magnitude of the impact of credit rating change on CEO incentive level is significant. The median and mean of PPS in our sample are \$7.663 and \$24.291, respectively. Thus a one-notch downgrade of firm credit rating improves CEO incentive level by 38.38% (12.11%) relative to the sample median (mean).

Modifying CEO compensation behavior takes time. Therefore, we expect the effect of credit rating changes on CEO incentives to last for several years. In Columns (2)-(4), we define ΔPPS as the average PPS in the two-year, three-year, and four-year periods after the credit ratings

[14]To check whether the two simultaneous equations are properly identified, we examine if the error term in Equation (1) is correlated with the instruments Z. That is, $E[\epsilon z] = 0$. We find very low F-statistics in most of our regressions. Throughout our empirical analysis, we stick to this set of instrumental variables.

[15]The first-stage regression results show that the rating change, with downgrading denoted by positive rating changes, is positively related to the debt and risk levels in the benchmark year and the changes in debt and risk from the benchmark year to the event (rating-change) year; the rating change is negatively related to credit rating, size, profit margin, and growth opportunity in the benchmark year and the change in profit margin from the benchmark year to the event year. The results also imply that the downgrading tends to reduce firm size and increase firm risk and aggregate institutional ownership. The other parameter estimates are statistically insignificant.

changes minus PPS in year t-1 respectively. The explanatory variables in Equation (1) are defined accordingly by lagging their averages by one year. E.g., $\Delta size$ in Column (2) is defined as the average firm size from t to t+1 minus firm size in t-1, while $\Delta size$ in Column (3) is defined as the average firm size over the period from t to t+2 minus firm size in t-1. Again, we estimate Equations (1) and (2) simultaneously. We only report the second-stage regression results in Table 4. The estimated coefficients of *Change* in Columns (2)-(4) are 3.796, 4.673, and 5.586 respectively. All of them are statistically significant. We note an increasing pattern in the magnitude of the coefficient of *Change* across time, suggesting that the impact of credit rating change on CEO incentives tends to intensify over time. Take the result from Column (3) as an example. A one-notch downgrade of a firm's credit rating on average causes a \$4.673 increase in its CEO's incentive from its pre-rating-change level in the three-year period after the credit change, which represents a 60.98% (19.24%) increase from the sample median (mean).

The contrasting effect of downgrades (where $Change > 0$) and upgrades (where $Change < 0$) is puzzling. One may suspect whether the explanatory power of the variable *Change* is solely driven by upgrading firms or downgrading firms. In addition, our above approach uses linear probability models, which implicitly assumes that the average quality difference between any two adjacent ratings, such as AAA and AA+, is the same as that between BBB and BB+. Although no conclusive evidence has demonstrated that a conceptually superior probit model performs better than the linear probability model, we employ the probit model to check the robustness of our findings.[16]

We partition our samples into two sub-samples — one contains the downgrading firms and their control firms, and the other contains upgrading firms and their control firms. Instead of using *Change* as a measure of credit ratings changes, we define two dummy variables $DOWN$ and UP. $DOWN$ (UP) takes the value of 1 if $Change > 0$ (< 0) and zero otherwise. We modify the basic model in equation (1) as follows

$$\begin{aligned} \Delta PPS_i &= \beta_0 + \beta_1 DOWN_i(UP_i) + \beta_2 \Delta size_i + \beta_3 \Delta vol_i + \beta_4 \Delta mtb_i + \beta_5 \Delta insth_i \\ &\quad + \beta_6 \Delta instc_i + \varepsilon_i. \end{aligned} \tag{3}$$

[16]Kaplan and Urwitz (1979) and Noreen (1988) compare the performance of of the linear probability model and the probit model and do not find convincing evidence showing one is better than the other.

To control for the endogeneity of $DOWN$ and UP, we specify the following equation for the first-stage regression:

$$\begin{aligned} DOWN_i(UP_i) &= \theta_0 + \theta_1 \Delta size_i + \theta_2 \Delta Vol_i + \theta_3 \Delta mtb_i + \theta_4 \Delta INSTH_i + \theta_5 \Delta INSTC_i \\ &\quad + \tau Z_i + \delta_i, \end{aligned} \tag{4}$$

where Z is the same set of variables as specified in Equation (2).

We fit the treatment-effects model using the Heckman's (1979) two-step consistent estimation on the set of equations specified in equations (3) and (4). The treatment-effects model considers the effect of an endogenously chosen binary treatment ($DOWN$ or UP in our study) on another endogenous continuous variable (ΔPPS in our study). We estimate a probit model on equation (4) in the first step and substitute the fitted probabilities for the treatment dummies in the second-step estimation of equation (3). We use the Stata command "treatreg" to implement the estimation of the treatment-effects model, and we calculate robust standard errors by adjusting for hetereoscedasticity and clustering of firms. Columns (1)-(4) of Table 5 present the second-step estimation results when we apply this model specification to the downgrading firms and their control firms. Here we examine the average CEO incentive changes relative to its pre-event level in the one-year, two-year, three-year, and four-year periods after the credit downgrades. We find that the estimated coefficients of $DOWN$ are 2.27, 4.42, 7.44, and 9.09 respectively. All of them are statistically significant. The result indicates that relative to the control firms, downgrading firms' CEO incentives tend to improve after the credit downgrades.

Table 5, Columns (1')-(4') report the second-step estimation results for the upgrading firms and their control firms. Similarly, we examine the average CEO incentive changes relative to its pre-event level in the one-year, two-year, three-year, and four-year periods after the credit upgrades. The estimated coefficients of UP are -6.97, -8.63, -11, and -18.11

respectively. Although it is not significant in the first year after the upgrades, it becomes statistically significant afterwards.

The results in Table 5 offer support for the evidence reported in Table 4. That is, downgrades cause a statistically and economically significant increase in CEO incentives in up-to four years after the downgrades, while upgrades lead to a significant decrease in CEO incentives.

4.2 An alternative model specification

The success of our empirical strategy hinges on whether we can successfully cope with the endogeneity of the credit rating changes variables. In this section, we propose an alternative model specification to offer further evidence that our results are robust.

For each treatment firm under observation, we compute the average change in PPS for its control firm over the same period, $\Delta PPStrend$, and use it as a regressor:

$$\begin{aligned} \Delta PPS_i &= \beta_0 + \beta_1 PPStrend_i + \beta_2 \Delta size_i + \beta_3 \Delta Vol_i + \beta_4 \Delta mtb_i + \beta_5 \Delta INSTH_i \\ &\quad + \beta_6 \Delta INSTC_i + \varepsilon_i. \end{aligned} \tag{5}$$

In the above equation, the variable $\Delta PPStrend$ controls for unobserved factors in the contracting environment, which may affect the CEO incentives. Since we are using differenced variable in the specification, the effect of the unobserved firm-specific time-invariant factors is eliminated. Equation (5) thus provides one alternative way to resolve the endogeneity of credit ratings changes. We estimate Equation (5) among the downgrading firms and upgrading firms separately. We compute changes in firm characteristics as controls for changes in PPS level. The changes in firm characteristics are computed accordingly by lagging one year. β_0 is the coefficient of interest.

We report the regression results in Table 6. Columns (1) to (4) presents the regression results for downgrading firms up to fours years after the downgrades. After we control for the factors that may affect changes in CEO incentives, we find that the intercept coefficient, β_0, is positive and significant at the 10% level. The estimated coefficients are 1.17, 1.47, 3.11, and 3.85 respectively. The results suggest that credit downgrades lead to an increase in CEO incentives and such an impact tend to increases over time. Columns (1') to (4)' present the regression results for upgrading firms. The intercept coefficients, β_0, are negative in all four cases. However, it is not statistically significant in the first three cases, but becomes significant if we examine the four-year average. The results offer a weak support for our early finding that credit upgrades lead to reduced CEO incentives.

4.3 The economic magnitude of credit ratings changes

Our three specifications in Sections (4.1) and (4.2) all offer consistent empirical evidence that credit upgrades and downgrades have contrasting effect on CEO incentives. However, it is still unclear whether such changes in CEO incentives would have any material economic effects after credit rating changes.

We examine the economic consequence of credit ratings changes in this section. We examine both a firm's operating performance and its stock market performance. We define ROA as a firm's return on total asset, and RET as a firm's annualized stock return in a given year. We then compute a firm's average changes in ROA and RET up to two years after credit rating changes.[17] We specify the following model:

$$\begin{aligned} \Delta ROA_i(\Delta RET_i) &= \beta_0 + \beta_1 DOWN(UP) + \beta_2 \Delta size_i + \beta_3 \Delta Vol_i + \beta_4 \Delta mtb_i + \beta_5 \Delta INSTH_i \\ &\quad + \beta_6 \Delta INSTC_i + \varepsilon_i, \end{aligned} \tag{6}$$

where $DOWN$ and UP are the downgrade and upgrade dummies defined earlier. To control for the endogeneity of $DOWN$ and UP, we apply the two-stage regression approach and estimate Equations (6) and (4) simultaneously. We report the results in Table 7.

Columns (1) to (4) present the results for downgrading firms and their control sample, where the changes in ROA and RET in the one-year, and two-year periods are used as the dependent variables respectively. As shown in Column (1), the coefficient of $DOWN$ is significantly negative at -5.36, indicating that a downgrading firm's operating performance worsens in the year immediately after the downgrade. The finding shows that rating agencies do make sound assessment about firms' future cash flow situations. Results in Column (3) however shows that the coefficient of $DOWN$ is significantly positive at 5.09, indicating that firms' operating performance improves two years after downgrades. This finding, together with our early finding that CEO incentives tend to improve after credit ratings changes, seems to support that credit rating downgrades help to discipline CEOs' behavior and as a result, lead to improved performance. In an unreported analysis, we examine the correlation between ΔROA and ΔPPS in the two-year period after downgrades, and find that

[17] We also examine firms' performance changes two year after credit rating changes and find qualitatively similar results.

it is significantly positive.

Columns (2) and (4) offer further support by showing that downgrades lead to improved firm stock market performance. The estimated coefficients of $DOWN$ are significantly positive at 0.58 and 0.50 when average $\Delta RETs$ in the one-year and two-year periods are used as the dependent variables, respectively. It is interesting to note that stock market performance starts to improve even one year after downgrades, although the operating performance keeps worsening. We examine the correlation between ΔRET and ΔPPS and find that it is positive.

We then apply this equations system to the upgrading firms and their control sample. We report the second-stage regression results in Columns (1') to (4'). The coefficient of UP, when the average change in ROA in the one year period is used as the dependent variable, is significantly positive at 6.36. This result suggests that upgrading firms' operating performance continues to go strong one year after upgrades. However, the operating performance starts to worsen in the two-year period. As shown in Column (3'), the estimated coefficient of UP is significantly negative at -7.51 when the two-year average change in ROA is used as the dependent variable.

Columns (2') and (4') offer evidence that upgrades lead to worsened firm stock market performance following credit rating upgrades. The estimated coefficients of up are significantly negative at -1.45 and -1.06, when average $\Delta RETs$ in the one-year and two-year periods are used as the dependent variables respectively. We examine the correlation between ΔRET and ΔPPS in an unreported analysis. Again, we find that these two variables are significantly and positively related to each other, indicating that improved PPS leads to improved stock market performance.

4.4 Discussions of the results

The empirical evidence stated in Sections 4.1- 4.3 shows that credit ratings changes have significant impact on CEO incentive levels — while upgrades caused reduced CEO incentives, downgrades help to improve CEOs' incentive levels. Our results are robust to model specifications.

Our findings so far are clearly inconsistent with the risk-incentive tradeoff based theory. Although credit ratings downgrades associate with heightened risk, CEOs' incentives increase. Similarly, upgrades imply reduced risk, but our analysis shows that CEO incentives reduce. Our findings provide partial support for the information dissemination based argument. Changes in credit ratings are well-disseminated information events. Principals are thus able to better leverage

newly disseminated information to better motivate CEOs. This line of reasoning explains improved CEO incentives following downgrades well. But it does not go along with the evidence that upgrades lead to reduced incentives, unless we assume that upgrades worsen the informativeness in the contracting environment.

Our empirical evidence also lends support for the CEO private control benefits based argument. CEOs, out of concerns that they may lose their private control benefits and sunk their firm-specific human capital investment, may align their interest more closely with the firm interest. However, this line of reasoning can not fully account for the observation of reduced CEO incentives following credit upgrades. Upgrades reduce the likelihood of CEO losing private control benefits and firm-specific human capital investment, but they do not necessarily lead to a much decreased incentive level.

Another plausible theory that may account for our empirical findings so far is that credit ratings changes affect CEO incentives through corporate governance channel. Credit ratings changes may complement incentive pay as one important corporate governance mechanism to discipline the mangers. In the case of downgrades, public attentions are drawn to the firms, CEOs' quiet life are terminated, and various corporate governance mechanisms (e.g., institutional investors, boards, medias, and etc.) are triggered to play much more effective roles. As a result, CEOs' incentive levels get improved. In the case of upgrades, bondholders' disciplinary role may get weakened for several reasons. First, upgrades indicate strong earnings prospects, which may strengthen CEOs' bargaining power and weaken the power of principals to discipline managers. CEOs are thus better positioned to renegotiate more favorable compensation packages for themselves. To the extent that the increased pay increases the risk on the CEOs through excessive ownership of shares and options, CEOs are likely to reduce their share ownership by selling shares.[18] Second, the reliance on pay-for-performance compensation schemes may decrease as a result credit ratings upgrades.[19]

[18] See for example, Ofek and Yermack, 2000; and Bertrand and Mullainanthan, 1999.

[19] Another plausible reason for the reduced PPS after upgrades is that CEOs may have inside information about firms' true earnings prospects. They are able to time the market by selling share when ratings are upgraded (stock prices go up) and buying shares when ratings are downgraded (stock prices go down).

5 Cross-sectional Evidence

The aforementioned theories (except for the risk-incentive tradeoff theory) collectively explain our empirical findings. To better understand through which potential channels credit ratings changes impact on CEO incentives, we carry out cross-sectional analysis below.

5.1 Investment grades vs. speculative grades

We start with the pre-event credit rating levels. We conjecture that the effect of credit rating changes on CEO incentives is more pronounced for firms with investment grade debts. To test this, we partition our sample into two subsamples based on whether a firm's credit rating at the end of the year immediately before the downgrades/upgrades is BBB or higher (investment grade). We estimate the simultaneous set of equations as specified in Equations (1) and (2) on the two subsamples separately, and report the results in Table 8.

Columns (1) and (2) present the second-stage regression results of the average change in PPS in the one-year and two-year periods for the firms with investment grade debts. We find results analogous to those obtained earlier for the full sample — PPS increases with *Change*. That is, downgrades lead to improved pay-performance sensitivity while upgrades lead to reduced pay-performance sensitivity. In contrast, as shown in Columns (3) and (4), we find that the coefficient of *Change* is not significantly different from zero for the firms with speculative grade debts.

The results in Table 8 seem to suggest that CEOs of firms with investment grade debts are more concerned with credit ratings changes, and respond more strongly to changes in credit ratings, while CEOs of firms with speculative grade credit ratings tend to be less responsive.

5.2 Does the presence of institutional shareholders matter?

As our second cross-sectional analysis, we split the firms into two sub-samples depending on whether the percentage of shares held by institutional investors at the end of the year $t-1$ immediately exceeded 63.5% (the sample median). We conjecture that institutional investors can better exert their monitoring effect on the CEO when a firm's shares are largely held by institutional investors. In the case of downgrades, both information dissemination based theory and corporate governance based theory predict that CEOs of firms with a larger presence of institutional

shareholders tend to improve their incentives. In the presence of institutional investors, using new information disseminated through the downgrades of credit ratings, the principals can better design compensation contracts. Meanwhile, downgrades may trigger larger public attentions and more effective monitoring on the CEOs when the shares are largely held by institutional shareholders. In the case of upgrades, the information dissemination theory may not apply any more. However, the corporate governance theory still holds. In the presence of institutional shareholders, the reliance on incentive pays to align CEOs' interests with those of the shareholders may get weaker when good news (upgrades) arrives. Other corporate governance mechanisms (e.g., institutional shareholders) step in and have been shown to be effective.

We estimate the simultaneous set of equations as specified in Equations (1) and (2) on the two subsamples separately. we report the results in Table 9. As shown in Columns (1) and (2), for the firms with a larger presence of institutional shareholders, we find that CEO incentives increase with *Change*, which is analogous to the results obtained from the full sample. However, for firms with a smaller presence of institutional shareholders, results from Columns (3) and (4) show that *Change* is not significantly different from zero. Clearly, our earlier empirical findings are more likely to be driven by firms with larger presence of institutional investors.

5.3 Is the impact of credit ratings changes a function of the effectiveness of incentive pay contract?

Core and Guay (1999) find that firms use annual grants options and restricted stocks to CEOs to manager the optimal level of equity incentive levels. Specifically, they model optimal equity incentive levels for CEOs, and use the residuals from this model to measure deviations between CEOs' holdings of equity incentives and optimal levels. They find that grants of new incentives from options and restricted stock are negatively related to these deviations. Given the findings in Core and Guay (1999), one wonders whether the impact of credit ratings changes on CEO incentives would be more significant for firms whose CEOs' incentive levels deviate from the optimal levels the most.

Our conjecture is based on the following two reasonings. First, when a CEO's incentive level largely deviates from the optimal level, the credit rating change triggers the adjustment of the CEO's incentive pay towards the optimal level because new information comes out. Second, such

adjustment could be more urgent since CEOs' quiet life has been terminated and the demand for more effective corporate governance mechanism gets heightened. To test this conjecture, we first follow Core and Guay (1999) and model a firm's optimal CEO incentive level as follows:

$$\begin{aligned} PPS_{i,t-1} &= \gamma_0 + \gamma_1 size_{i,t-2} + \gamma_2 Vol_{i,t-2} + \gamma_3 mtb_{i,t-2} + \gamma_4 CEOTenure_{i,t-2} + \gamma_5 INSTH_{i,t-2} \\ &\quad + \gamma_6 INSTC_i + \gamma_7 industry\ dummy_{i,t-2} + e_{i,t-1}. \end{aligned} \tag{7}$$

We then use the absolute value of the residuals from the above model, $PPSDEV$, to split our sample into two sub-samples. Firms with $PPSDEV$ larger than the sample median (4.37) are the firms which practice ineffective incentive pay schemes.

We estimate the simultaneous equation set specified in Equations (1) and (2) on the two subsamples separately. We report the results in Table 10. Columns (1) and (2) report the second-stage regression results for firms with ineffective incentive pay contracts at the end of the year immediately before the credit rating changes. Column 1 shows that the estimated coefficient of *Change* is significant positive at 4.349, indicating that CEOs' incentive tend to improve after downgrades and reduce after upgrades. Such impact last into the second year after credit ratings changes (as shown in Column 2). However, the results from Columns (3) and (4), where we examine the firms with $PPSDEV$ smaller than the sample median, show insignificant estimated coefficients for *Change*. Our earlier empirical findings likely are driven by firms with less effective incentive pay contracts.

5.4 Does firm size matter?

We wonder whether the impact of credit ratings changes CEO incentives varies across firm size. Large firms tend to have less severe information asymmetry problem. But on the other hand, their CEOs may have more significant career and reputation concerns. Also, large firms tend to draw more public attentions. It is thus an empirical issue whether large firms' CEO are more sensitive to credit ratings changes than smaller firms' CEO.

We partition our sample into two subsamples based on whether a firm's equity market valuation at the end of the year immediately before the downgrades/upgrades is bigger than the sample median (its natural logarithm is 7.79). We then estimate the simultaneous set of equations as

specified in Equations (1) and (2) on the two subsamples respectively, and report the results in Table 11.

Columns (1) and (2) present the second-stage regression results of the average change in PPS in the one-year and two-year periods for the large firms, while Columns (3) and (4) report the regression results for small firms. For large firms, as shown in Columns (1) and (2), we find results analogous to those obtained earlier for the full sample. Specifically, we find that the estimated coefficients of *Change* are significantly positive, suggesting that CEO incentives increase with downgrades but decrease with upgrades. As a contrast, the estimated coefficient of *Change* is not significantly different from zero for the firms with their size smaller than the sample median.

The results in Table 11 seem to suggest that CEOs of large firms are more concerned with credit ratings changes, and respond more proactively to the changes in credit ratings, while CEOs of small firms tend to be less responsive.

5.5 Does the information environment matter?

As our last cross-sectional analysis, we wonder whether the information environments in which the firms operate would have any impact on our empirical findings. This conjecture is based on the following reasoning. If a firm's stock investors lack access to public information, they will not be able to exert effective monitoring on the CEOs. However, the credit rating changes disseminate new information, which the shareholders can leverage to better motivate CEOs. Thus, we expect that the impact of credit rating changes on CEO incentives is more significant for firms with a lack of access to public information.

To test whether it is true, we use probability of informed trading (PIN) developed by Easley, Kiefer, and O'Hara (1996, 1997) as a proxy for the amount of private information based trading. That is, a high PIN suggest a stock's trading is more likely to be driven by private information, thus a firm might lack enough access to public information. We therefore expect that CEOs of firms with higher PIN tend to respond more responsively towards credit ratings changes. We compute PIN for each firm in our sample on an annual basis. We then split our sample firms into two groups based whether a firm's PIN measure is bigger than the sample median (0.13) at the end of the year immediately before the credit ratings changes. we repeat the same routine and estimate the simultaneous set of equations as specified in Equations (1) and (2) on the two subsamples

respectively. We report the results in Table 12.

Columns (1) and (2) present the second-stage regression results of the average change in PPS in the one-year and two-year periods for the firms with larger PIN — that is, firms without enough access to public information. As shown in Columns (1) and (2), we find empirical results analogous to those obtained earlier for the full sample. We find that the estimated coefficients of *Change* are significantly positive, suggesting that CEO incentives increase with downgrades but decrease with upgrades. However, when we examine the subsample of firms with smaller PIN, we find that the estimated coefficient of *Change* is not significantly different from zero any more. Clearly, the results in Table 12 suggest that information environment does affect the impact of credit ratings changes on CEO incentives.

6 Concluding Remarks

In this paper, we provide evidence on an important, yet unaddressed, issue that is at the confluence of executive compensation and credit rating literatures — do credit ratings changes affect CEO incentives? Modeling credit ratings changes and changes in CEO incentives as jointly endogenous variables, we document evidence that rating agencies' (or more broadly bondholders) monitoring helps to discipline the mangers and resolve agency conflicts. Specifically, we find that credit downgrades increase CEOs' equity-based incentives, while upgrades reduce CEO incentives. We also find evidence showing that the effects of credit ratings changes on CEO incentives are more significant for larger firms, firms with investment grade debts, firms with a larger presence of institutional investors, and firms with less access to valuable information. We also document that credit ratings changes help to adjust CEOs optimal incentive level, especially for those whose CEOs have been seriously mis-compensated previously. Overall, our findings show that credit ratings changes affect CEO incentives and such effects tend to be more significant when agency costs of managerial discretion and the demand for more effective corporate governance mechanisms are higher. This paper adds a new dimension to the traditional principal-agent model by emphasizing the roles of rating agencies (debt holders). The introduction of bond holders twists the principal-agent dynamics. It also yields several interesting empirical implications that are supported by our empirical findings.

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