

Credit Ratings as Coordination Mechanisms

Arnoud W. A. Boot

University of Amsterdam and CEPR

Todd T. Milbourn

Washington University in St. Louis

Anjolein Schmeits

New York University

In this article, we provide a novel rationale for credit ratings. The rationale that we propose is that credit ratings serve as a *coordinating mechanism* in situations where multiple equilibria can obtain. We show that credit ratings provide a “focal point” for firms and their investors, and explore the vital, but previously overlooked implicit contractual relationship between a credit rating agency (CRA) and a firm through its credit watch procedures. Credit ratings can help fix the desired equilibrium and as such play an economically meaningful role. Our model provides several empirical predictions and insights regarding the expected price impact of rating changes.

Credit ratings are quite prevalent in financial markets. Most corporate bond issues have at least one rating, many have two. In fact, the two most prominent rating agencies—Moody’s and Standard & Poor’s (S&P)—adhere to a policy of providing a rating for most taxable corporate bonds publicly issued in the United States. For many observers of the financial markets, credit ratings appear to have real importance. However, the financial economics literature has cast doubt on the importance of ratings. For example, in their leading textbook, Brealey and Myers (2003) claim that “[firms and governments] almost certainly exaggerate the influence of rating agencies, which are as much following investor opinion as leading it” (p. 685). More broadly, there appears to be fundamental disagreement on whether ratings play a meaningful economic role and, relatedly, whether ratings (and rating changes) have a real informational content. In fact, the empirical evidence surrounding credit ratings seems

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far from conclusive. In our view this is not surprising. What is missing from the literature is an understanding of the way ratings come about and the role credit ratings actually play in the financial markets. From this perspective, we will show that credit ratings play an economically meaningful role, confirming their increasingly important role in practice.¹ Moreover, our analysis speaks directly to why such seemingly disparate empirical findings may not be so puzzling, nor disparaging of the value of credit ratings.

What we show is that credit ratings can serve as “focal points”. By this we mean that credit ratings help fix the desired equilibrium in environments for which multiple equilibria would otherwise exist. In doing so, credit ratings help reduce fragility in the financial markets. We believe that credit ratings derive their value primarily from two institutional features. The first is the monitoring role of credit rating agencies, which is most apparent in their credit watch procedures. The second is the role credit ratings play in the investment decisions of institutional investors. The credit watch procedure is a previously much overlooked institutional feature of credit rating agencies. Their job is not just the initial information dissemination, but also to take action when market and/or firm developments threaten to affect the credit rating. In that case, a monitoring regime is put in place through a credit watch procedure. The credit watch allows for an implicit contract between the firm and the credit rating agency (CRA) where the former implicitly promises to undertake specific actions—recovery effort in our formulation—to mitigate the possible deterioration of its credit standing (and rating). While we will explicitly link the implicit contract to the (formal) credit watch procedure, it could also work without such a formal (and publicly announced) procedure. The second institutional feature is important for the incentive compatibility of the implicit contract. That is, the practice that institutional investors condition their investment decisions on the rating gives “bite” to the implicit contract between the CRA and the firm. We show that the credit rating and the associated implicit contract is incentive compatible provided that a group of (institutional) investors conditions its decisions on the rating.²

¹ Ratings appear to have gained importance over time. Some illustrations are the proliferation of credit-risk models, their prominence in the new Basel (BIS II) capital regulation framework and the importance of credit ratings for the growth of structured finance. See Nickell, Perraudin and Varotto (1999), Carey and Hrycay (2001), Altman, Bharath and Saunders (2002), and Saunders (2002) for some interesting work on the issue of credit-risk models. Also the behavior of firms suggests that credit ratings are really important, for example, Kisgen (2005) shows that firms adjust their capital structure to maintain a particular bond rating. Faulkender and Petersen (2005) show that firms that have a bond rating choose higher levels of debt financing.

² The conditionality of investment decisions on the credit rating is also recognized in the recent SEC report on the role and function of credit rating agencies: “Today, credit ratings affect securities markets in many ways, including an issuer’s access to capital, the structure of transactions, and *the ability of fiduciaries and others to make particular investments*” (emphasis added) [SEC (2003), p. 5].

There is ample evidence on the presence of this second institutional feature. Pension fund guidelines often stipulate that investments are only allowed in highly-rated issues (e.g., those of investment grade). Dating back to as early as 1936, government regulations in the United States have prohibited various types of financial institutions from holding speculative-grade bonds.³ Similarly, specific markets, such as the Eurobond market, may simply require the presence of a particular minimum rating before listing the debt issue. These rigidities effectively condition the investors' decisions on the observed rating, and let rating agencies play their role as "focal points."⁴

In the setting that we analyze, we let firms that are in need of debt financing interact with the financial market. Investors in the market cannot readily observe the firms' project choices nor the recovery effort. This may induce moral hazard. We show that depending on the beliefs of the market, a firm might be induced to choose a high-risk strategy rather than a more viable low-risk one. For instance, if the market anticipates a high-risk project choice, it will demand a high coupon rate. The market's belief then may be self-fulfilling: once the firm is confronted with the high funding cost, it will *optimally* engage in the high-risk project. Alternatively, the firm might be induced to choose a low-risk project if that is what the market anticipates. Thus, multiple equilibria may be present, and depending on which project is first best, the equilibrium might be dissipative.⁵

What we show in our model is that if a sizeable proportion of investors (e.g., pension funds) *follows* the credit rating and bases its investment decisions on the rating, others rationally follow as well. This can resolve the multiple equilibria problem and resolve recovery effort moral hazard, and points at the focal point role of credit ratings that we develop in this article.⁶

³ Cantor and Packer (1997) provide a select list of rating-based US regulations. For instance, the Congressional promulgation of the Financial Institution Recovery and Reform Act of 1989 prohibited savings & loans institutions from investing in below-investment-grade bonds. Imposing a higher ratings bar, the SEC amendment to Rule 2a-7 under the Investment Company Act of 1940 required money market mutual funds to limit holdings of low-rated bonds, where the minimum rating imposed was A+ (A1).

⁴ Other examples of links between investor behavior and credit ratings are clauses that link particular decisions to credit ratings. For example, in the case of Enron, the proposed takeover by Dynegy was made contingent on having an investment-grade rating. Moreover, some of Enron's partnerships required accelerated debt repayments if stock prices declined significantly *and* a credit rating downgrade to noninvestment-grade (speculative) status occurred [International Herald Tribune (2002), February 9–10, p. 9].

⁵ The underlying asset substitution problem is similar to Stiglitz and Weiss (1981), but their single creditor focus excludes coordination problems. Fragility is also found in Dow and Rossienky (1999). They build a model of a financial firm that finances itself by issuing risky debt. After funds are raised, the investment opportunity set may change and cause a suboptimal asset-liability mix inducing multiple equilibria problems.

⁶ The role that credit ratings play in our theory has links to the literature on "cheap talk", such as Spatt and Srivastava (1991) and Morris (2001). The argument is that a credit rating in the "focal point" interpretation only has value because some investors choose to take the announced rating seriously. In doing so, they affect the funding cost and consequently the behavior of the firm, which in turn confirms the rating.

Our article does not address the criticism that ratings are often lagged indicators of firm quality, as has been put forward in, for example, the recent collapse of Enron.⁷ However, our theory could explain lags when rating agencies grant firms some time to put recovery effort in place before deciding on the rating change. We also do not consider moral hazard problems on the part of credit rating agencies.⁸ These issues are undoubtedly of great importance and rightfully feature in the public policy debate. However, we see uncovering the *raison d'être* of credit ratings as a necessary first step in understanding the role and functioning of credit rating agencies. Filling this void is our primary objective.⁹

Our work incorporates some other insights that are brought forward by practice. Practitioners often claim that credit ratings are deemed essential to access a wider group of investors. S&P writes [Dallas (1997)] that

Among the key benefits, ratings often provide the issuers with an “entry” ticket in public debt markets, broadening the issuers’ financing opportunities.

Issuing bonds to a specific group of investors or floating them on a particular market may only be feasible if a credit rating is present. For example, ratings may help in disseminating information to relatively uninformed investors. Rating agencies could be seen as information-processing agencies that may speed up the dissemination of information to financial markets. As put forward by Moody’s [McDaniel (1997)], another prominent rating agency,

The ratings are intended to provide investors with an independent, forward-looking assessment of long-term credit risk according to a globally comparable standard.

⁷ See US Senate Hearings (2002): “On March 20, 2002, the Senate Committee held a hearing – entitled ‘Rating the Raters: Enron and the Credit Rating Agencies’ [...]. The hearing sought to elicit information on why the credit rating agencies continued to rate Enron a good credit risk until four days before the firm declared bankruptcy [...].”, and US Senate Staff Report (2002): “[...] in the case of Enron, credit rating agencies displayed a lack of diligence in their coverage and assessment of Enron.”

⁸ Covitz and Harrison (2003) investigate whether credit rating agencies are conflicted and favor issuer interests at the expense of investor interests. They find no support for this. A fundamental issue is also whether the increasing income that rating issuers get from structured finance related services could undermine their core corporate bond rating business, for example, induce conflicts of interest.

⁹ The lack of theory and the almost exclusive empirical focus of the literature on credit ratings is one of the main conclusions in the Editorial of the November 2004 Special Issue on Credit Ratings of the *Journal of Banking and Finance*, see Cantor (2004).

Thus, ratings could act as “information equalizer”, thereby enlarging the investor base.¹⁰ In our theory, credit ratings have a role as information equalizer, albeit a more subtle one. In particular, we will argue that ratings serve as a focal point in that in the end all investors may rationally base their investment and pricing decisions on the rating, anticipating that sufficiently many will do so. As discussed, institutional rigidities (such as restrictions to hold only investment-grade securities) could make such an equilibrium robust. If we are right, and we do believe that the coordination of beliefs function of ratings is quite significant, ratings may actually be insurance policies against a bad equilibrium.

Our analysis produces several implications that are consistent with existing empirical evidence. In particular, the pervasive empirical finding that stock prices respond negatively to rating downgrades, yet are relatively unresponsive to upgrades, is predicted by our analysis. In addition, our model generates several new and empirically-testable predictions related to the credit watch procedure, the firm’s initial credit quality, and the feasibility of recovery effort. With respect to the price effects of the announcement of rating changes, our model suggests that rating changes occurring after a credit watch procedure will be more informative than in the absence of a credit watch. Actually, our theory suggests that the empirically verifiable informational content of ratings is primarily linked to the credit watch procedure. This yields a set of sharper empirical tests. For example, we predict that firms for which recovery effort is most likely to be effective will experience only a small stock price drop at the initial release of bad news and then only a small and positive reaction to a rating confirmation after a credit watch procedure. However, if the same firms are downgraded after a credit watch, the stock price response will be large and negative. Ultimately, our predictions directly link the credit watch procedure to the anticipated price response to rating changes. Our model additionally yields predictions about the likelihood of firms being put on credit watch after a deterioration in credit quality. This likelihood is nonmonotonic in the effectiveness of recovery effort and also depends on the firm’s initial credit quality.

The rest of the article is organized as follows. Section 1 describes the model and contains the basic equilibrium analysis. Section 2 examines credit ratings as a resolution to multiple equilibria. In Section 3, we extract several new empirical predictions and discuss existing empirical evidence. Section 4 discusses applications and extensions of our analysis.

¹⁰ This “information equalizer” feature is reminiscent of the information sharing in credit markets through credit bureaus as observed in many countries [Pagano and Jappelli (1993, 2002)]. Although credit bureaus typically focus on consumer and small business lending, some information production and sharing on larger corporations is observed as well (e.g., credit reports of Dun & Bradstreet). An unexplored question is how this type of information sharing relates to that of credit rating agencies.

Section 5 concludes and delineates additional avenues for future research. All the proofs are in the Appendix.

1. The Model

1.1 Production possibilities for firms

We model an economy in which firms seek \$1 of external financing from investors to invest in a project. Each firm in the economy has access to a viable (low-risk) project or strategy VP , and a high-risk alternative HR . Both projects (strategies) have a positive NPV, but $NPV(VP) > NPV(HR)$. We assume universal risk neutrality and a zero riskfree interest rate.

The viable project VP generates a cash flow of X_{VP} with a probability $\tilde{p} \in [0, 1]$, and 0 otherwise. The parameter \tilde{p} can be thought of as the credit quality of the firm. The ex ante ($t = 0$) anticipated value of \tilde{p} equals p_0 , but the firm's credit quality may change over time. To simplify the analysis, we allow for a potential shift in credit quality *prior* to the actual financing and investment. In particular, at $t = 1$, the firm may receive a good signal elevating the credit quality to p_G or receive a bad signal resulting in a credit quality p_B , with $p_B < p_0 < p_G$. If the credit quality has deteriorated to p_B , we allow the firm to engage in a costly recovery effort e that with a probability $\beta \in [0, 1]$ succeeds in restoring the credit quality to p_0 . Following this, the project choice is made. Project cash flows are realized at $t = 2$. We summarize the sequence of events in Table 1.

Alternatively, the firm can deviate to a high-risk project or strategy HR . Project HR yields a cash flow of $X_{HR} > X_{VP}$ with a probability $q \in [0, 1]$, and 0 otherwise. We assume that $p_B X_{VP} > q X_{HR} > 1$. That is, investment in project VP is first-best efficient, *even* if the credit quality is low.

1.2 Information structure, funding costs, and equilibrium behavior

The information structure is such that investors cannot contract on the firm's project (or risk) choice as this is privately known to the firm. Thus

Table 1
Sequence of events

$t = 0$	<ul style="list-style-type: none"> • The firm announces that it needs to raise \$1 of external financing for investment • Nature determines the initial credit quality $\tilde{p} = p_0$ of the viable project (VP)
$t = 1$	<ul style="list-style-type: none"> • Credit shock leads to $\tilde{p} \in \{p_B, p_0, p_G\}$, with $p_B < p_0 < p_G$ (publicly observable) • Potential for costly "recovery effort" e of the firm. If successful, this can elevate p_B realization to p_0 • Actual financing and investment. Investors lend \$1 in exchange for a fixed repayment F^T, with $\tau \in \{VP(\tilde{p}), HR\}$. The firm chooses between the viable project VP and the high-risk project HR
$t = 2$	<ul style="list-style-type: none"> • Project's payoff is realized. The firm makes debt repayment, if possible, and will default otherwise

project payoffs are unobservable and noncontractible. The signals about credit quality are publicly observable. All financing is through debt contracts.¹¹ Each loan consists of \$1 to fund the investment and dictates a repayment amount denoted by F^τ , where $\tau \in \{VP(\tilde{p}), HR\}$ represents the market's conjecture of the firm's project choice and in the case of project VP also its credit quality \tilde{p} . Note that since investors cannot observe the firm's project choice nor the recovery effort after the bad signal, they can only condition the terms of the loan on their beliefs with respect to the project (and recovery effort) chosen by the firm. For now, we ignore the recovery effort; thus, following a bad signal, the credit quality is (and remains) p_B .

We assume that credit markets are perfectly competitive. Investors therefore determine the repayment amount F^τ which yields them zero expected profit in equilibrium. That is, $E(F^\tau) = 1$ for $\tau \in \{VP(\tilde{p}), HR\}$. Given the firm's credit quality $\tilde{p} \in \{p_B, p_0, p_G\}$, the repayment amount on the loan if investors anticipate that the firm chooses project VP is given by

$$F^{VP(\tilde{p})} = \frac{1}{\tilde{p}}. \quad (1)$$

If investors anticipate that the firm chooses project HR , the repayment amount on the loan satisfies

$$F^{HR} = \frac{1}{q}. \quad (2)$$

Since $\tilde{p} > q$, we have $F^{HR} > F^{VP(\tilde{p})}$. Given the funding costs in (1) and (2), the firm's equilibrium project choices are as follows. We focus on Bayesian Perfect Nash Equilibria.

Theorem 1. *The firm's project choice in equilibrium depends on its credit quality \tilde{p} . In particular, the following regions can be distinguished:¹²*

1. *If $\tilde{p} < \underline{p}$, then the firm always chooses project HR , regardless of investors' beliefs (anticipation) with respect to its project choice.*
2. *If $\underline{p} \leq \tilde{p} < \bar{p}$, then the firm chooses whichever project investors anticipate will be taken. That is, if investors anticipate that the firm chooses the viable project VP , the firm optimally chooses VP . However, if*

¹¹ In the work of Townsend (1979) and Gale and Hellwig (1985), costly state verification upon default has been used to rationalize debt contracts. Contrary to these models, our analysis also involves an asset substitution moral hazard problem. As in Diamond (1991), in such a setting optimality of debt can be established if verification costs of cash flows are substantial and consumption cannot be negative. See also Allen and Winton (1995).

¹² Dependent on the parameters in the model, region 2 and/or region 3 could be empty. This is the case if the quality of project HR is either very high or very low (i.e., if the success probability q is either very large or very small). For details, see the proof of Theorem 1 in the Appendix.

investors anticipate project HR, then it is optimal for the firm to choose HR. Hence, in this region there are multiple equilibria.

3. *If $\tilde{p} \geq \bar{p}$, then the firm chooses the viable project VP, regardless of investors' beliefs with respect to its project choice.*

The results in Theorem 1 show that the project choice for a firm of medium credit quality ($\underline{p} \leq \tilde{p} < \bar{p}$, region 2) depends on the market's prior beliefs with respect to its project choice. If the credit quality of the firm is low ($\tilde{p} < \underline{p}$, region 1) or high ($\tilde{p} \geq \bar{p}$, region 3), then investors' beliefs about the firm's project choice are unimportant. The intuition is that for low \tilde{p} (region 1), the quality of the viable project vis-à-vis the high-risk project is relatively low, such that the firm has no incentive to invest in the viable project. In this case, the moral hazard problem is so severe that the firm always engages in asset substitution with external financing. That is, the high-risk project would be chosen even if the market anticipates the viable project choice. On the other hand, for high \tilde{p} (region 3), the quality of the viable project relative to the high-risk project is sufficiently high, such that the firm always chooses the viable project, irrespective of the repayment amount of the loan (i.e., even if the market anticipates the high-risk project choice). In this region, moral hazard problems are small, and we only observe the good equilibrium.

Theorem 1 shows that for a firm of medium quality ($\underline{p} \leq \tilde{p} < \bar{p}$, region 2), multiple equilibria are possible as investor beliefs about the firm's project choice are paramount in determining which equilibrium obtains. Within this region, it is optimal for the firm to choose the project that is *anticipated* by the market. Thus, even though the viable project is first best and is feasible, investor beliefs can drive the firm to the undesirable (bad) equilibrium where the high-risk project is chosen. In the remainder of the article, we focus on this region where multiple equilibria are possible.

1.3 Resolving the multiple equilibria problem

In this subsection, we show that if there exists a sufficiently large subset of investors that believe that a firm will choose the viable project *VP*, the remaining investors will also *rationally* conjecture that the viable project will be chosen. In Section 2, we analyze how credit ratings could facilitate such "coordination" among investors. The more fundamental issue is what does the investors' behavior imply for the firms for which multiple equilibria exist? As derived in Theorem 1, for region 2, firms optimally choose whichever project the market anticipates. However, this result can be generalized. That is, if a sufficiently sizeable subset of investors anticipates the viable project to be chosen, firms will in fact find it in their best interest to choose the viable project, and vice versa.

This observation can be modeled as follows. Let's for now assume that $\alpha \in [0, 1]$ is the proportion of investors that believes that a particular firm

always chooses the viable project VP . The remaining proportion $(1 - \alpha)$ of investors simply forms their own beliefs over the firm's project choice, but is aware of the presence of the α investors. What we will show is that if the proportion of investors "playing" the good equilibrium (α) is sufficiently large, the firm *always* chooses the viable project VP , regardless of the conjectures of the remaining $(1 - \alpha)$ investors.

Observe that with two different investor classes, we can envision the firm auctioning off the total debt claim in two portions involving the same security. Thus, both investor classes buy identical securities. The proportion α of investors anticipates the viable project VP . This implies that the price of their debt claim is such that $F^{VP} = 1/\tilde{p}$, see (1).¹³ If the remaining $(1 - \alpha)$ investors anticipate that the high-risk project HR will be chosen, they require a higher repayment amount, i.e., $F^{HR} = 1/q$, see (2). The total repayment amount faced by the firm is therefore given by

$$F^\alpha = \alpha F^{VP} + (1 - \alpha) F^{HR}. \quad (3)$$

It can easily be seen that for any $\alpha \in (0, 1)$, $F^\alpha \in (F^{VP}, F^{HR})$, and that this weighted average loan repayment amount is decreasing in the fraction α of investors anticipating the viable project choice (i.e., $\partial F^\alpha / \partial \alpha < 0$). Thus, the funding costs decline as the proportion α increases.

Facing such financing costs, the firm compares its expected net payoff from choosing project VP to that of project HR . If the firm chooses the high-risk project HR , as the $(1 - \alpha)$ investors anticipate, then its expected net payoff is given by

$$\Pr(HR \text{ succeeds}) \times (X_{HR} - F^\alpha) + \Pr(HR \text{ fails}) \times 0 = q(X_{HR} - F^\alpha), \quad (4)$$

while if it chooses the viable project VP , its expected net payoff equals

$$\Pr(VP \text{ succeeds}) \times (X_{VP} - F^\alpha) + \Pr(VP \text{ fails}) \times 0 = \tilde{p}(X_{VP} - F^\alpha). \quad (5)$$

The critical proportion α^* equates (4) and (5). We can now proceed to our result that formalizes the impact of the proportion α of investors on the firm's equilibrium project choice.

Theorem 2. *For every $\underline{p} \leq \tilde{p} < \bar{p}$, there exists a critical proportion of investors $\alpha^* = \alpha^*(\tilde{p})$ that believe the viable project will be chosen, such that for $\alpha > \alpha^*$ the firm always chooses the viable project VP . In this case, the remaining $(1 - \alpha)$ investors also rationally assume that the firm chooses VP . Hence, the financing costs are given by F^{VP} whenever $\alpha > \alpha^*$.*

¹³ In the remainder of the analysis, we suppress the argument \tilde{p} in the expression of $F^{VP(\tilde{p})}$.

What this theorem states is that a significant proportion of investors playing the good equilibrium (conjecture VP) can actually guide firm behavior to the desired (first-best) project choice. The remaining proportion $(1 - \alpha)$ of investors should then rationally anticipate the viable project choice as well. The intuition for this result is as follows. Investors who anticipate that the firm will choose the viable project will price the debt repayment commensurately. And while there are other investors who may anticipate that the high-risk project will be chosen, funding costs are reduced as the proportion of investors playing the good equilibrium (α) increases (recall that $\partial F^\alpha / \partial \alpha < 0$). The critical proportion α^* of investors playing the good equilibrium is such that for all $\alpha > \alpha^*$ the funding costs F^α [see (3)] are low enough to induce the firm to choose the viable project VP , even when the other $(1 - \alpha)$ investors would anticipate the high-risk project choice. At any proportion of such investors above this threshold, the firm will always choose the viable project. Since the beliefs of these α investors are then fully confirmed in equilibrium, the remaining $(1 - \alpha)$ investors rationally conjecture the firm's preference for VP as well. Thus, all investors anticipate the viable project choice, and the funding costs equal F^{VP} given in (1), for all $\alpha > \alpha^*$.

The assessment of the viable project's credit quality \tilde{p} determines the precise value of α^* .

Corollary to Theorem 2. *The critical proportion of investors, α^* , such that the firm always chooses the viable project whenever $\alpha > \alpha^*$, is decreasing in the firm's credit quality \tilde{p} .*

This Corollary to Theorem 2 states that the minimum proportion of investors playing the good equilibrium (α^*) that is necessary to ensure the selection of the viable project is strictly decreasing in the assessment of the viable project's credit quality \tilde{p} . The intuition is similar to that of Theorem 2. Intuitively, at higher levels of credit quality (i.e., higher \tilde{p}), the funding cost is relatively low and asset substitution problems are small. Hence, a lower threshold α^* is sufficient. Similarly, a deterioration in the viable project's credit quality may induce the firm to shift to the high-risk project; consequently, a higher proportion α is needed to prevent this.¹⁴

¹⁴ Observe that with a substantial deterioration in credit quality the firm may migrate to region 1 in Theorem 1, in which case project HR is always chosen.

2. Credit Ratings as a Resolution to Multiple Equilibria

In this section, we establish the role that credit ratings play in our model and derive the key results. We first focus on the interactions between the CRA and the firm and subsequently analyze the role of credit ratings within the context of our model.

2.1 Interactions between CRA and the firm

Central to our theory is that credit ratings help mitigate the multiple equilibria problem in that the credit ratings serve as focal points. In our model formulation, this is relevant for the region of credit qualities where multiple equilibria are possible ($p \leq \tilde{p} < \bar{p}$, region 2). A key element to our theory is that institutional rigidities link the actions of some investors to the observed credit ratings. For example, institutional investors make up a sizeable portion of the debt market, but are often restricted to invest in only highly-rated firms. Their investment behavior is therefore (partially) driven by the announced ratings. The question now is why some investors are ever willing to base their investment decisions on the rating.

Recall that the rating as focal point has no informational content in our model. While it could identify the good equilibrium, the possibility of such an equilibrium was already known to the market. Here it is crucial to consider the role a CRA plays in practice and, in particular, the credit watch procedure. What has previously been ignored is that a CRA does have regular interactions with firms and engages in implicit contracting with the firm. How does this work? Whenever the CRA observes *potential* changes in firm characteristics, it will notify management and ask for clarification. The rating is then often put “on watch.” The firm will generally be asked to provide information on how it is going to deal with the change. The firm implicitly commits to undertake specific actions (the recovery effort) to mitigate the possibly adverse consequences of the change. For this, concrete targets with associated deadlines are often set. During this period the rating continues to be “on watch.” If the firm manages to live up to this implicit contract and the firm’s actions are effective, the rating may get reconfirmed. If not, a downgrade could occur.¹⁵

¹⁵ Observe that this is *not* a “consultative” service of CRAs. Rather, the firm may try to undertake corrective action to prevent a downgrade. While we have linked this process to the credit watch procedure, the same mechanism could be at work even when the credit watch has not formally been put in place. This was particularly relevant for Moody’s before the early 1990s and S&P before 1981, when formal credit watch procedures did not yet exist. The credit watch procedure should be distinguished from the “rating outlook” feature. Like the credit watch procedure, the rating outlook feature seeks to provide investors with timely information about potential changes. The credit watch procedure occurs under special circumstances, such as unanticipated operating developments, regulatory action, and mergers and recapitalizations and typically covers short periods of time (mostly resolved within 90 days). The outlook feature is an ongoing feature of all long-term ratings (except for structured finance), incorporating trends and risks with less certain implications for credit quality. Its horizon is more long term (typically over two years) and it should be considered more of a refinement of the rating.

An example of the dialogue that takes place between CRAs and firms can be found in the European telecommunications industry.¹⁶ During the years 2000 and 2001, several credit rating downgrades were suffered by prominent telecom firms, including British Telecom, France Telecom, Deutsche Telekom, and KPN. These downgrades came on the heels of several exchanges between various CRAs and these firms, as seen by the following quote: “Last September, Moody’s downgraded companies including KPN and France Telecom and said it would give them 12–18 months to reduce their debt in line with their new ratings (effectively threatening them with further downgrades).”

The existing credit ratings literature has ignored this interaction between CRA and firm and, therefore, overlooked the “control” that the CRA has over the behavior of the firm. Strictly speaking, the control comes from the investors that base their investment and pricing decisions on the credit rating and in doing so make the implicit contract between CRA and firm incentive compatible. For market participants, this implies that a credit rating has a potentially valuable contractual feature and could now have informational content.¹⁷

The interaction between CRA and firm—and the implicit contract associated with this—often points at a “negative watch” qualification. Credit rating agencies typically contract with firms on preventing downgrades. Not surprisingly then, our theory predicts that (ultimate) downgrades are negative news and have a negative stock market impact, whereas upgrades may not have a stock market impact. The following analysis formulates the process by which credit ratings can serve as an incentive-compatible coordination mechanism.

2.2 Credit ratings in equilibrium

We assume that $\underline{p} \leq p_0 < \bar{p}$. That is, the initial credit quality associated with the viable project VP places the firm in region 2 (see Theorem 1).¹⁸ Before it raises the financing (i.e., *before* the financing terms are set), the firm receives a good or a bad signal that determines the ultimate value of \tilde{p} . In the case of a good signal, we assume a sufficiently positive adjustment in the credit quality, such that it pushes the firm up to region 3, that is, $\tilde{p} = p_G > \bar{p}$. Similarly, in the case of a bad signal, the firm’s viable

¹⁶ See Alice van Duyn and Rebecca Bream, “Credit Rating Agencies Show Their Teeth,” *Financial Times*, February 27, 2001, p. 28.

¹⁷ Credit rating agencies are exempt from Regulation FD, which stipulates that all information should be revealed to the market. This helps facilitate the potential information content of the rating changes themselves. Indeed, Jorion, Liu and Shi (2005) show that following the introduction of Regulation FD the informational role of CRAs has increased, albeit that the asymmetry in the magnitude of stock price responses to rating changes (downgrades versus upgrades) has been preserved.

¹⁸ Where relevant, we will also consider region 1 or region 3 as starting regions for p_0 in the remainder of our analysis.

project's quality is pushed down to region 1, that is, $\tilde{p} = p_B < \underline{p}$. The signal received by the firm is publicly observable.

A key feature in our model is that after receiving a bad signal (i.e., $\tilde{p} = p_B$), the firm can engage in costly "recovery effort" (see Section 1.1) and restore the credit quality to the initial level p_0 . That is, the firm can undertake actions that mitigate the negative impact of the signal on the credit quality of the viable project. Recovery effort, however, is not always successful. Only with a probability $\beta \in [0, 1]$ does it elevate the success probability to p_0 . With probability $(1 - \beta)$, recovery effort does not help and leaves the success probability equal to p_B . The parameter β reflects the "effectiveness" of recovery effort and is commonly known, but the success or failure of the recovery is only privately known. The firm (and potentially the CRA) can learn whether recovery effort is effective *after* the firm has committed to put in such effort. The private cost of recovery effort is c , with $c > 0$.

Although the signal with respect to the value of \tilde{p} is publicly observable, the recovery effort put in by the firm is not observable to investors nor verifiable. We assume that the cost of recovery effort is sufficiently small, such that

$$p_0 X_{VP} - c > p_B X_{VP}. \quad (6)$$

That is, if effective, recovery effort increases the surplus from investment in the viable project.

The role of the CRA is as follows. It assigns a credit rating ρ to the debt claim, where ρ depends on the credit quality \tilde{p} , that is, $\rho = \rho(\tilde{p})$. The credit rating ρ is a monotonically increasing function of the expected credit quality (or success probability) of the project choice that is anticipated by the CRA. In the case of a bad signal, the CRA can monitor the effectiveness of the firm's recovery effort in the context of a "credit watch". That is, the CRA can approach the firm after a bad signal has been received and have the firm commit to undertake recovery effort to restore the credit quality of the viable project. The CRA then effectively enters into an implicit contract with the firm and monitors the firm's recovery effort. Thus, the credit rating assigned by the CRA is based on a promise by the firm to undertake the specific actions necessary for recovery, as well as the effectiveness of the firm's actions to restore the risk profile of its investment opportunities. Through the credit rating ρ , the CRA communicates to the market whether recovery effort is effective or not.¹⁹ In this regard, ratings can bring new information to the market. The CRA seeks to induce the first-best project choice.

¹⁹ The CRA is an information seller and monitor in one. It is a financial intermediary that does not provide funding. See, for example, Allen (1990) for a model on the incentive compatibility of information sellers.

Table 2
Sequence of events in the presence of a Credit Rating Agency (CRA)

$t = 0$	<ul style="list-style-type: none"> • The firm announces that it needs to raise \$1 of debt financing to invest in a new project • Nature determines the initial credit quality $p_0 \in [p, \bar{p}]$ of the viable project VP • The CRA sets an initial credit rating ρ_0 based on the anticipated project choice, the viable project VP or the high-risk project HR
$t = 1$	<ul style="list-style-type: none"> • Both the firm and investors in the market may receive a publicly observable signal with respect to the credit quality of the viable project VP, leading to credit qualities $\tilde{p} \in \{p_B, p_0, p_G\}$ • In case of a bad signal, the CRA could initiate a credit watch procedure, in which case it monitors the firm and specifies the (costly) recovery effort the firm needs to exert to maintain its initial rating ρ_0 (CRA—with credit watch) • The firm chooses whether or not to undertake recovery effort. The recovery effort, if undertaken, is successful with probability β. The CRA assigns a rating ρ, either not knowing whether recovery effort is undertaken (in absence of a credit watch) or after observing the recovery effort and its success or failure (with credit watch) • Institutional investors condition their investment decisions on the rating. If the CRA assigns a high rating reflecting project VP, then the proportion α of institutional investors is allowed to invest, and conjectures that the firm chooses the viable project VP. Otherwise, they abstain from investing. The remaining $(1 - \alpha)$ of investors form beliefs about the firm's investment behavior based on the size of α • Investors lend \$1 in exchange for a fixed repayment $F(\rho)$ based on their beliefs about the firm's investment behavior and the credit rating • The firm chooses between the viable project VP and the high-risk project HR
$t = 2$	<ul style="list-style-type: none"> • The project's payoff is realized. The firm will repay its debt obligation, if possible, and will default otherwise

We assume that there is a proportion α of institutional investors in the economy that is restricted to investing in debt issues of sufficient quality. These investors are prohibited from investing in debt issues if the high-risk project HR is anticipated. The proportion $(1 - \alpha)$ of other investors faces no such restrictions. When institutional investors are barred from investing, we assume that there are sufficiently many other investors in the market to absorb the supply.²⁰ Observe that the debt funding cost at each moment in time reflects all public information, *including* the credit rating.

In what follows, we first focus on a “passive” role for the CRA. That is, we abstain from the credit watch procedure, and the CRA can only play a beliefs-coordinating role. Following this, we examine what happens when we introduce the credit watch procedure. Our primary focus is on what happens if the firm receives a bad signal. In that case, moral hazard problems become paramount, and a role for the CRA could emerge through the credit watch procedure. Table 2 summarizes the sequence of events in the model including the CRA.

²⁰ In our model there is no difference between barring institutional investors from investing or prohibiting them from conditioning their demand upon the bond's rating (as well as its price).

2.2.1 Firm and CRA: No credit watch. The starting point of our analysis is that the firm receives a bad signal at $t = 1$. The firm must now decide whether or not to put in recovery effort. We first establish the following result.

Lemma 1. *If no recovery effort is put in, or the recovery effort fails (with a probability $1 - \beta$), the credit quality remains at p_B , with $p_B < \underline{p}$, and the firm will always deviate to the high-risk project *HR*. If recovery effort is undertaken and succeeds, then the credit quality of the firm is restored to p_0 , with $\underline{p} \leq p_0 < \bar{p}$.*

The result in Lemma 1 shows that when the deterioration in credit quality is not (successfully) remedied, this pushes the firm toward the high-risk (second-best) strategy *HR*. Observe that if recovery effort is undertaken and is successful, then, similarly to Theorem 1, multiple equilibria exist. Depending on the beliefs of investors, the firm will choose the viable or high-risk project.

We now analyze how coordination among investors could come about. Effectively, we are back to the coordination problem of Theorem 2, but the situation is even worse because of recovery effort moral hazard. In the absence of monitoring by the CRA (and hence, no credit watch), CRAs could still play a role in coordinating investors' beliefs. Let's assume that sufficiently many institutional investors follow the rating assigned by the CRA. Thus, in the context of Theorem 2, α is sufficiently large to push the firm toward the viable project for any $\tilde{p} \in [\underline{p}, \bar{p}]$. We can now establish the following result.

Theorem 3 (no credit watch). *In the case of a bad signal ($\tilde{p} = p_B$), there exists a cutoff level $\bar{\beta} \in [0, 1]$ for the probability that recovery effort is successful, such that*

1. *If $\beta \geq \bar{\beta}$ (effective recovery effort), the firm undertakes recovery effort and the CRA assigns a rating $\rho(p_n)$, with $p_n \equiv \beta p_0 + (1 - \beta)q$, provided that the proportion of institutional investors that follow the rating exceeds α_n , with $\alpha_n > \alpha^*$, where α^* is defined in Theorem 2. The firm invests in the viable project if recovery effort is successful, otherwise it chooses project *HR*.*
2. *If $\beta < \bar{\beta}$ (ineffective recovery effort), the firm does not undertake recovery effort and the CRA assigns its lowest rating $\rho(q)$, reflecting the firm's choice for project *HR*.*

In this theorem with the credit watch procedure absent, the CRA plays a rather passive role. In the case $\beta < \bar{\beta}$, no recovery effort is undertaken and we have rating $\rho(q)$. In the case $\beta \geq \bar{\beta}$, it does not know whether the recovery effort was successful; the CRA can only assign an average rating $\rho(p_n)$. Because the repayment obligation $F^{VP}(\rho)$ is now always higher

than in the case of credit quality p_0 , moral hazard is worse and we now need the minimum proportion of institutional investors α_n to exceed α^* (as derived in Theorem 2) to make the coordinating role of the CRA effective. Only in the limit (as $\beta \rightarrow 1$) does α_n become equal to α^* . The theorem also shows that, when the firm's recovery effort is less effective ($\beta < \bar{\beta}$), the firm will abstain from recovery effort and instead always prefer to switch to the high-risk project; the coordinating role of a "passive" CRA is then not incentive compatible. We will show in the next subsection that this problem and also the larger institutional investor base $\alpha_n > \alpha^*$ needed in the case of $\beta \geq \bar{\beta}$ are mitigated by the credit watch procedure that is typical for CRAs.

Observe finally that in the absence of a credit watch procedure, the CRA does not have any informational advantage relative to investors in the market. Therefore, a rating change does *not* convey new information, but instead follows publicly available information, and the CRA only has a beliefs-coordinating role. Because this coordinating role could be anticipated, the rating (and rating changes) by itself would not have any announcement effect on stock prices. Thus, in the absence of a credit watch procedure, we expect to observe stock price responses only immediately following the publicly observed signals. A good signal will obviously be followed by a positive stock market response. The opposite is true for a bad signal; however, that response will be more intricate. Indeed, a negative stock market response will be observed following a bad signal, but for firms with $\beta \geq \bar{\beta}$ this response is muted by the anticipated recovery effort. Over time, the effect of the recovery effort becomes known to the market (it may fail). This will lead to some further positive or negative adjustments over time.

2.2.2 Firm and CRA with credit watch. An "active" CRA can initiate a credit watch procedure by announcing that it puts the firm "on watch". If the CRA initiates a credit watch procedure, the CRA can observe the firm's recovery effort, and discover (along with the firm) whether the recovery effort was successful in restoring the credit quality of the viable project. The CRA can then condition its credit rating ρ on this information and better anticipate the actual risk choice of the firm. The following theorem is the analog of Theorem 3 but now with the credit watch procedure.

Theorem 4 (credit watch). *In the case of a bad signal ($\tilde{p} = p_B$), there exists a cutoff level $\underline{\beta} \in [0, 1]$ for the probability that recovery effort is successful, such that*

1. *If $\beta \geq \underline{\beta}$ (effective recovery effort), the firm undertakes recovery effort. The CRA assigns a rating $\rho(p_0)$ if the recovery effort is successful, provided that the proportion of institutional investors*

- exceeds α^* , as defined in Theorem 2. The firm then chooses the viable project. If the recovery effort is not successful, the CRA assigns its lowest rating $\rho(q)$, and the firm chooses project *HR*.
2. If $\beta < \underline{\beta}$ (ineffective recovery effort), the firm does not undertake recovery effort, and the CRA assigns its lowest rating $\rho(q)$, reflecting the firm's choice for project *HR*.

Corollary to Theorem 4. *A credit watch procedure increases the range of values of β for which the firm engages in recovery effort compared to the passive case with only beliefs-coordination by CRAs; all firms with $\beta \geq \underline{\beta}$, where $\underline{\beta} < \bar{\beta}$ (see Theorem 3), commit to put in recovery effort.*

In comparing Theorem 4 to Theorem 3, we see that the credit watch procedure improves matters along two dimensions. First, the ability of the CRA to condition the credit rating on the success of the recovery effort helps in coordinating the beliefs of investors. In the case of $\beta \geq \underline{\beta}$ and successful recovery effort, only α^* of institutional investors are needed to enforce the good equilibrium. This occurs because such a firm is no longer confronted with an “average” rating $\rho(p_n)$ but with a precise rating $\rho(p_0)$. Thus, the credit watch procedure fine-tunes the interaction between the firm and investors. A second positive effect of the credit watch procedure is that it lowers the threshold β (to $\underline{\beta}$) above which the firm will choose to undertake the recovery effort. The reason for this is that with a credit watch procedure, deviations to the high-risk project are better anticipated. In particular, choosing to abstain from recovery effort and choosing project *HR* instead will immediately lead to the lowest rating $\rho(q)$. That is, given $p_B < \underline{p}$ and observing a firm not engaging in recovery effort, the CRA realizes that the firm optimally chooses project *HR* (see Theorem 1). From an *ex ante* perspective, this more severe punishment makes undertaking recovery effort more attractive to firms. This discussion clarifies the economic value of credit watch procedures. Credit watches make it easier for the CRA to coordinate beliefs (a lower α suffices), and the recovery effort moral hazard problem can be better mitigated.

Because in the presence of a credit watch and with $\beta \geq \underline{\beta}$, a CRA knows more about the effectiveness of recovery effort than investors in the market, a rating change for these firms conveys information, and thus impacts stock prices. As in the case without credit watch, the firm's stock price will always go down after the publicly observed bad signal is received in the market, but the stock price response is smaller for firms with $\beta \geq \underline{\beta}$, anticipating the higher probability that the recovery effort will be successful. If the CRA ultimately downgrades the firm (signaling failure of recovery effort), the higher is the β , the more negative is the stock price effect of the rating change (i.e., the failure of recovery effort is

more of a surprise for high- β firms). Thus, the size of the immediate impact of the bad news on stock prices is *negatively* correlated with the impact on stock prices of a subsequent downgrade. In the case where recovery effort is effective and no downgrade occurs, we would observe a negative stock price response to the bad signal, but a positive response when the CRA confirms the firm's original rating.

If the probability that recovery effort is effective is very low (i.e., if $\beta < \underline{\beta}$), the firm will not exert any recovery effort, and the credit watch procedure does not play a role. Since a CRA in this case does not have more information than investors in the market, a downgrade does not reveal new information and only the initial bad signal will have a stock price impact.

2.3 The role of the CRA in case of a good signal

If the firm receives a good signal at $t = 1$, we have the following result.

Theorem 5. *In the case of a good signal ($\tilde{p} = p_G$), the CRA assigns a rating $\rho(p_G)$. All investors in the market anticipate that the firm chooses the viable project. The loan repayment amount becomes $F^{VP}(\rho) = 1/p_G$, and the firm optimally chooses the viable project.*

The intuition is straightforward. Observe that the role of the CRA following a good signal is passive, no credit watch is observed. In the case of a good signal, the viable project (which was already first-best efficient) becomes even better relative to project *HR*. If, starting from region 2, a good signal pushes the firm into region 3 (see Theorem 1), the firm always chooses the viable project, irrespective of investor beliefs. Similarly, if the firm remains in region 2, the lower repayment obligation $F^{VP}(\rho)$ makes it easier to guarantee the good equilibrium. A smaller proportion α^0 , with $\alpha^0 < \alpha^*$, will now suffice to facilitate the choice of the viable project (see the Corollary to Theorem 2). Provided that such institutional investors are present, the CRA upgrades the firm's rating to $\rho(p_G)$.

These conclusions differ little if we start from region 1, that is, if the firm's initial credit quality is $p_0 < \underline{p}$. In this case, a good signal could push the firm up into region 2. While also now no credit watch is needed, the CRA still has a coordinating role that could be anticipated by the market. Assuming that the market knows that a sufficiently sizeable proportion α of institutional investors is present (i.e., $\alpha > \alpha^*$), the firm will invest in the viable project, and the positive stock price response will immediately follow the release of the good signal, with no further response to the subsequent rating change.²¹

²¹ If the proportion α^* is not present (and this was anticipated by the market), then the stock price impact of the good news is subject to the uncertainty about which equilibrium will become reality.

2.4 When to invoke the credit watch procedure?

The CRA's decision to initiate a credit watch procedure is endogenous. When is it valuable for the CRA to engage in such a procedure? From the Corollary to Theorem 4 we can conclude that the credit watch procedure adds most value for firms with $\beta \in [\underline{\beta}, \bar{\beta})$. In that region, the credit watch induces the firm to undertake recovery effort from which it otherwise would have abstained. For all firms with $\beta \in [\bar{\beta}, 1]$ the credit watch procedure reduces only the proportion α that is needed to give incentive compatibility to the beliefs-coordinating role of the CRA, but this benefit is decreasing in β and approaches zero in the limit (as $\beta \rightarrow 1$). These observations imply that for a small positive cost d associated with the credit watch procedure, the credit watch procedure is optimally invoked for firms with $\beta \in [\underline{\beta}, \beta_d)$, with $\beta_d \geq \bar{\beta}$. The range $[\bar{\beta}, \beta_d)$ is nonempty for d sufficiently small.

A question that comes up is how we could interpret β , the probability that recovery effort is successful. The value of β could depend on a variety of factors, including the reputation and/or quality of management, the way the firm is organized and financed (e.g., a more flexible, less overhead-dependent structure could facilitate prompt corrective action), and the type of activity in which the firm is involved.

In our analysis, we have assumed that β is publicly known. We could have alternatively assumed that nobody knows the precise value of β , but everybody has a common expectation $E(\beta)$. In that case, not much would change; depending on their *expected* β s firms could now envision a benefit from the credit watch procedure. We could also think of the firm and CRA *privately* knowing more about β *prior* to invoking the credit watch procedure. In that case, initiating the credit watch procedure would signal information about β to the market, particularly when the market had anticipated a β outside the range $[\underline{\beta}, \beta_d)$. If the market had anticipated $\beta < \underline{\beta}$, invoking the credit watch is good news; for an anticipated $\beta \geq \beta_d$, the credit watch announcement is bad news.

2.5 When is the CRA's coordination role most valuable?

The focal point story essentially purports credit ratings as an insurance policy against uncoordinated jumps to the bad equilibrium. When is this most valuable? The value of credit ratings depends on the effectiveness of the recovery effort. If recovery effort becomes less effective (lower β), it becomes more difficult to establish the beliefs-coordinating and monitoring roles of the CRA, and ratings deteriorate on average. The firm may then move to region 1 (and *always* choose the high-risk project) or need a higher proportion α of institutional investors to provide incentive compatibility to the role of the CRA.

The value of credit ratings also arguably depends on how divergent and uncoordinated the beliefs of investors in the market are. Observe that the

only coordination of investor beliefs that exists in the model is that among the institutionally-constrained α -investors. Obviously, this rigidity may vary in reality. However, financial markets may also be characterized by some herding behavior of “free” investors. Analysts may play an important role in forming opinions and effectively play a role in coordinating beliefs as well. It would be reasonable to conjecture that CRAs are most valuable when analyst expectations are divergent. Although, strictly speaking, outside of the context of the model, this would suggest that with divergent analyst expectations, credit ratings have the biggest pricing impact. It also suggests some degree of substitutability between the coordinating roles CRAs and analysts play.²²

Divergence in investor beliefs could be interpreted as a manifestation of uncertain times, which could put pressure on the coordination role of the CRA. It is not inconceivable that because of excessive divergence in investors’ beliefs, the implicit contract between the CRA and the rated firm cannot be made incentive compatible. So paradoxically, credit ratings may have most added value when analyst beliefs are divergent, but beliefs that are too divergent may make it impossible for the CRA to focus beliefs sufficiently and resolve the multiple equilibria problem. In that case, credit ratings lose much of their value, thereby causing fragility and multiple equilibria problems to reemerge. A potential manifestation of this is that the funding cost differential between the high-risk and the viable projects may increase in such uncertain times, which is consistent with Fama and French’s (1989) empirical observation that the funding cost differential between different rating classes varies over time and peaks in economic downturns.

CRAs thus play a delicate role; they are most valuable in uncertain times, but it is precisely in those times that the coordinating role of ratings may break down.²³

3. Existing Evidence and New Empirical Predictions

In this section, we first discuss the existing empirical evidence related to credit ratings and importantly, how it relates to the predictions of our analysis. Next, we delineate several new empirically-testable predictions that stem from our model.

²² Ederington and Goh (1998) document that both credit rating agencies and stock analysts bring information to the equity market. They also document that the actions of analysts and rating agencies fuel each other, suggesting that they play complementary roles as well. That is, while bond downgrades are typically preceded by declining earnings forecasts, actual and forecasted earnings also fall following a bond downgrade.

²³ The incentive compatibility of the implicit contract may also depend on the importance firms place on having access to the financial market. If the firm has no need for new funding and its existing debt is unlikely to be repriced soon, incentive compatibility might be more difficult to establish.

3.1 Linking our model to the existing empirical evidence

A cursory review of the existing empirical evidence has previously provided a rather skeptical view toward the predictive power of rating agencies, inducing some to question whether ratings have any value. While acknowledging Brealey and Myers' (2003) cautionary note that we highlighted in the Introduction, we believe that a careful reading of the existing empirical evidence in light of our theory does definitely give some value to ratings and, in particular, to the credit watch procedure.

Early empirical studies of credit ratings, such as West (1973), Liu and Thakor (1984), and Ederington, Yawitz, and Roberts (1987), focus primarily on ratings as an explanatory variable for cross-sectional differences in yield spreads. Not surprisingly, ratings are found to correlate with observed yield spreads. This observation, however, was to be expected: ratings and credit risk are obviously related. More interestingly, later studies seek to discover the empirical impact of rating changes on security prices. These studies address whether rating changes convey new information to the market. The pervasive finding in these studies—including Weinstein (1977), Holthausen and Leftwich (1986), Ederington and Yawitz (1987), Cornell, Landsman, and Shapiro (1989), Hand, Holthausen, and Leftwich (1992), Goh and Ederington (1993), and Dichev and Piotroski (2001)—is that there is a significant and negative stock price reaction to bond downgrades, but there is no significant reaction to upgrades.²⁴

We believe that the evidence above is consistent with the rationale we have offered for credit rating agencies. Specifically, the implicit contracting that is at the core of our theory is mostly relevant in situations where the CRA and firm strike agreements that should prevent (further) downgrades. In other words, the role CRAs play in practice make a downgrade a truly informative event (after a credit watch) as it implies that the firm has not been successful in restoring its credit quality. In the case of upgrades, the positive information preceding the upgrade has not only been observed by the entire market—implying that the credit rating upgrade is uninformative at the margin—but the CRA has no incentive to impose a credit watch and thereby learns nothing new. Consistent with this view, Ederington and Goh (1998) argue that rating agencies apparently expend more resources in detecting deteriorations in credit quality than in detecting improvements.

²⁴ Dichev and Piotroski (2001) actually find a significantly positive stock price effect for upgrades, but as they themselves argue, the effect is economically insignificant (i.e., it is quite small relative to the price reaction to downgrades). Moreover, their estimate for upgrades is of the same order of magnitude as the aforementioned studies, and therefore, the statistical significance is most likely just a result of their larger data sample. Ammer and Clinton (2004) find a result similar to these studies for asset-backed securities, see also our discussion of structured finance in Section 4.1.

In addition to examining security price reactions to actual bond downgrades and upgrades, Hand, Holthausen, and Leftwich (1992) also examine the price impact of firms being added to S&P's "Credit Watch List". When a firm is added to the credit watch list, its addition is designated as an "indicated upgrade" or "indicated downgrade". If a change in rating is likely but its direction is unknown, it is designated as "developing". Consistent with our model firstly is their observation that of the 253 bonds put on the credit watch list with either an indicated downgrade or upgrade, only 38 were indicated upgrades. That is, while these data could be specific to their sample period, the credit watch procedure appears to be invoked more often in response to a deterioration in the credit quality of a firm, as opposed to an improvement. Our model captures this notion, as the CRA only considers imposing a credit watch if a bad signal has been observed.

When considering all credit watch additions, Hand, Holthausen and Leftwich (1992) document virtually no price impact to indicated downgrades or upgrades for either bond or stock prices. This finding is consistent with our model in that we assume that the change in credit quality (\bar{p}) is observable to all market participants and is not privately observed by the CRA. Thus, when the CRA puts the firm on credit watch, the market has already rationally anticipated this at the time of the negative news realization. However, Hand, Holthausen and Leftwich (1992) partition the credit watch additions into those that are either "expected" or "unexpected" using a price-impact model. Their intention is to isolate cases where the addition to the credit watch list was a surprise to the market, which allows for a more meaningful empirical analysis.

They sort such credit watch additions as follows. If the prevailing market-based yield on the bond that is added to the credit watch list already incorporates the direction of the credit watch designation (i.e., indicated upgrade or downgrade), then they code this observation as an "expected" addition. On the other hand, if the prevailing yield shows no evidence of a directional change, it is coded as "unexpected". They then repeat their price impact analysis for these two subgroups. Consistent with their full sample results, there is no statistically significant impact on bond or stock prices if the credit watch was expected. However, if the addition was unexpected by the market (i.e., prior bond yields did not vary significantly from a peer group of bond yields with the same rating), then both bond and stock prices react negatively (and significantly) to an indicated downgrade, with no significant response in either to an indicated upgrade. At a minimum, we can interpret this finding as providing evidence that the CRA brings new information to the market, even though in our analysis this revelation occurs after the credit watch procedure has been concluded.

In related empirical work, Kliger and Sarig (2000) further focus on the causality between stock price movements and rating downgrades. In particular, they design a test that separates rating changes from potential (simultaneous) changes in credit standing and thus seek to resolve the uncertainty about the causality. The motivation for such an analysis is similar to Hand, Holthausen and Leftwich (1992). Kliger and Sarig (2000) focus on a change in reported credit rating *categories*, that is, the April 26, 1982 introduction by Moody's of a finer rating partition. This event applied to the whole universe of issuers, and could effectively imply a downgrade when put into a lower partition or an upgrade when put into a higher one. Focusing on the introduction of this finer partitioning allows them to exclusively consider the informational content of the rating change absent any concurrent information regarding the firm's credit quality. Their main result is that (changes in) credit ratings have no statistically significant impact on total firm value, but do have an effect on the value of outstanding debt with an opposite effect on equity value. In practice, a higher rating has a positive impact on the value of the debt, but has a negative impact on the value of equity. For a lower rating, the opposite effects are observed.

What their empirical findings suggest is that in the absence of a change in credit quality, the information content of credit ratings is linked to (assessing) risk, with only a secondary or even negligible informational content for total firm value. These findings are also consistent with our modeled role for the CRA as a coordination mechanism of investor beliefs. That is, while the earlier empirical evidence of Hand, Holthausen, and Leftwich (1992) speaks to the efficacy of the credit watch procedure in response to *changes* in the firm's credit quality, Kliger and Sarig's (2000) findings highlight the CRA's role in coordinating investor beliefs about firms' risk choices. The interpretation would be that a switch between equilibria in our analysis is largely about the *level of risk* in the firm's investment opportunity set. Further evidence of this can be found in Kliger and Sarig's (2000) observation that implied stock price volatilities *increase* after a rating downgrade. In our model, situations in which either the firm's recovery effort fails under a credit watch (which is revealed to the market by a subsequent rating downgrade) or the firm is not put on watch but is instead immediately downgraded [i.e., the likelihood of a successful recovery effort (β) is too low] imply that the CRA cannot coordinate investor beliefs and the firm's risk profile changes.

3.2 New empirical predictions

As argued above, the theory that we have developed in this article is consistent with the existing empirical evidence. However, there are several additional and empirically-testable predictions that can be drawn from the model. We are unable to directly link these predictions

to existing empirical work because no paper, except for Holthausen and Leftwich (1986) and Hand, Holthausen and Leftwich (1992), has considered the price impact of rating changes conditional on the presence of a credit watch procedure. Moreover, even though Hand, Holthausen, and Leftwich (1992) consider the stock price impact of additions to the Credit Watch list, they do not examine the actual rating changes in light of the firm's debt being put on credit watch. Similarly, Holthausen and Leftwich (1986) only note that stock prices respond less to a downgrade when the firm is coming off the credit watch. That said, there are a host of empirical predictions directly related to the announcement effects of rating changes and both the likelihood of being put on credit watch and of coming off of it with a rating confirmation or change. We delineate these next.

Prediction 1. *Stock prices respond negatively to publicly-observed bad news, but the magnitude of this reaction is dampened the higher the likelihood of a successful recovery β , provided that this exceeds a critical minimum, that is, $\beta \geq \underline{\beta}$.*

The negative stock price reaction to bad news is muted in the presence of a credit watch because this procedure enables firms to attempt a restoration of their credit quality, and the market rationally anticipates this. This applies for firms with $\beta \geq \underline{\beta}$. For firms with $\beta \geq \bar{\beta} (> \underline{\beta})$, this can be observed even without a credit watch procedure.

Prediction 2. *Upon completion of the credit watch procedure, stock prices react positively to rating confirmations and negatively to rating downgrades. However, if the CRA downgrades the firm's debt after the conclusion of the credit watch, the negative stock market response that this implies is negatively correlated with the magnitude of the initial stock price response to the bad news.*

Theorem 4 in our model predicts that *after* the conclusion of the credit watch procedure, stock prices should react negatively to a downgrade and positively to an upgrade. Although the empirical literature suggests that stock price reactions to upgrades are on average zero, our model suggests that one must *first* consider whether the firm's debt was put on credit watch prior to the ultimate rating decision. The reason is that a rating change after a credit watch procedure is more likely to be informative than a rating change in the absence of a credit watch.²⁵ Our model also speaks directly to the magnitude of these price reactions after a credit watch as a function of the likelihood that the recovery effort will be

²⁵ In absence of the credit watch procedure, the market only learns about the failure of the recovery effort over time, thus the negative price impact takes more time to materialize.

successful (β). For firms with a high β (i.e., firms with a higher probability of successful recovery), we would expect a smaller negative price effect at the time the initial bad news becomes public, and then only a small, yet positive reaction to the rating confirmation after the credit watch procedure. However, if such a firm is ultimately downgraded, the announcement effect of the downgrade would yield a large and negative price impact.

If we allow the likelihood that the recovery effort is successful to be private information (see Section 2.4), a firm's addition to the credit watch list can be "unexpected" [in the spirit of Hand, Holthausen and Leftwich (1992)] under the assumption that β is privately known by the firm and the CRA before the credit watch procedure is initiated, and market participants only know the expected value of β . There we showed that only firms for which $\beta \in [\underline{\beta}, \beta_d)$ enter the credit watch procedure. However, market participants could have a high or low expectation of β , even when the true β lies in the range $[\underline{\beta}, \beta_d)$. Then our model extension suggests that the addition to the credit watch list could either dampen or exacerbate the negative announcement effect to the publicly observed deterioration of the firm's credit quality.

Prediction 3. *If the market assesses that the success of a firm's recovery effort is very low (e.g., $E(\beta) < \underline{\beta}$), the credit watch announcement will cause a slightly positive stock price response (after the large initial negative reaction to the bad news) since this implies that the CRA believes that recovery effort is feasible and efficient. On the other hand, if the market's assessment is that the firm's recovery effort success probability is relatively high (e.g., $E(\beta) \geq \beta_d$), inclusion on the credit watch list will cause an additional decline in the stock price since this signals that the CRA believes that the firm needs monitoring in order to put in the recovery effort.*

Observe that Hand, Holthausen and Leftwich (1992) document a negative stock price response for firms that are unexpectedly added to the credit watch list with an indicated downgrade, but within the context of our model, this is actually a joint signal of the negative news (i.e., the firm's credit quality has deteriorated) and the firm's addition to the credit watch list. Thus, this prediction remains untested. However, empirical proxies for β and the other parameters of our model can be readily identified. The level of institutional investors (α) could be proxied by some variable measuring the state of development of the financial market. As argued in Section 2.4, β refers to the adaptability of firms, which could depend on the cost structure, the type of assets, and the financial structure of the firm, as well as the quality of management. The divergence in beliefs can be proxied by differences in analyst earnings forecasts. Finally, the underlying asset substitution problem may crucially depend on the

competitive environment and the intangibility and liquidity of the firm's assets.

The predictions stemming from our analysis also link the firm's credit quality (\tilde{p}) and the coordination problem to the likelihood that recovery effort is successful (β). Consider first an environment in which the firm's initial credit quality lies in region 2, where the multiple equilibria problem can arise, and drops to the lowest region after a bad signal. If β is very low ($\beta < \underline{\beta}$), recovery effort nearly always fails and the firm will never put in recovery effort, even in the presence of a credit watch. Because $\partial \underline{\beta} / \partial p_0 < 0$, we know that a credit deterioration starting from a lower p_0 leads to a wider range of values of β for which recovery effort fails. What this says is that firms that face a credit deterioration starting from a lower level p_0 (hence p_B is also lower) will not undertake recovery effort, nor will they be put on credit watch for a wider range of β values [$\beta \in [0, \underline{\beta}]$]. Therefore, these firms will suffer an extra large price drop after the observation of the bad signal, and no credit watch procedure will be observed. We summarize this result in the following prediction.

Prediction 4. *There will be an acceleration in the deterioration of credit quality for firms that face a drop in credit quality starting from a lower initial credit quality p_0 .*

This prediction would be consistent with the observed widening of credit spreads in uncertain times, as discussed in Section 2.5. An economic downturn could be interpreted as shifting downwards a firm's initial credit quality (p_0), thus limiting the effectiveness of the CRA and increasing the cost of debt financing. Finally, our model speaks to the likelihood of a firm entering the credit watch procedure in response to negative economic news, as opposed to being directly downgraded. This likelihood is nonmonotonic in the distribution of \tilde{p} .

Prediction 5. *The likelihood of being put on credit watch is (i) very small for low quality firms since the credit watch procedure is unlikely to be effective, (ii) small for firms of very high quality as the credit watch procedure is redundant, and (iii) large for firms of intermediate quality for which the credit watch procedure is most valuable.*

These five predictions stem directly from our model and should be testable. More importantly, they arise from a model in which credit ratings can often play a valuable role by monitoring a firm's recovery effort, but need not always do so. Thus we argue that a sharper cut at the data along the lines we suggest should provide a more complete picture of the role credit ratings actually play in practice.

4. Applications and Extensions

In this section we discuss several applications of our analysis. We start out with a discussion on the role of CRAs in structured finance, particularly in the context of collateralized mortgage obligations (CMOs) and collateralized debt obligations (CDOs). We then relate our analysis to the public debt versus bank debt debate (including the resolution of financial distress). We subsequently discuss two extensions of the analysis. First, we discuss the impact of multiple rating agencies. Second, we focus on the optimality of rating-linked investment restrictions for institutional investors.

4.1 Role of CRAs in structured finance

The application of our model transcends to asset-backed securities, particularly CMOs and CDOs. Increasingly, CRAs are involved in rating the tranches of such structured finance transactions [see Stone and Zissu (2000) and SEC (2003)]. The extent to which our model applies to CMOs depends in part on the type of CMO, that is, whether it is agency-backed or private label. For agency-backed CMOs (the CMO issues backed by Freddie Mac, Fannie Mae or Ginnie Mae), CRAs have not played a role. These issues are perceived as investment grade (in fact, AAA) by the market and fit within the investment restrictions that institutional investors face. The absence of CRAs from this part of the market is not surprising. Agency-backed CMOs involve underlying assets that are of a specific standardized quality, that is, single-family mortgages that conform to strict guidelines. These are structured such that they face negligible quality deterioration over time. Moreover, these issues have little, if any, credit risk inherent in them, given the implied backing of the agencies by the US Treasury.

Private-label CMOs, on the other hand, are both rated by CRAs and are frequently put on credit watch.²⁶ These issues, again packaged with single-family mortgages, face less stringent underwriting guidelines. For instance, the loan-to-value (LTV) ratios on these mortgages may be significantly higher than in an agency-backed issue. Moreover, the credit risk of these issues is greater since they lack the implied backing of the US Treasury. In these private-label CMOs, the CRA typically interacts with a trustee and can ask for more collateral or for the provision of specific information which assures the CRA that the credit quality of the issue has not deteriorated (these actions can be interpreted as the exertion of recovery effort). For private-label CMOs, the CRA therefore has both a coordination role and a disciplinary role through the credit watch procedure (similar to the case of corporate bonds). The coordination role is basically a certification of asset quality.

²⁶ Some of the big players in this market are Countrywide Financial, Bear Sterns and Citigroup, among others.

CDOs are structured debt securities with unsecured senior or junior bonds in the trust, where the bonds were issued by corporations or sovereign obligors. In practice, CDOs are closely monitored by CRAs and will be put on watch for the same reasons as private-label CMOs. Based on the collateral characteristics, CDOs are more likely to be put on watch as there is greater event risk. For instance, one could have a AAA-rated CDO tranche that is collateralized by junk bonds. Economic events will naturally influence the collateral's performance, and the CRA will monitor this performance and step in (through the credit watch procedure) as in the case of private-label CMOs.

4.2 Bank financing versus public debt

The key to the role of credit ratings as focal point is the coordination failure among multiple (dispersed) creditors. Effectively, the CRA is able to “resolve” the coordination failure because its actions—the assigned rating and the credit watch process—affect firm behavior through conditioning of investment decisions on the assigned rating by investors. This role of CRAs in the financial market qualifies the distinction between public debt and bank financing. In this literature [Diamond (1991)] bank debt offers monitoring advantages which would not be available in the financial market. The typical argument is that free-rider problems prevent effective monitoring in the financial market. What we show is that credit rating agencies do add a monitoring type element to the financial market, and resolve a potential coordination failure. The mechanism is, however, less “direct” than in the case of bank financing: the credit rating (and particularly the threat of a downgrade) *induces* good firm behavior.

For a sufficiently severe moral hazard problem ($\bar{p} < \underline{p}$ in Theorem 1 or $\bar{\beta} < \underline{\beta}$ in Theorem 4), the CRA cannot succeed. In those cases, the bank financing alternative is probably superior because it does not have the coordination problem associated with dispersed investors in the financial market. Apart from bank loans, the nonbank private debt market potentially offers a more “direct” alternative than the control of credit rating agencies in the public debt market. As a matter of fact, private debtors often impose more discipline than banks and hence serve even riskier borrowers [Carey, Post and Sharpe (1998)]. Another mechanism that links the role of banks to that of CRAs is the certification role of bank loans. Datta, Iskandar-Datta and Patel (1999) show that the monitoring associated with bank loans *facilitates* access to the public debt market. This certification role that banks play, with the positive spin-off to the public debt market, is complementary to the role that CRAs play in our analysis.

In related work, Da Rin and Hellmann (2002) show that banks could resolve a multiple equilibria problem among investing firms (borrowers). In their setting, bank lending decisions affect investment decisions of

firms by basically opening up new markets, which will then encourage other firms to make investments in those activities as well. As in our analysis, a potential multiple equilibrium problem is mitigated. The focus of that paper is, however, on initializing real investments and hence coordination on the real investment side. Our analysis centers around coordination among financiers.

A coordination problem can also be encountered in case of financial distress. The central issue is that conflicts between claimholders could effectively destroy firm value and make all worse off [Gertner and Scharfstein (1991), Aghion, Hart and Moore (1992)]. As in our analysis, lack of coordination between investors destroys value. The design of the bankruptcy process together with an optimal seniority structure of debt could facilitate coordination and possibly facilitate an efficient resolution. Credit ratings play a role in this process as well. A downgrade could trigger default. For example, some debt contracts dictate accelerated debt repayments when the rating falls [see SEC (2003)]. This rating trigger, together with the direct effects of a downgrade, could give sufficient incentives to the firm to timely address the threat of financial distress.²⁷

4.3 Multiple rating agencies

So far we have focused on a single rating agency. In practice, there are three prominent rating agencies (Moody's, S&P, and Fitch) along with several smaller agencies, and many corporate bonds are rated by at least two agencies. In fact, most US-listed bonds are rated by both Moody's and S&P because these two agencies commit to assign ratings in these cases. How does the presence of multiple ratings (or CRAs) affect our analysis? Three issues need to be considered:²⁸ (i) How are the rating-dependent restrictions of institutional investors made dependent on multiple ratings?; (ii) How does the credit watch procedure work when multiple agencies are present?; and (iii) What impact does it have on the empirical predictions?

On the first issue, an important consideration is how the institutional investment restrictions deal with split ratings, and particularly what happens with a split rating between investment and noninvestment grade. Cantor and Packer (1997) document that in case of rating-based

²⁷ The SEC (2003) emphasizes the potential (ex post) downside of this in that rating triggers may cascade firms into default. For this put option type feature, see also David (2001).

²⁸ An additional issue that we do not address here is the dominance of the rating industry by just a few rating agencies. Partnoy (1999) observes that the main rating agencies have been granted exclusive licenses through the Nationally Recognized Statistical Rating Organization (NRSRO) classification. He argues that this exclusivity, together with their role in compliance legislation, is their sole source of value. Others have argued that the NRSRO classification acts as a barrier to entry in the rating industry [see White (2002) and SEC (2003)]. These competition issues also feature in the debate on whether CRAs "blackmail" firms into paying for ratings. See the literature on solicited versus unsolicited ratings, for example, Gan (2004).

US regulations, it is common practice to recognize the highest or second-highest rating provided by Nationally Recognized Statistical Rating Organizations (NRSROs). This suggests some flexibility.²⁹

What we see in practice, however, is that many do not allow for such split ratings at the time of purchase; both ratings (in the case of two) need to be of investment grade. But some allow the investment to continue when one rating is downgraded to noninvestment grade. However, there are no pervasive patterns; a variety of practices is observed. That said, practitioners argue that portfolio managers facing investment-grade restrictions tend to shy away from split ratings when one of the ratings is below investment grade, and the fallout from extreme cases such as Enron has made them even more cautious.

On the second issue of how the credit watch procedure may be applied when multiple rating agencies are present, empirical documentation is even more limited. Our extensive discussions with industry professionals indicate that there is no obvious pattern to the assignment of S&P's Credit Watch list or Moody's Watchlist. In fact, the agencies themselves claim that neither agency explicitly tracks what issues the other rating agency currently has on watch, and we do observe split ratings on the same debt issue in practice. Jewell and Livingston (1998) find that approximately 17% of US industrial debt issues rated by both Moody's and S&P have a split letter rating.³⁰ Given that we observe split ratings with significant frequency, it seems reasonable to assume that these agencies will invoke credit watch procedures that are at times independent. Here we can turn to the data, although only anecdotally. We do observe that CRAs often simultaneously put a firm's debt on watch. For example, on June 24, 2004, both Moody's and S&P put Stanadyne Corporation on watch with a negative outlook. In some cases, we observed only a one-day delay. However, in other instances, one CRA may put a firm on watch while another does not immediately change its outlook for the firm's debt. For instance, on June 21, 2004, S&P put ThermaClime, Inc. on watch with a negative outlook, while Moody's had not commensurately followed as of July 2, 2004.

In practice, the rating agencies are basing their analysis on similar, if not identical, information, so it would not be particularly surprising to see

²⁹ For example, Lehman Brothers just recently added Fitch Ratings in its bond index (speculative or investment grade) classification and will use the middle rating from the three agencies. See Aparajita Saha-Bubna, *Dow Jones Newswires*, January 25, 2005.

³⁰ Cantor, Packer and Cole (1997) document that nearly 13% of debt issues have meaningful split ratings. It is worth noting that both of these papers, along with earlier work by Billingsley *et al.* (1985), Liu and Moore (1987), and Perry, Piu and Evans (1988), focus on the empirically observed bond yields associated with these split ratings, rather than on stock market reactions to a rating change that resulted in a split rating, or reactions to an addition to either rating agency's credit watch list. It is in fact these latter issues that would be more relevant to our work here. Similarly, Santos (2003) empirically examines the cost of debt financing in the presence of split ratings but focuses on how this varies over the business cycle.

both agencies have a firm's debt on credit watch at the same time. Nonetheless, an interesting extension to our work is to examine the credit watch listings of S&P and Moody's more systematically. Although purely speculative at this point, it would be interesting to see if there is a clear pattern of one rating agency moving before another on average.³¹ Moreover, one could also address whether it appears that rating agencies tend to herd with one another. It seems intuitive that one rating agency would at least view the addition of a firm they rated to another rating agency's credit watch list as an important piece of information. However, an additional question arises in that rating agencies might also tend to free-ride on one another, as is modeled in Bikhchandani, Hirshleifer, and Welch (1992). Thus far, we have assumed away moral hazard problems on behalf of the rating agency in our model, but in practice, these could be of real concern; the presence of Holmström's (1982) moral hazard in teams effect and free-riding among rating agencies cannot be excluded. Again, until these issues are formally modeled and brought to the data, such predictions remain speculative.

Turning now to the last issue, the impact of the presence of multiple credit rating agencies on our predictions, observe that we have several empirical predictions related to the firm being put on credit watch (i.e., Predictions 2, 3, and 5). These predictions came directly from our model and are based on a well-specified rationale for the credit watch procedure. The rationale that we have identified does not depend on the number of rating agencies. The qualitative nature of the announcement effects is therefore unlikely to be affected. What is going to be true is that the design of the empirical tests has to carefully take into account the possible multiple credit watch announcements. This, and the possibly more or less tentative behavior of the rating agencies, will have a potential impact on the *size* of the announcement effects. To date, we have little empirical work to guide us. The only papers to our knowledge that include the price effects of *sequential* rating changes (both S&P and Moody's) are Holthausen and Leftwich (1986) and Hand, Holthausen and Leftwich (1992). In their primary tests of stock price responses to rating changes, Hand, Holthausen and Leftwich (1992) include all rating changes from these two agencies. Thus, a firm's debt issue may appear twice in the analysis if S&P and Moody's announce a rating change on different days. In their final analysis of bond pricing, they include another independent variable to capture the possibility that there was a recent prior rating change for the same company by the other agency. What they find is that the bond price response to a rating change is significantly less if the other agency had already announced its rating change to the market. An

³¹ Turning back to the case of split ratings, Jewell and Livingston (1999) found no evidence on Moody's or Standard & Poor's moving first, but do report a special (follower) role of Fitch.

analogous analysis and finding for stock price effects is included in Holthausen and Leftwich (1986).

4.4 Optimality of investment restrictions

At the core of our analysis is that institutional investors face investment restrictions that are linked to credit ratings. These restrictions are exogenous to our analysis, but could we say something about the *optimality* of such restrictions? We can make the following observations.

The important observation is that investors that adopt explicit requirements that investments are only made in rated securities essentially buy into a collective coordination and monitoring arrangement. As we indicated, such an arrangement is incentive compatible once sufficiently many investors join such arrangement (i.e., adopt rating-linked investment guidelines). Further, observe that such a mechanism fails to be effective if the firm's credit quality is too low (see Section 2.5); hence the investment-grade restriction that we observe.

The remaining question is whether investors themselves could have replicated the role of the CRA. The answer is that the cost involved could well be prohibitive for a single institutional investor, and free-rider problems would prevent collective action. Hence, the CRA arrangement might be better. Note also that an individual investor cannot benefit by "free-riding" on the CRA arrangement. Credit ratings are paid for by the issuing firms and *not* the investors. Also, (secretly) lifting the investment restrictions would not benefit an investor, because then he ends up investing in below-investment-grade issues for which the CRA does not provide a collective coordination and monitoring arrangement. Investment restrictions, therefore, may well be optimal.

5. Conclusion

Credit ratings are one of the most puzzling features of today's financial markets. Their importance is evident from the behavior of market participants; however, academic researchers have generally been skeptical about their incremental value. In this article, we have argued that researchers have failed to understand the role credit rating agencies play and have not adequately appreciated the manner in which credit ratings come about. In particular, we have shown that credit ratings could play a key role as "focal points" once institutional rigidities are considered. The analysis shows that credit ratings can coordinate investors' beliefs. Together with the implicit contract and monitoring relationship between the CRA and the firm, ratings have a real impact. The analysis produces several empirically-testable predictions that could be taken to the data, potentially adding to our understanding of the actual credit rating process.

Our article suggests that there are additional avenues that could be explored further. First, our analysis could explain why firms in practice view their funding costs as discrete, as suggested by the discreteness in credit ratings. The presence of a multiple equilibria problem—and potential switching between equilibria—could introduce discreteness in a firm's funding cost.³² Second, we have shown that credit rating agencies can solve the multiple equilibria problem and often mitigate undesirable risk-shifting. What we have not explored is how the presence and reliance on credit rating agencies by market participants might discourage other monitoring mechanisms, and potentially fuel an excessive dependence on credit rating agencies. We leave such issues to future research.

Appendix

Proof of Theorem 1. Let F^* be the loan repayment amount for which a firm with credit quality \tilde{p} is indifferent between choosing project VP and HR . Then F^* satisfies

$$\tilde{p}(X_{VP} - F^*) = q(X_{HR} - F^*) \Leftrightarrow F^* = \frac{\tilde{p}X_{VP} - qX_{HR}}{\tilde{p} - q}.$$

It can easily be seen that $\partial F^*/\partial \tilde{p} > 0$ and $\partial F^*/\partial q < 0$. Define \underline{p} as the level of \tilde{p} for which $F^* = F^{VP}$, and $\bar{p} > \underline{p}$ as the level of \tilde{p} for which $F^* = F^{HR}$, see equations (1) and (2). Now first consider region 1. A firm with credit quality \tilde{p} always chooses project HR (irrespective of investor beliefs) if

$$\tilde{p}(X_{VP} - F^{VP}) < q(X_{HR} - F^{VP}),$$

that is, if $F^{VP} > F^*$. This is the case if \tilde{p} is sufficiently small, i.e., if $\tilde{p} < \underline{p}$. The moral hazard problem then is so severe that the high-risk project is chosen even if the market anticipates the viable project choice, resulting in the bad equilibrium with F^{HR} given in (2).

Next consider region 3. The firm always chooses project VP (irrespective of investor beliefs) if

$$\tilde{p}(X_{VP} - F^{HR}) \geq q(X_{HR} - F^{HR}),$$

that is, if $F^{HR} \leq F^*$. This occurs if \tilde{p} is sufficiently large, or $\tilde{p} \geq \bar{p}$. In this case, the moral hazard problem is so small that the firm chooses the viable project, even if the market anticipates the high-risk project choice, resulting in the good equilibrium with F^{VP} given in (1).

Finally, consider region 2 with $\underline{p} < \tilde{p} < \bar{p}$. In this region, $F^{VP} \leq F^*$ and $F^{HR} > F^*$, and the firm chooses the project anticipated by investors. That is, if the market anticipates the viable project choice and charges F^{VP} given in (1), then the firm optimally chooses project VP . Similarly, if the market anticipates the high-risk project choice and charges F^{HR} given in (2), then the firm chooses project HR . We therefore have both a good and a bad equilibrium in this region.

³² Lizzeri (1999) analyzes the *precision* of the information communicated by intermediaries. He shows that providing only yes/no type information (e.g., has the minimum standard been met, yes or no?) can be an optimal strategy. This type of discrete communication of information (as is common in credit ratings) can also create a discrete price impact.

As a final comment, observe that region 1 always exists. Region 2 and/or region 3 may or may not exist, dependent on the parameter values in the model. It can be shown that region 2 is nonempty (i.e., $\bar{p} < 1$) if $(X_{VP} - qX_{HR})/(1 - q) > 1$, and region 3 is nonempty (i.e., $\bar{p} < 1$) if $\frac{1}{q} < (X_{VP} - qX_{HR})/(1 - q)$. These conditions are satisfied if q is not too large (region 2) or too small (region 3).

Proof of Theorem 2. Let F^* be the loan repayment amount for which the firm is indifferent between project VP and HR (see the proof of Theorem 1). A firm with credit quality $\bar{p} \leq \bar{p} < \bar{p}$ then strictly prefers the viable project VP over HR if $\bar{p}(X_{VP} - F^\alpha) > q(X_{HR} - F^\alpha)$, that is, if $F^\alpha < F^*$, with F^α given in (3). If $\alpha = 0$, then $F^\alpha = F^{HR} > F^*$. Since all investors then anticipate the high-risk project choice, the firm confirms this conjecture in equilibrium and optimally chooses project HR . If $\alpha = 1$, then $F^\alpha = F^{VP} \leq F^*$. Since all investors then anticipate the viable project choice, the firm optimally invests in project VP . The result now follows since $\partial F^\alpha / \partial \alpha < 0$. That is, for any $\bar{p} \in [\bar{p}, \bar{p})$, there exists a critical proportion $\alpha^* \in (0, 1]$ of investors who believe that the viable project will be chosen, such that $F^\alpha < F^*$ for $\alpha > \alpha^*$, and the firm always chooses project VP . Consequently, the remaining $(1 - \alpha)$ investors also rationally anticipate the viable project choice, and funding costs drop to F^{VP} given in (1).

Proof of Corollary to Theorem 2. Recall that α^* is the value of α that equates $\bar{p}(X_{VP} - F^\alpha)$ and $q(X_{HR} - F^\alpha)$, with F^α given in (3). The cutoff value α^* then can be written as $\alpha^* = (F^{HR} - F^*) / (F^{HR} - F^{VP})$. Since $\partial F^{VP} / \partial \bar{p} < 0$ and $\partial F^* / \partial \bar{p} > 0$, it can easily be seen that $\partial \alpha^* / \partial \bar{p} < 0$.

Proof of Lemma 1. In the absence of (successful) recovery effort, the firm's credit quality after a bad signal equals p_B . Observe from Theorem 1 that for any $\bar{p} < \bar{p}$, the firm always chooses project HR . Actually, in this case the preference for project HR is even stronger, since the best success probability anticipated by the market equals $\beta p_0 + (1 - \beta)p_B \leq p_0$. If recovery effort is successful, the credit quality is restored to p_0 , which is in the multiple equilibria region.

Proof of Theorem 3. In the absence of a credit watch, the CRA cannot observe whether recovery effort is successful or not. If the CRA anticipates that the firm puts in recovery effort and chooses project VP if recovery effort is successful, it assigns a rating $\rho(p_n)$ to the firm, where $p_n \equiv \beta p_0 + (1 - \beta)q$ reflects the average success probability of the firm's investment strategy. Recall from Lemma 1 that the firm switches to project HR if recovery effort is unsuccessful. Let α be the proportion of investors who follow the rating and anticipate the viable project choice if recovery effort is successful. These investors consequently would set a repayment amount $F = 1/p_n$. Now first consider part (i) of Theorem 3. If the firm successfully puts in recovery effort, the credit quality p_0 of the viable project lies in the multiple equilibria region 2. The firm then strictly prefers project VP over project HR if

$$p_0(X_{VP} - F^\alpha) > q(X_{HR} - F^\alpha),$$

with $F^\alpha = \alpha(1/p_n) + (1 - \alpha)F^{HR}$, see (3). This condition is satisfied if $\alpha > \alpha_n \equiv (F^{HR} - F^*) / [F^{HR} - (1/p_n)]$, where $\alpha_n \geq \alpha^*$, since $1/p_n \geq F^{VP}$ (see the Corollary to Theorem 2). All investors will then anticipate the viable project choice VP and charge $1/p_n$. The firm now will put in recovery effort if

$$\beta p_0 \left(X_{VP} - \frac{1}{p_n} \right) + (1 - \beta)q \left(X_{HR} - \frac{1}{p_n} \right) - c \geq q \left(X_{HR} - \frac{1}{p_n} \right), \quad (7)$$

that is, if $\beta(p_0X_{VP} - qX_{HR}) - \beta(p_0 - q)(1/p_n) \geq c$. In this case, the expected increase in total surplus with recovery effort (net of funding costs) exceeds the cost of recovery effort, and moral hazard problems are small. This condition is satisfied if $\beta \geq \bar{\beta} \equiv (-B + \sqrt{B^2 - 4AC})/2A$, with $A \equiv (p_0 - q)(p_0X_{VP} - qX_{HR})$, $B \equiv (p_0X_{VP} - qX_{HR}) - (p_0 - q)(1 + c)$, and $C \equiv -cq$. As can be seen immediately, $\bar{\beta} > 0$ and $\bar{\beta} < 1$ if $c < p_0X_{VP} - qX_{HR} - (p_0 - q)/p_0$. This condition guarantees incentive compatibility of the recovery effort and the firm choosing project *VP* instead of project *HR* when β equals 1 and project *VP* is anticipated. This condition is compatible with equation (6) and is assumed to hold. The CRA's credit rating $\rho(p_n)$ then is confirmed by the firm's investment behavior.

Next consider part (ii) of Theorem 3. The firm will not put in recovery effort if $\beta < \bar{\beta}$. In this case, the recovery effort moral hazard problem is so severe that the firm prefers project *HR* even if all investors believe that the firm puts in recovery effort and chooses the viable project if recovery effort is successful and charge $1/p_n$. The CRA now assigns the lowest rating $\rho(q)$, resulting in a loan repayment amount $F^{HR} = 1/q$, thus confirming the firm's choice of project *HR*.

Proof of Theorem 4. If the CRA initiates a credit watch procedure, it monitors the firm and effectively conditions the credit rating on the success or failure of the firm's recovery effort. If the CRA observes that recovery effort is successful and anticipates the viable project choice *VP*, it confirms the firm's original rating ρ_0 . Investors who anticipate the viable project choice then set the repayment amount equal to $F^{VP} = 1/p_0$, see (1). In the absence of (successful) recovery effort, the CRA assigns a rating $\rho(q)$, and investors consequently charge $F^{HR} = 1/q$, see (2). First consider part (i) of Theorem 4. If recovery effort is successful, the firm strictly prefers project *VP* if $\alpha > \alpha^*$ (see the proof of Theorem 2). All investors then anticipate the viable project choice *VP* and charge F^{VP} . The firm now undertakes recovery effort if

$$\beta p_0(X_{VP} - F^{VP}) + (1 - \beta)q(X_{HR} - F^{HR}) - c \geq q(X_{HR} - F^{HR}), \quad (8)$$

that is, if $\beta(p_0X_{VP} - qX_{HR}) \geq c$. In this case, the expected increase in total surplus with recovery effort exceeds its cost, and moral hazard problems are small. This condition is satisfied if $\beta \geq c/(p_0X_{VP} - qX_{HR}) \equiv \underline{\beta}$, where $\underline{\beta} > 0$ since $p_0X_{VP} > qX_{HR}$, and $\underline{\beta} < 1$ since $c < (p_0 - p_B)X_{VP}$ [see equation (6)].

Next consider part (ii) of Theorem 4. The firm will not put in recovery effort, but instead invests in the high-risk project *HR* if $\beta < \underline{\beta}$, even if all investors believe that the firm puts in recovery effort and chooses the viable project (severe moral hazard). The CRA now assigns the lowest rating $\rho(q)$, resulting in a loan repayment amount $F^{HR} = 1/q$, thus confirming the firm's choice of project *HR*.

Proof of Corollary to Theorem 4. This result follows from a comparison of the conditions (7) and (8). Recall that $\bar{\beta}$ and $\underline{\beta}$ are the values of the probability that recovery effort is successful which satisfy (7) and (8) with equality (see the proofs of Theorem 3 and 4). Since the LHS of the conditions (7) and (8) are equal and monotonically increasing in β , it is sufficient to prove that the RHS of (7) is larger than the RHS of (8), that is, $\bar{\beta} > \underline{\beta}$ since $(1/p_n) < (1/q)$ for all $\beta \geq \underline{\beta}$.

Proof of Theorem 5. Recall from the proof of Theorem 1 that if $\bar{p} = p_G > \bar{p}$, the firm always invests in the viable project *VP*. Since $p_G > p_0$, the CRA assigns a rating $\rho(p_G) > \rho_0$ to the firm, and institutional investors who follow the rating are willing to invest. All investors in the market thus rationally anticipate the viable project choice, and set the loan repayment amount equal to $F^{VP}(\rho) = (1/p_G) < F^*$, confirming the choice of project *VP*.

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