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Credit Ratings as Coordination Mechanisms*

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Credit Ratings as Coordination Mechanisms

Abstract

In this paper, we provide a novel rationale for credit ratings. The rationale that we propose is that credit ratings can 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. We explore the vital, but previously overlooked implicit contractual relationship between a credit rating agency and a firm. 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 ratings changes, the discreteness in funding cost changes, and the effect of the focus of organizations on the efficacy of credit ratings.

1 Introduction

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 ratings agencies – Moody's and Standard & Poor's – adhere to a policy of providing a rating for all taxable corporate bonds publicly issued in the U.S. For many observers of the financial market, credit ratings appear to have real importance, that is, the common perception is that lower ratings lead to higher funding costs, and vice versa. However, the financial economics literature has cast doubt on the importance of announced changes in these ratings. A common argument is that the rating change may actually go hand in hand with, or even more likely *follow* an informational release and thus may have by itself no informational content.

The empirical evidence surrounding credit ratings is far from conclusive. In fact, most empirical studies provide mixed results for the effects of rating changes on stock prices.[1] 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.[2]

Academics have previously examined credit ratings from an informational content/market efficiency point of view. We believe that credit ratings derive their value much more from two institutional features. 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. The first key to our theory is the ongoing monitoring role of credit rating agencies through their credit watch procedures. This is a previously much overlooked feature of credit rating agencies. Their job is not just the initial information dissemination, but also the ongoing monitoring aspect through credit watch procedures. Here implicit contracts play an important role. In particular, a credit rating agency will interact with the firm that it rates,

[1]In Section 4.1, we discuss the extant empirical evidence.

[2]Another illustration of the increased importance of credit ratings is the proliferation of credit risk models. See Nickell, Perraudin, Varotto (1999), Carey and Hrycay (2000), and Saunders (1999) for some interesting work on this issue.

and write implicit contracts with management once potential changes in firm characteristics and/or market circumstances threaten to affect its credit rating. The credit rating procedure allows for a "deal" (implicit contract) between the firm and credit rating agency where the former promises to undertake specific actions to mitigate the possible deterioration of its credit standing (and rating). We show that the credit rating and associated implicit contract is incentive compatible provided that a group of (institutional) investors conditions its decisions on the rating. The latter is the second institutional feature that is important for our theory.

There is ample evidence on the presence of our 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 U.S. 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 rating before listing the debt issue. These rigidities effectively condition the investors' decisions on the observed rating.

In the setting that we analyze, we let firms that are in need of debt financing interact with the financial market. The market cannot readily observe the quality of the firms' investment opportunities. This may induce moral hazard. We show that depending on the beliefs of the market, the firm might be induced to choose high-risk or low-risk strategies. For instance, if the market anticipates a risky project choice, it will demand a high coupon rate in the debt contract. However, this belief may well be self-fulfilling: once the firm is confronted with the high funding cost, it will *optimally* engage in the risky project. Alternatively, the firm might be induced to choose the low-risk strategy 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.

What we show in our model is that if a sizable proportion of investors (e.g., pension funds) *follows* the credit rating (i.e., bases their investment decisions on the credit rating because of

[3] Cantor and Packer (1997) provide a select list of ratings-based U.S. regulation. For instance, the Congressional promulgation of the Financial Institution Recovery and Reform Act of 1989 prohibited Savings & Loans 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).

institutional rigidities), others rationally follow as well. This can resolve the multiple equilibria problem and points at the focal point role of credit ratings that we develop in this paper.

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. Dallas (1997) argues 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, a 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.[4]

Thus, ratings would act as 'information equalizer', thereby enlarging the investor base. Much of the literature on credit ratings focuses on how, as independent information producers, credit rating agencies can help disseminate information about firms to investors.

In our theory, credit ratings have a role as 'information equalizer', albeit a more subtle one. In particular, we will argue that ratings really 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.

The role that credit ratings play in our story has links to the literature on "cheap talk", such as Spatt and Srivastava (1991) and Morris (1999). 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

[4]See McDaniel (1997).

in turn confirms the rating. If we are right, and we do believe that the coordination of beliefs function of ratings is quite significant, ratings may have little informational content but actually be insurance policies against a bad equilibrium.[5] This is consistent with the mixed empirical evidence.

The rest of the paper is organized as follows. Section 2 describes the model and contains the basic equilibrium analysis. Section 3 examines credit ratings as a resolution to multiple equilibria. In Section 4, we extract several empirical predictions and discuss existing empirical evidence. Section 5 extracts other implications of the analysis, and Section 6 concludes. All proofs are in the Appendix.

2 Model Setup

We model an economy in which there are firms of varying quality seeking debt financing from investors. We assume a perfectly competitive financial market. The investment opportunity sets vary across firm type, where firms are either of good (G) quality or they are lemons (L). The prior probability that a given firm is good is $\beta \in [0, 1]$. We assume universal risk neutrality and a risk-free rate of zero.

2.1 Projects

Each type of firm has access to at least one type of project. All projects require an investment of $I > 0$, and neither firm has any resources available to invest in the project. Instead, firms must raise I in debt from investors. We allow good firms access to two types of projects, a safe one (S) and a risky one (R). A safe project is risk free and pays off a positive amount X_S with probability 1. The risky project pays off a positive amount $X_R > X_S$ with probability γ, and zero with probability $1 - \gamma$. We assume that the first-best project choice is the safe one in that the expected value of the safe project exceeds that of the risky project ($\gamma X_R < X_S$). Lemon firms

[5] Our focal point interpretation has some similarities to Dow and Rossiensky (1999). They build a model of a financial firm that finances itself by issuing risky debt. Financial firms raise money first, and then choose which assets to hold. Thus, liability structure and investment policy are inextricably linked in that a liability structure is chosen in *anticipation* of particular investment opportunities. However, after funds are raised, if the investment opportunity set has changed, the finance company is left with a suboptimal asset-liability mix which could induce multiple equilibria problems. We identify situations in which multiple equilibria might arise as well, but our focus is on how these can be *resolved* by credit ratings.

have access to only the risky (R) projects. We assume that both projects have a positive NPV in that $X_S > \gamma X_R > I$.

2.2 Information Structure, Funding Costs and Equilibrium Behavior

Firms approach the market for debt financing. Each loan consists of an amount lent (I) to fund the investment. The loan also dictates the repayment amount due, which we denote F_β^τ, where $\tau \in \{S, R\}$ represents the market's conjecture of the *good* firm's project choice and β is the prior belief over the type of firm requesting funds, i.e., the possibility that the firm is "good". The lemon firm only has access to the very risky (V) project.

The information structure is such that the market cannot distinguish good firms from lemons. The cross-sectional distribution of good borrowers (β) and lemons ($1-\beta$) is public information. Thus, the repayment amount (F_β^τ) depends on the belief (β) over the type of the borrowing firm and the conjectured project choice of the good firm. Since the financial market is competitive, investors are risk neutral and the riskless discount rate is zero, the expected repayment – with expectations taken over the cross-sectional distribution of good borrowers (β) and lemons ($1-\beta$) – on any loan in equilibrium will be equal to the amount lent. That is, $E[F_\beta^\tau] = I$, for all $\tau \in \{S, R\}$ and $\beta \in [0,1]$. *Lemma 1* gives the repayment amounts required by investors.

Lemma 1

Investors condition the terms of the loans they offer based on the conjecture of a good firm's project choice. If investors anticipate that a good firm will choose the safe project, they require a repayment amount of

$$F_\beta^S = \frac{I}{\beta + [1-\beta]\,\lambda}. \tag{1}$$

Alternatively, if the investors anticipate that a good firm will choose the risky project, they require a repayment of

$$F_\beta^R = \frac{I}{\gamma}, \tag{2}$$

where repayment amount $F_\beta^R > F_\beta^S$.

The results of *Lemma 1* are straightforward. Given the potential asset-subsitution moral hazard problem, investor beliefs regarding the investment behavior of the good firm have an important effect on financing costs.[6] The required repayment is higher if the market anticipates that a good firm will choose the risky project over the safe alternative. Moroever, since firm type is unobservable by the market, the required debt repayment when the safe project choice is anticipated by investors depends on the prior belief (β) that the firm is good. This is not the case when the risky project choice is anticipated as the good firm and the lemon earn identical expected payoffs in this case. Thus, as the prior belief that the firm is good increases, the financing cost it faces when investors anticipate the safe project choice strictly declines, but the risky project choice repayment is unaffected.

Given the funding costs derived in *Lemma 1*, the good firm's equilibrium choices are delineated in *Theorem 1*.

Theorem 1

The good firm's project choices in equilibrium can be summarized as follows:[7]

1. *If the prior belief over firm quality is very high ($\beta \geq \overline{\beta}$), the good firm will choose the safe project regardless of the market's beliefs about its anticipated project choice.*

2. *If the prior belief over firm quality is very low ($\beta \leq \underline{\beta}$), the good firm will choose the risky project regardless of the market's beliefs about its anticipated project choice.*

3. *If the prior belief over firm quality is in an intermediate range, $\beta \in (\underline{\beta}, \overline{\beta})$ (i.e., prior belief is neither too high nor too low), the good firm will choose whichever project the market anticipates will be taken. Thus, if the market anticipates the safe choice, the good firm optimally chooses the safe project. However, if the market anticipates the risky project, it is then optimal for*

[6] Recall that lemons have only one project choice; they always choose the risky (R) project.

[7] Depending on the parameters in the model, any of these three regions, $\beta \geq \overline{\beta}$, $\beta \leq \underline{\beta}$, or $\beta \in (\underline{\beta}, \overline{\beta})$, could be empty.

the good firm to choose the risky project in equilibrium. Hence, there are multiple equilibria in this intermediate β range.

The results of *Theorem 1* show that a good firm's investment choice in equilibrium depends on the market's prior beliefs on the investment choice for intermediate value of β, $\beta \in (\underline{\beta}, \overline{\beta})$. If the uncertainty over firm type is quite low – either it is very likely that the firm is a lemon *or* that it is good – the good firm has a dominant investment strategy and investor beliefs about the good firm's project choice are unimportant. At the low end ($\beta \leq \underline{\beta}$), if the market is convinced that the firm is a lemon, financing costs are sufficiently high even if investors anticipate that the safe project will be chosen, inducing the good firm to always choose the risky project in equilibrium. Analogously, if the market attaches a high probability to the firm being good ($\beta \geq \overline{\beta}$), financing costs are relatively low and good firms always choose the safe project in equilibrium. Therefore, investor beliefs regarding the risk choices of the good firm are unimportant at the lower and upper extremes of priors over firm quality.

However, *Theorem 1* shows that when uncertainty about firm type is high ($\beta \in (\underline{\beta}, \overline{\beta})$), multiple equilibria are possible as investor beliefs over the good firm's project choice are paramount in determining which equilibrium obtains. Within this region of severe firm-type-uncertainty, it is optimal for the good firm to choose the project that is *anticipated* by the market. Thus, even though the safe project is the first best and is a feasible outcome in this region of firm quality, investor beliefs can drive the firm to the undesirable equilibrium where the risky project is chosen. In the remainder of the paper, we focus on this interior region where multiple equilibria are possible and seek out resolutions to this problem.

2.3 Resolving the Multiple Equilibria Problem

In this subsection, we show that if there exists a sufficiently sizeable subset of investors that believes good firms will choose the safe project, the remaining investors will also *rationally* conjecture that the safe project will be chosen. In Section 3, 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*, within the region $\beta \in (\underline{\beta}, \overline{\beta})$, good firms optimally choose whichever project the market anticipates. However, this result can be generalized. If a sufficiently sizeable subset of investors anticipates the safe project to be chosen, good firms will in fact find it in their own best interests to choose the safe project, and vice versa.

This observation can be modelled as follows. Let $\alpha \in [0,1]$ be the proportion of investors that anticipates that a particular good firm always chooses the safe project.[8] The remaining $1-\alpha$ proportion of investors simply form their own beliefs over the good 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 safe equilibrium (α) is sufficiently big, the good firm *always* picks the safe project regardless of the conjectures of the remaining $1-\alpha$ investors.

Observe that with two different investor classes, we can envision the firms auctioning off the debt claim in two tranches. The proportion α of (institutional) investors anticipates the safe project. This implies that the price of this debt claim is such that $F_\beta^S = \frac{I}{\beta+[1-\beta]\lambda}$ (see (1)). If the $1-\alpha$ investors anticipate that the risky project will be chosen, they require a higher repayment value, i.e., $F_\beta^R = \frac{I}{\beta\gamma+[1-\beta]\lambda}$ (see (2)). The total repayment obligation faced by a good firm is therefore given by

$$F_\beta^\alpha = \alpha F_\beta^S + [1-\alpha] F_\beta^R. \tag{3}$$

It is obvious that for any $\alpha \in (0,1)$, $F_\beta^\alpha \in (F_\beta^S, F_\beta^R)$, and that this weighted-average debt-repayment amount is decreasing in the fraction of investors, α, anticipating the safe project choice ($\frac{\partial F_\beta^\alpha}{\partial \alpha} < 0$). Thus, the total funding costs decline as the proportion α increases.

Facing such financing costs, the good firm compares its net expected benefit from choosing the safe project to that of the risky project. If it would choose the risky project (as the $1-\alpha$ investors anticipate), it receives in expectation

$$\begin{bmatrix} \Pr(\text{Risky Project Succeeds}) \times \left[X_R - F_\beta^\alpha\right] \\ + \Pr(\text{Risky Project Fails}) \times [0] \end{bmatrix} = \gamma \left[X_R - F_\beta^\alpha\right]. \tag{4}$$

[8]In the next section, we address what could explain why a particular set of investors might play only the good equilibrium.

While if it chooses the safe project, which is risk free, it receives

$$X_S - F_\beta^\alpha. \tag{5}$$

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 equilibrium.

Theorem 2

For every prior $\beta \in (\underline{\beta}, \overline{\beta})$ that the firm is good, there exists a critical proportion α^* of investors that believe the safe project will be chosen such that for $\alpha > \alpha^*$, the good firm will always choose the safe project. In these cases, the remaining $1-\alpha$ investors also rationally assume that the good firm chooses the safe project. Hence, financing costs are given by F_β^S whenever $\alpha > \alpha^*$.

What this theorem states is that a significant proportion of investors playing the safe equilibrium can actually guide firm behavior to the desired (first-best) risk choice. The remaining proportion $(1-\alpha)$ of investors should then rationally anticipate the safe project choice as well. The intuition for this result is as follows. Investors who anticipate that the good firm will play the safe equilibrium will price the debt repayment commensurately. And while there are other investors who may anticipate that the risky project will be taken, total funding costs are reduced as the proportion of investors playing the safe equilibrium (α) increases (i.e., $\frac{\partial F_\beta^\alpha}{\partial \alpha} < 0$). The critical proportion of investors playing the safe equilibrium (α^*) is simply the proportion of investors that equates the good firm's expected benefits from investing in the safe and the risky project, respectively, anticipating that the others $(1-\alpha)$ will anticipate the risky project choice. At any proportion of such investors above this threshold, the good firm will always play the safe equilibrium. The beliefs of these α investors are then fully confirmed in equilibrium, and the remaining $1-\alpha$ investors now rationally conjecture the good firm's behavior as well. Thus, with both sets of investors anticipating the safe project choice, total funding costs drop to F_β^S, for all $\alpha > \alpha^*$.

The prior over firm quality (β) plays a key role in the formation of this critical proportion α^* of investors.

Corollary to Theorem 2

The critical proportion of investors, α^*, such that the good firm will always choose the safe project whenever $\alpha > \alpha^*$, is decreasing in the prior over firm quality (β).

This *Corollary to Theorem 2* states that the minimum proportion of investors playing the safe equilibrium (α^*) that is necessary to insure the selection of the safe project, is strictly decreasing in the prior over firm quality, β. The intuition is similar to that of *Theorem 2*. As the prior that the firm is good increases, the total funding costs decline. Since the favorable effect of an improving prior (higher β) is greater for the safe project than the risky project, i.e., the increase in the expected benefits from choosing the safe project exceeds the increase in the expected benefit of choosing the risky one, the critical proportion of investors α^* decreases. Intuitively, at higher levels of β (thus, a higher average quality of firms), asset substitution problems (project choices) are smaller, and hence a lower threshold α^* resolves these problems.

3 Credit Ratings as a Resolution to Multiple Equilibria

In this section, we establish what we see as the key role of credit ratings. 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 interior range of firm qualities where multiple equilibria are possible. As emphasized in the Introduction, a key element to our theory is that institutional rigidities link the actions of some investors to the observed credit ratings and other investors are aware of the institutional rigidities that some face. The institutional rigidity we model is that a nonzero proportion of investors acts on the basis of the announced credit rating. For example, institutional investors make up a sizeable portion of the debt market, but are often restricted to invest in only highly-rated firms. Thus, we let the proportion of investors represented by institutions be given by α. Their investment behavior is therefore (partially) driven by the announced ratings.

3.1 Interactions Between CRA and the Firm

The immediate question underlying our premise is why some investors – i.e., the institutional investors – are ever willing to base their investment decisions on the rating? That is, what makes the credit rating credible?

Recall that the rating as such has no informational content. 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 credit rating agency 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, they 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 CRA and firm can strike "a deal" where the firm promises to undertake specific actions 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, the rating may get reconfirmed. If not, a downgrade could occur.

A recent example of the dialogue that takes place between CRAs and firms can be found in the European telecommunications industry.[9] Credit rating downgrades were recently suffered by four prominent 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." *Table 1* summarizes the recent history for two other players in this industry.

Table 1: Credit Rating Changes in the Telecommunications Industry

[9] See Alice van Duyn and Rebecca Bream, "Credit Rating Agencies Show Their Teeth", *Financial Times*, February 27, 2001, page 28.

	Credit Rating Agency	
Firm/Date	**S&P**	**Moody's**
British Telecom		
Feb 2000	AA plus	Aa1
Apr 24 2000	Put on negative watch	–
May 4 2000	–	Put on negative watch
Aug 24 2000	Cut to A	–
Sep 6 2000	–	Cut to A2
Feb 16 2001	Put on negative watch	–
Deutsche Telekom		
Feb 2000	AA minus	Aa2
Apr 26 2000	Put on negative watch	–
Jun 22 2000	–	Put on negative watch
Oct 5 2000	–	Cut to A2
Oct 6 2000	Cut to A minus*	–

* With a negative outlook

The existing credit ratings literature has ignored this interaction between the CRA and the firm, and therefore overlooked the "control" that the CRA has over the behavior of the firm. Strictly speaking, the actual 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 the CRA and firm incentive compatible. For market participants, this implies that a credit rating has a potentially valuable contractual feature, even in the absence of an informational advantage. The examples in *Table 1* all point at a "negative watch" qualification. This is typical for the implicit contracts upon which we focus. 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, while 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.

3.2 Credit Ratings in Equilibrium

We assume the existence of a credit rating agency (CRA) that assigns a credit rating ($c \in \{c_R, c_S\}$) to the debt claim a firm is trying to sell to the market. The rating can designate that the issuing firm will engage in the risky project ($c = c_R$) or the safe project ($c = c_S$). Since the CRA is *not* screening firms in our model, the lemons continue to affect the borrowing cost of the good firms. The presence of lemons in the marketplace effectively adds noise and increases the funding cost regardless of the credit rating assigned by the CRA. Thus, the CRA's assigned credit rating is *not* based on private information, but is based on a promise by the firm to choose the designated risks. In addition, institutional investors (α) are restricted to investing in debt issues for which the safe credit rating is assigned. In what follows, we examine what happens when the CRA assigns these ratings. In *Table 2* we have summarized the sequence of events in the model that now includes the CRA.

Table 2: Sequence of Events

At t = 0
1. Nature moves and firms are either "good" or "lemons" with probabilities β and $1-\beta$, respectively
2. Firm needs \$$I$ to invest in project (good firms have access to safe and risky projects, lemons only have access to risky projects)
3. Debt investors will lend an amount I, and ask for a *fixed* repayment based on their conjecture of the good firm's project choice. Here, the sequence is:
3.1 The CRA announces either c_S or c_R (safe or risky) rating
3.2 If c_S is announced, institutional α investors are allowed to invest and conjecture that good firm will choose safe project. If c_R is announced, then α investors abstain from lending
3.3 Remaining $1-\alpha$ investors then form beliefs about firm's investment behavior based on size of α
3.3 Investors (including institutional investors only in the case of c_S rating) lend I in exchange for a fixed repayment based on their beliefs about investment behavior
4. Firm then chooses project based on proposed repayment schedule offered by investors
At t = 1
5. Projects pay off; safe projects pay off $X_S > 0$ for sure, and risky projects pay off $X_R > X_S$ with probability γ (and zero otherwise)
6. Firm repays debt obligation if project payoff is positive, and defaults otherwise

CRA announces Risky Rating

The case where the CRA announces the risky rating is straightforward. Observe that if $c = c_R$, the proportion of institutional investors is $\alpha = 0$. These investors can only lend funds if the safe credit rating is assigned to the firm's debt. The non-institutional investors who do not face any investment restrictions now lack guidance. They will simply play either the good or the bad equilibrium, the multiple equilibria problem manifests itself again, and the good firm will choose whichever project is anticipated by investors.

CRA announces Safe Rating

If the CRA announces the safe credit rating (c_S), institutional investors are in the market. These investors condition their investment behavior on the credit rating. Here, the result of *Theorem 2* plays a key role. If a sufficient proportion of institutional investors are present, the good firm will optimally choose the safe project. The intuition is analogous to that of *Theorem 2*. With a sufficiently large proportion of institutional investors (conditioning their pricing on the safe credit rating), the funding cost for the firm is relatively low. This induces the firm to choose the safe project and effectively induces *all* investors to price according to the announced credit rating. We formulate this in the next result.

Theorem 3

If the proportion of institutional investors exceeds α^* (see Theorem 2), the CRA will engage in implicit contracting with the firm and announce a credit rating $c = c_S$. The firm optimally chooses the safe project, and all investors will condition their investment and pricing decisions on this rating.

What this theorem shows is that credit ratings have a role as an incentive-compatible "coordination mechanism". The mechanics by which this process works is as follows. The CRA fixes firm behavior with its implicit contract, and firms choose to adhere to this implicit contract because it rationally anticipates that investors condition their investment and pricing decisions on the rating, thereby confirming the rating and investor beliefs.

As a final observation, note that we have implicitly assumed that if the CRA can add value, it will do so. The CRA will then seek to induce the first-best project-choice, and this is the safe project. While it would be of interest to quantify the potential agency problem with the CRA, it is not the focus of our analysis.[10]

3.3 Impact of Noise and Moral Hazard on Credit Ratings

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 three frictions in the model:

1. the severity of noise, i.e., the mispricing caused by lemons in the model;
2. the moral hazard problem faced by the (good) firm. That is, how easy is it to engage in asset substitution? And
3. how divergent and uncoordinated are the beliefs of investors in the market?

To start with the last friction, 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, real financial markets may also be characterized by some herding behavior of "free" investors. In particular, 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. While this is, strictly speaking, outside of the context of the model, this would suggest that with divergent analyst expectations, credit ratings have the biggest pricing impact.

[*fix with fuller discussion based on:*]As Ederington and Goh (1998) point out, "the rating agencies claim to receive inside information unavailable to stock analysts such as minutes of board meetings, profit breakdowns by product, and new product plans".

The first two frictions have a more straightforward effect, and can be analyzed within the context of our model. The severity of the lemons problem is represented by the parameters β and λ. More lemons (lower β) and/or more risky lemons (lower λ) will amplify the pricing impact of

[10] 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.

credit ratings. The same holds for the severity of the moral hazard problem of the good firms. The next *Corollary* summarizes these insights.

Corollary to Theorem 3

As the noise becomes more severe (i.e., either the cross-sectional proportion of lemons ($1 - \beta$) increases and/or as the probability that the lemon firm's project succeeds (λ) decreases), the funding cost differential between the cases when the market anticipates the risky and safe project choices, respectively, strictly increases. Thus, the differential between the pricing in case of a safe, respectively risky, rating increases. Similarly, more severe moral hazard (i.e., lower γ, thus more risk in the risky project) would increase this differential in pricing.

All these issues manifest themselves by increasing the funding cost differential between the risky and safe project choices. That is, $F_{\beta}^{R} - F_{\beta}^{S}$ increases as β, γ and/or λ falls. This result is consistent with the empirical observation that the funding cost differential between different rating classes goes up and down over time. It is particularly high in uncertain times, where uncertain times are positively associated with more noise, increased moral hazard, and greater divergence in investor beliefs. Consequently, the value of credit ratings – which can coordinate investor beliefs on the safe equilibrium – is greater in uncertain times.

Having said this, in uncertain times the coordination role put on credit ratings might be hard pressed. It is not inconceivable that due to 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 very 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 re-emerge in the financial markets.

CRAs thus play a delicate role; if they manage to do their job, they are most valuable in uncertain times. However, it is precisely in those times that the coordinating role of ratings may break down.

4 Existing Evidence and New Empirical Predictions

4.1 Existing Empirical Evidence

An interpretation of the existing empirical evidence has previously provided a rather skeptical view towards the predictive power of rating agencies, inducing some to question whether ratings have any value.[11] For example, Brealey and Myers (2000) claim that "Firms and governments, having noticed the link between bond ratings and yields, worry that a reduction in rating will result in higher interest charges. They almost certainly exaggerate the influence of the ratings agencies, who are as much following investor opinion as leading it." In contrast to such claims, we believe that a careful reading of the existing empirical evidence in light of our theory gives some value to ratings.

Early empirical studies of credit ratings, such as West (1973), Liu and Thakor (1984) and Ederington, Yawitz, and Roberts (1984, 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. The pervasive finding in these studies – including Weinstein (1977), Ederington and Yawitz (1987), Cornell, Landsman, and Shapiro (1989), Hand, Holthausen, and Leftwich (1992) and Goh and Ederington (1993) – is that there is a significant and negative stock price reaction to bond downgrades, but there is no significant reaction to upgrades.

We believe that this evidence 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 would make a downgrade a truly informative event as it implies that the firm has not complied with the implicit contract during the "on watch" period.

An alternative interpretation of the observed empirical relationship between stock prices and

[11] Partnoy (1999) argues that while rating agencies are taken seriously in the market (in particular, a lower rating can have serious repercussions), this attention is unwarranted. He essentially argues that credit ratings introduce sunspots. He favors a "new" rating system that relies on market-observed credit spreads.

rating downgrades is that the rating changes may go hand in hand with changes in credit standing, with the causality stemming from the latter event. Kliger and Sarig (2000) seek to mitigate the possibility of this interpretation by isolated the issue by focussing on a change in reported credit ratings *categories*. This change in "methodology" where a finer partitioning was introduced allows them to exclusively focus on the informational content of the rating change.[12] 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 this empirical finding suggests is that the information content of credit ratings is primarily linked to (assessing) risk, with only a secondary or negligible informational content for total firm value. Thus, these findings are also consistent with our story. When credit ratings serve as focal points, changes in them *could* have a price impact. The interpretation would be that the firm will move from one equilibrium to the next. But note that the equilibrium is largely about the *risk level*. What this means is that the overall price impact is limited, as credit rating changes lead to redistributions of wealth among the financiers, consistent with Kliger and Sarig's (2000) empirical findings.

4.2 Empirical Predictions

As argued above, the theory that we have developed in this paper is consistent with the existing empirical evidence. However, there are several additional and empirically-testable predictions that can be drawn from the model. These predictions follow from the *Corollary to Theorem 3* and the discussion surround this *Corollary*. In particular, the importance of credit ratings depends on: i. the level of noise ("presence of lemons"); ii. the severity of moral hazard; and iii. the divergence of beliefs among investors. All three factors affect the increase in funding cost associated with a drop in the rating from the safe to the risky level. Empirical proxies for each of these three

[12] Kliger and Sarig (2000) focus on 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 downgrading when put into a low partition, or an upgrading when put into a relatively high one.

factors can be found. Noise, as well as the divergence in beliefs, can be proxied by the divergence in analyst earnings forecasts. The moral hazard problem really refers to the severity of asset substitution problems in a particular industry. The irreversibility of investments in a particular industry, and/or the firm's access to liquidity, could be reasonable proxies.

[arnoud – ADD!?] What about Manju's third prediction: "it seems that one implication of your story is that credit ratings should be more important in industries where larger amounts of risk shifting is possible, and in such industries should be a better predictor of yields. Again, this is potentially testable."

5 Other Implications of the Model

In this section, we explore several additional implications of our analysis of credit ratings. These include the corporate perception that funding costs are discrete, the predictability of firm behavior, and the benefits of more transparent firms.

5.1 Funding Cost Discreteness

Our analysis helps explain *discreteness*, that is, why firms in practice do not view their funding costs as being continuous. The presence of a multiple equilibria problem – and potential switching between equilibria – possibly introduces discreteness in a firm's funding cost. More specifically, a rating change in our model can change the firm's choice of risk level, and thereby induce a discrete change in the risk profile, and hence funding cost. The more fundamental lesson is that credit ratings guide investor beliefs, and that changes in ratings can lead to drastic revisions in these beliefs.[13]

[13] 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 also common in credit ratings) can possibly create a discrete price impact.

5.2 Credit Rating Agencies, Fragility and Rumors

Important in our theory are the implicit contracts between firms and credit ratings agencies. We could say that credit ratings substitute for other explicit forms of monitoring, and actually could make firm behavior more predictable. The idea is that since the credit rating agency is examining (and controlling) the firm's choice of risk level, other market participants may rationally reduce monitoring and hence become less responsive to interim signals regarding the quality of the claims they hold. Such reluctance to react to every observable signal of firm quality by instead looking primarily to the credit rating could help reduce the fragility of equilibria.[14]

In our model, credit ratings provide an economically meaningful role by fixing an equilibrium when multiple equilibria could otherwise obtain. Observe that in the region where multiple equilibria are possible, market rumors could have a serious impact on firm risk choices as investors try to anticipate firm behavior. In this sense, credit ratings may provide some stability by fixing the equilibrium, implying that market rumors will have a diminished impact on firm behavior. The credit rating agency's implicit contracting feature makes the environment of the firm more predictable and facilitates access to financial markets. Rumors are consequently more contained.

Similarly, a firm with a strong reputation is also less susceptible to the volatility (fragility) imposed by market rumors as good behavior is anticipated from firms with strong reputations. In addition, an increase in a firm's reputation may move it outside the range where multiple equilibria obtain, thereby substituting for the credit rating. However, credit ratings and firm reputation can have complementary effects in resolving the multiple equilibria problem. When multiple equilibria are possible, credit ratings can fix the desired equilibrium if a sufficient proportion of institutional investors are present. As we saw in the *Corollary to Theorem 2*, this threshold level of institutional (α^*) investors above which the good firm always plays the safe equilibrium is strictly decreasing in

[14] Gale (1993) builds a model of banks that acquire information about borrowers and develop these relationships over time. However, if a bank were to fail, good borrowers that used this bank are forced to go into the market for a new bank. If there are limits on the aggregate amount of information processing that can be carried out, good borrowers face a lemons problem. Congestion of the information system may lead to market failure. Our model, while not applied directly to banks, purports that credit ratings may help ameliorate such fragility by inducing a substantial proportion of the providers of capital to be content to ignore interim signals that arise. In a recent paper, Da Rin and Hellmann (2001) argue that the most important role served by banks has been as coordinating agents that help the economy achieve the pareto dominant equilibrium when there are multiple equilibria. In their setting, banks must be sufficiently large to both service a critical mass of firms and possess sufficient market power to profit.

the prior belief that the firm is good. Applying our model to a dynamic setting, the prior belief (β) could naturally be interpreted as the posterior belief about firm quality, or its reputation. A stronger reputation implies that a lower threshold level of institutional presence is necessary for credit ratings to serve as focal points and resolve the multiple equilibria problem.

5.3 Implications for Focus of Firms

The focal point story necessitates a responsive organization. That is, the threat of a change in the credit rating (as dictated by the implicit contract) should lead to a change in behavior or to a particular action by the company. This responsiveness may ask for a well-focussed organization. To see this, first consider a multi-divisional firm. In this type of organization, the impact of a credit rating change, or more generally a change in funding cost, is *diluted* at the divisional level. In some sense, divisions free-ride on one another, and see their choices only partially reflected in the firm's cost of capital. This would dilute the impact of credit ratings, unless internal cost of capital allocation systems, such as an EVA (or RAROC) based system, reestablish the link between the division's behavior and its true (divisional) cost of capital. Alternatively, a very centralized firm, where decisions are made at the top, could mitigate these concerns. But this type of resolution seems at odds with the perceived importance of decentralized decision making.[15] In the end, however, focus might be important for the effectiveness of credit ratings as a coordinating device or focal point.

6 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 importance. In this paper, 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

[15] See Harris and Raviv (1998) for a recent model of intrafirm decisionmaking.

a key role as "focal points" once institutional rigidities and practices are considered as part of the equilibrium.

The analysis shows that credit ratings can coordinate investors' beliefs. Together with the implicit contract and monitoring relationship between credit rating agency and 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.

7 Appendix

7.1 Proof of Lemma 1

We prove this lemma by first determining funding costs when the type of firm requesting funds is observable to the market, and then use these derivations to solve for funding costs under firm-type uncertainty.

Funding Costs When Firm Type is Known

Funding Costs for Good Firms In the case of a good firm, the cost of funding depends on whether the good firm chooses the safe or the risky project. If investors expect the good firm to choose the safe project, the face value of the debt repayment will be equal to the amount lent. That is, $I = F^S$ since the project, and hence the debt, is riskless. The good firm's expected return from choosing the safe project, net of funding costs, is given by

$$\begin{aligned} E[V_G|S] &= X_S - F^S \\ &= X_S - I, \end{aligned}$$

where $E[V_G|S]$ represents the good firm's expected value, conditional on choosing the safe (S) project, net of the debt repayment.

Alternatively, if investors expect that the good firm will choose the risky project, the necessary debt repayment is higher. With the risky project, the good firm can only repay the debt with probability γ. Hence, the necessary repayment is given as the solution to

$$E[F] = \gamma F^R = I.$$

This implies that the requested repayment is

$$F^R = \frac{I}{\gamma} > I. \tag{6}$$

Since we claim that the safe project is first best, if there is no adverse selection over firm type, the good firm should always chooses the safe project, even if investors anticipate the risky project.

Thus, the good firm's expected return from choosing the safe project must dominate the expected return from choosing the risky project. For this to be true, the risky project cannot be too good. Given the values of X_R and X_S, this puts an upper bound on the probability (γ) of the positive payoff occurring for the risky project (X_R). This upper bound on γ, denoted by $\overline{\gamma}$, is the solution to

$$X_S - F^R > \overline{\gamma}[X_R - F^R],$$

which yields

$$\overline{\gamma} \equiv \frac{X_S - F^R}{X_R - F^R}. \tag{7}$$

Observe that the cutoff $\overline{\gamma}$ is increasing in the payoff on the safe project and decreasing in the positive payoff of the risky project.

From this point forward, we assume that $\gamma < \overline{\gamma}$. Observe that $\gamma < \overline{\gamma}$ also insures that the good firm never prefers to deviate to the risky project when investors anticipate that the safe project will be chosen. To see this, note that

$$X_S - F^S > \gamma\left[X_R - F^S\right] \tag{8}$$

for all $\gamma < \frac{X_S - F^S}{X_R - F^S}$. Since $\overline{\gamma} \equiv \frac{X_S - F^R}{X_R - F^R} < \frac{X_S - F^S}{X_R - F^S}$ (the necessary cutoff that satisfies (8)), the good firm never deviates to the risky project when investors *know* that the firm is good and anticipate that it chooses the safe project.

Funding Costs for Lemons We determine the funding cost for the lemons. If the market knows for sure that the firm is a lemon, it knows that the firm has access to only one project, the very risky (V) project. In loaning I, it sets the repayment F^V, such that $E[F^V] = \lambda F^V = I$. This implies that

$$F^L = \frac{I}{\lambda} > \frac{I}{\gamma} = F^R. \tag{9}$$

The lemon's expected return when choosing the very risky project is then

$$\lambda\left[X_R - F^L\right].$$

With the funding cost of the lemons in hand, we can establish our last modelling ingredient. Since lemons face very costly financing, we assume that if the good firm faced such costs, it would optimally choose the risky project. For this to be true, the probability (γ) of the positive payoff X^R occurring under the risky project should not be too low. That is, if the good firm faced the financing offered to lemons, it will prefer the risky project to the safe one. This implies that

$$\gamma \left[X^R - F^L\right] > X^S - F^L,$$

or that

$$\gamma > \underline{\gamma} \equiv \frac{X^S - F^L}{X^R - F^L}. \tag{10}$$

It is easy to show that $\underline{\gamma} < \overline{\gamma}$, and henceforth we let $\gamma \in \left(\underline{\gamma}, \overline{\gamma}\right)$. Therefore, the good firm will not deviate from the safe project if the (safe) financing of F^S is offered, and will optimally choose the risky project if the (very risky) lemon financing of F^L is offered.

Funding Costs When Firm Type is Unknown

In our model, we assume that firm type is not known *a priori*. Under firm-type uncertainty, a firm is good with probability β, and a lemon with probability $1 - \beta$. There are now only two relevant funding costs to consider. In the first case, the market expects the good firm to choose the safe project, while in the second case, it expects the good firm to choose the risky project.

Good Firm Chooses Safe Project If investors anticipate that the good firm chooses the safe project, they will lend I and require a repayment of F^S_β, where the subscript β denotes that there is now uncertainty over the quality of the firm requesting funds. Risk-neutral investors require that $E[F^S_\beta] = I$, hence, F^S_β is the solution to

$$\beta F^S_\beta + [1 - \beta] \lambda F^S_\beta = I.$$

With this expression, observe that if the prior belief over firm type is that the firm is good for sure ($\beta = 1$), then the required repayment is just what is asked of a good firm ($F^S_\beta = F^S = I$). Alternatively, if the prior belief is that the firm is a lemon for sure ($\beta = 0$), the required repayment is that of the lemon financing ($F_\beta^S = F^L$). Thus, when the prior over firm quality is nondegenerate ($\beta \in (0,1)$), funding costs are now higher for the good firm when the safe project choice is anticipated by the market ($F_\beta^S > F^S = I$). Ultimately, we have

$$F_\beta^S = \frac{I}{\beta + [1-\beta]\lambda}. \tag{11}$$

Good Firm Chooses Risky Project Now, if investors anticipate that good firms choose the risky project, they will lend I and require a repayment of F_β^R. Again, risk neutral investors require that $E[F_\beta^R] = I$. Hence, F_β^R is the solution to

$$E[F_\beta^R] = \beta\gamma F_\beta^R + [1-\beta]\lambda F_\beta^R = I.$$

Analogous to above, if the firm is good for sure ($\beta = 1$), then $F_\beta^R = F^R = \frac{I}{\gamma}$, whereas if the firm is a lemon for sure ($\beta = 0$), $F_\beta^R = F^L$. Thus, for situations of true type uncertainty ($\beta \in (0,1)$), financing costs born by the good firm are higher ($F_\beta^R > F^R = \frac{I}{\gamma}$). Therefore, when the risky project choice is anticipated, we have

$$F_\beta^R = \frac{I}{\beta\gamma + [1-\beta]\lambda} > \frac{I}{\beta + [1-\beta]\lambda} = F_\beta^S. \tag{12}$$

■

7.2 Proof of Theorem 1

We proceed in two steps. First, we establish the lower bound on β such that the good firm is indifferent between choosing the safe and risky project when investors anticipate that the safe project is chosen. Second, we establish the upper bound on β such that the good firm is indifferent between choosing the safe and risky project when investors anticipate that the risky project is chosen. Outside of this range, the good firm has a dominant investment strategy, irrespective of investor beliefs.

Lower Bound

The lower bound on β, given by $\underline{\beta}$, is the prior belief such that the good firm is indifferent between choosing the safe project and the risky project when investors anticipate that the *safe* project is chosen. Thus, for all $\beta < \underline{\beta}$, the good firm would always prefer the risky project. In a world where there is uncertainty over firm quality, firms face a funding cost of F_{β}^{S} when the market expects the good firm to choose the safe project. Hence, $\underline{\beta}$ is the solution to

$$X_S - F_{\beta}^{S} = \gamma \left[X_R - F_{\beta}^{S} \right], \tag{13}$$

where $F_{\beta}^{S} = \frac{I}{\beta + [1-\beta]\lambda}$. It is obvious that both sides of (13) are increasing in β. However, we also know that $F_{\beta}^{S} \in \left(F^S, F^L \right)$, and that at $F_{\beta}^{S} = F^S$, the good firm strictly prefers the safe project, and that at $F_{\beta}^{S} = F^L$, the good firm strictly prefers the risky project. Therefore, since $F_{\beta}^{S} = \frac{I}{\beta + [1-\beta]\lambda}$, there exists a $\beta = \underline{\beta}$, such that the good firm is indifferent between the safe and the risky project when the safe project is anticipated. This $\beta = \underline{\beta}$ is given by

$$\underline{\beta} = \frac{I[1-\gamma]}{[X_S - \gamma X_R][1-\lambda]}. \tag{14}$$

We can also see that at $\beta = \underline{\beta}$, if the market expects the risky project to be taken, the good firm will *strictly* prefer the risky project. Observe that if the market expects the risky project, they require a repayment of F_{β}^{R}. We can compare the good firm's expected return from choosing the safe project to its expected return from choosing the risky project, and show that the former expectation is less. This can be expressed as follows

$$X_S - F_{\underline{\beta}}^{R} < \gamma \left[X_R - F_{\underline{\beta}}^{R} \right].$$

This inequality holds since $F_{\beta}^{R} > F_{\beta}^{S}$ for any β, and thus the left hand side is reduced by $\left[F_{\underline{\beta}}^{R} - F_{\underline{\beta}}^{S} \right] > 0$ and the right hand side is only reduced by $\gamma \left[F_{\underline{\beta}}^{R} - F_{\underline{\beta}}^{S} \right]$, which is less than $\left[F_{\underline{\beta}}^{R} - F_{\underline{\beta}}^{S} \right]$.

Upper Bound

The upper bound on β, given by $\overline{\beta}$, is the prior belief such that the good firm is indifferent between choosing the safe project and the risky project when investors anticipate that the *risky* project is chosen. Thus, for all $\beta > \overline{\beta}$, the good firm would always prefer the safe project. Again, with uncertainty over firm quality, the good firm faces a funding cost of F_{β}^{R} when the market expects the good firm to choose the risky project. Hence, $\overline{\beta}$ is the solution to

$$X_S - F^R_\beta = \gamma \left[X_R - F^R_\beta \right]. \tag{15}$$

We know that $F^R_\beta \in \left(F^R, F^L\right)$, and that at $F^R_\beta = F^R$, the good firm strictly prefers the safe project, and that at $F^R_\beta = F^L$, the good firm strictly prefers the risky project. Therefore, since $F^R_\beta = \frac{I}{\beta\gamma + [1-\beta]\lambda}$, there exists a $\beta = \overline{\beta}$, such that the good firm is indifferent between the safe and the risky project when the risky project is expected to be undertaken. Here, $\beta = \overline{\beta}$ is given by

$$\overline{\beta} = \frac{I\left[1-\gamma\right]}{\left[X_S - \gamma X_R\right]\left[\gamma - \lambda\right]}. \tag{16}$$

As above, we can also see that at $\beta = \overline{\beta}$, if the market expects the safe project to be taken, the good firm will *strictly* prefer the safe project. With the safe project, the market requires a repayment of F^S_β. Comparing the good firm's expected return from choosing the safe project over the risky, this yields

$$X_S - F^S_{\overline{\beta}} > \gamma \left[X_R - F^S_{\overline{\beta}} \right].$$

This inequality holds since $F^R_\beta > F^S_\beta$ for any β, and thus the left hand side is increased by $F^R_{\overline{\beta}} - F^S_{\overline{\beta}}$, and the right hand side is only increased by $\gamma \left[F^R_{\overline{\beta}} - F^S_{\overline{\beta}} \right]$, for $\gamma < 1$.

Using (14) and (16), it is also easy to see that $\overline{\beta} > \underline{\beta}$ since $\frac{1}{1-\lambda} < \frac{1}{\gamma-\lambda}$. Therefore, for $\beta < \underline{\beta}$, the good firm strictly prefers the risky project, and for $\beta > \overline{\beta}$, we see from (15) that the good firm strictly prefers the safe project, independent of investor beliefs. In the interim β-range, we see from the analysis above that the good firm's equilibrium behavior will depend on what the market anticipates the good firm's behavior to be. That is, for $\beta \in \left(\underline{\beta}, \overline{\beta}\right)$, the good firm will find it in its best interests to choose the safe project if the market expects it to choose the safe project, and will choose the risky project when the market expects it to choose the risky one. Thus, in the range over which firm uncertainty is greatest, there are multiple equilibria. ■

7.3 Proof of Theorem 2

Observe that for the good firm to prefer the safe project when facing funding costs of F^{α}_{β}, it must be the case that

$$X_S - F^{\alpha}_{\beta} > \gamma \left[X_R - F^{\alpha}_{\beta} \right].$$

It is obvious that while both the left and right hand sides are decreasing in F^{α}_{β}, the left hand side decreases at a faster rate. This can be seen most clearly by comparing the two extreme cases of having no investors playing the safe equilibrium ($\alpha = 0$) in the debt market to having only investors playing the safe equilibrium ($\alpha = 1$). When $\alpha = 0$, total funding costs are given by $F^{\alpha}_{\beta} = \alpha F^{S}_{\beta} + [1-\alpha] F^{R}_{\beta} = \left[0 \times F^{S}_{\beta} \right] + \left[1 \times F^{R}_{\beta} \right] = F^{R}_{\beta}$. Since all investors anticipate the risky project choice, the good firm confirms this conjecture in equilibrium and optimally chooses the risky project since (4) exceeds (5) for funding costs of $F^{\alpha}_{\beta}.= F^{R}_{\beta}$. The opposite result obtains if $\alpha = 1$. Here, total funding costs are $F^{\alpha}_{\beta} = \alpha F^{S}_{\beta} + [1-\alpha] F^{R}_{\beta} = \left[1 \times F^{S}_{\beta} \right] + \left[0 \times F^{R}_{\beta} \right] = F^{S}_{\beta}$ and the good firm optimally invests in the safe project since (5) now exceeds (4).

Thus, for any given β, there exists a critical proportion of investors, α^*, who believe that the safe project will be chosen such that for $\alpha > \alpha^*$, the good firm always chooses the safe project. Consequently, the remaining $1 - \alpha$ investors also rationally anticipate the safe project choice and total funding costs drop to F^{S}_{β}. ■

7.4 Proof of Corollary to Theorem 2

This can be shown by first examining the good firm's investment incentives at either β extreme. Consider first $\beta = \overline{\beta}$. We know from (16) that at this point, the good firm is indifferent between choosing the safe and the risky project when the market anticipates that the risky one to be chosen. However, since $F^{\alpha}_{\beta} < F^{R}_{\beta}$ for any $\alpha > 0$, the good firm will now strictly prefer the safe project even if the remaining $1 - \alpha$ investors anticipate the risky project.

In contrast, at the lower bound of the prior belief on firm type, $\beta = \underline{\beta}$, there must be $\alpha = 1$ investors believing that the safe project is chosen to induce the good firm to always choose the safe project. Again, we know from (14) that at this point, the good firm is indifferent between the two projects when the market anticipates the safe project. Since the financing costs in equilibrium are given by F_β^α, we know that $\alpha = 1$ must obtain for $F_\beta^\alpha = F_\beta^S$. Thus, given the continuity of the good firm's incremental expected value from choosing the safe project over the risky one, we have $\frac{\partial \alpha^*}{\partial \beta} < 0$. ■

7.5 Proof of Theorem 3

The proof of this theorem proceeds in six steps.

1. The credit rating agency "announces" the implicit contract with the firm and the c_S credit rating.

2. In the financial market, the competitive α investors, conditioning on the c_S rating, anticipate that the good firm will choose the safe project.

3. Based on *Theorem 2*, the total pricing of the debt claim for $\alpha > \alpha^*$ is sufficiently low that the good firm optimally chooses the safe project, even if $1 - \alpha$ investors anticipate the risky project.

4. Hence, given the firm's equilibrium behavior, the remaining $1 - \alpha$ investors now rationally anticipate that the good firm will choose the safe project.

5. Now, all investors anticipate that the safe project will be chosen, and the firm faces financing costs of F_β^S. Thus, the firm optimally chooses the safe project in equilibrium.

6. Consequently, the beliefs of the "competitive" α investors are confirmed in equilibrium, thereby making it optimal for them to condition on credit rating. ■

7.6 Proof of Corollary to Theorem 3

This corollary can be proven by taking the partial derivative of the difference in funding costs, given by

$$F_\beta^R - F_\beta^S = \frac{I}{\beta\gamma + [1-\beta]\,\lambda} - \frac{I}{\beta + [1-\beta]\,\lambda},$$

with respect to β, λ and γ. With respect to β, we see that

$$\frac{\partial\left(F_{\beta}^{R}-F_{\beta}^{S}\right)}{\partial\beta}=\frac{-\beta^{2}I\left[1-\gamma\right]\left[\gamma-\lambda\right]\left[1-\lambda\right]+I\lambda^{2}\left[1-\gamma\right]}{\left[\beta\gamma+\left[1-\beta\right]\lambda\right]^{2}\left[\beta\gamma+\left[1-\beta\right]\lambda\right]^{2}}.$$

It is readily seen that $\frac{\partial\left(F_{\beta}^{R}-F_{\beta}^{S}\right)}{\partial\beta}<0$ whenever

$$\begin{aligned} I\lambda^{2}\left[1-\gamma\right] &> \beta^{2}I\left[1-\gamma\right]\left[\gamma-\lambda\right]\left[1-\lambda\right] \\ \lambda^{2} &> \beta^{2}\left[\gamma-\lambda\right]\left[1-\lambda\right]. \end{aligned}$$

Thus, the condition is more easily satisfied for lower values of β (i.e., average firm quality improves) and γ (i.e., good firm's risky project gets riskier), and for higher values of λ (i.e., lemon firm becomes less risky).

With respect to γ and λ, we have

$$\frac{\partial\left(F_{\beta}^{R}-F_{\beta}^{S}\right)}{\partial\gamma}=\frac{-\beta I}{\left[\beta\gamma+\left[1-\beta\right]\lambda\right]^{2}}<0$$

and

$$\frac{\partial\left(F_{\beta}^{R}-F_{\beta}^{S}\right)}{\partial\lambda}=-\beta I\left[1-\beta\right]^{2}\frac{2\lambda\left[1-\beta\right]\left[1-\lambda\right]+\beta\left[1-\gamma\right]^{2}}{\left[\beta\gamma+\left[1-\beta\right]\lambda\right]^{2}\left[\beta\gamma+\left[1-\beta\right]\lambda\right]^{2}}<0.$$

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8 References

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