Rating Agencies

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For decades credit rating agencies were viewed as trusted arbiters of creditworthiness and their ratings as important tools for managing risk. The common narrative is that the value of ratings has been compromised by the evolution of the industry to a form where issuers pay for ratings. In this paper we show how credit ratings have value in equilibrium and how reputation insures that in equilibrium ratings will reflect the correct assessment of credit worthiness. There will always be an information distortion because of the fact that purchasers of ratings need not reveal them. We argue that regulatory reliance on ratings and the increasing importance of risk-weighted capital in prudential regulation have more likely contributed to distorted ratings than the matter of who pays for them. In this respect, much of the regulatory obsession with the conflict created by issuers paying for ratings is misguided.

I. Introduction

Credit ratings are signals of the likelihood that the terms of a credit contract will be fully honored. They are important elements in the allocation of capital in the economy because they can influence the cost of borrowing for issuers and the rate of return for investors.[1] In this paper we study how credit signals are provided and why they have value in equilibrium.

Many commentators on the financial crisis of 2007-2009 have argued that the major credit rating agencies – Fitch, Moody's, and Standard and Poor's – played a role in the crisis by assigning unrealistically high ratings to mortgage-backed securities, in particular to the upper tranches of collateralized debt obligations. Credit rating agencies are singled out in the Dodd-Frank Financial Reform Act as requiring further regulation and oversight. The Financial Crisis Inquiry Commission, which studied the root causes of the financial crisis, attributed many of the failures in financial markets to the fact that " ... major firms and investors blindly relied on credit rating agencies as their arbiters of risk."[2] This view of credit ratings and the firms that provide them as villains in the financial system represents a remarkable turnaround. For more than a century the credit rating agencies were viewed as important and valuable agents in the system, a view that was underscored by the fact that regulators at all levels relied on them to manage risk-taking in markets.

The ratings business began in 1909 when John Moody first began to offer ratings on corporate bonds. He was followed in 1916 by the Poor's Publishing Company, in 1922 by the Standard Statistics Company and in 1924 by Fitch Publishing Co. All of these publishers initially sold their ratings directly to investors. These credit ratings clearly had value for investors because they provided an independent assessment of the likelihood that the terms of debt contracts would be honored and investors continued to purchase the ratings.

Financial regulators also began to view credit ratings as a valuable tool for managing risk-taking in financial markets. The first distinction between investment grade and

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1) This sentence waffles a bit because the direction of influence is not always the one anticipated– for example, where sovereign ratings are concerned. These are essentially anomalies.
2) Financial Crisis Inquiry Commission, 2011.

non-investment grade securities in regulation was made in 1931 when the Office of the Controller of the Currency (OCC) ruled that bonds rated BBB or better could be carried on the balance sheets of banks at book value but lower rated bonds had to be marked to market. In 1936, the Federal Reserve Board and the OCC extended the reliance on ratings by ruling that banks could not hold bonds that were not rated investment grade by at least two agencies. From that point on the use of the distinction between investment grade and non-investment grade gradually spread. Throughout the 1940s and 1950s the insurance industry, whose companies were regulated by the states, moved toward a system of rule-based capital requirements where ratings played the crucial role.

A major shift in the regulatory reliance on ratings occurred in 1975 when the Securities and Exchange Commission introduced the concept of Nationally Recognized Statistical Ratings Organizations (NRSROs), initially Moodys, Standard and Poors, and Fitch. At the same time the SEC imposed on broker dealers capital requirements that relied on ratings issued by NRSROs. Beginning in 1982 the SEC also simplified disclosure requirements for issuers of investment grade securities. In 1974 the Employee Retirement and Income Security Act was passed and signed into law initiating another major category of regulatory reliance on ratings. Administered by the Department of Labor, ERISA began to reference ratings. ERISA has been amended several times and since 1989 the DOL has permitted pension funds to invest in asset backed pass-through securities provided they are rated in one of the three highest categories by at least one of the four largest NRSROs. In 1989 the Financial Institutions Recovery and Reform Act prohibited Savings and Loan organizations from investing in non-investment grade securities. And in 1991 the Investment Company Act of 1940 was amended to require money market mutual funds to limit their investments to securities that are rated in one of the two highest categories by at least two NRSROs. There were other modifications to regulations that further increased the reliance on ratings but the ones just cited enshrined the use of ratings by NRSROs into the regulatory architecture in the U.S.

Although they increased the reliance on ratings steadily over time regulators also began to view the ratings agencies as requiring regulation when the business model changed from the "investor pays" structure to an "issuer pays" model in the

1970s.[3] This was a concern because when the issuer both chooses the agency to rate its securities and pays for the rating there is a potential conflict of interest. The issuers of credit instruments clearly want higher ratings to lower their cost of raising capital and can shop among firms to issue that rating. This conflict of interest has been the focus of most suspicion and criticism of the ratings business. But, credit rating agencies base their existence on their ability to provide objective assessments of the credit risk of securities. It is important to understand how this apparent conflict between the issuers of ratings and issuers of debt instruments gets resolved.[4] We will argue that distortions introduced by the regulatory reliance on ratings are far more important in impairing the accuracy of credit ratings. Opp, Opp, and Harris (2013), and Bongaerts, Cremers and Goetzman (2013) have also cited the regulatory reliance on ratings as a factor in the buildup of problems with the CRAs.

How did the credit rating agencies evolve from trusted arbiters of credit worthiness to suspect players in the financial system? In this paper we show how credit signals have value by describing a financial market that includes firms, investors and providers of signals. We show that these signals have value in equilibrium regardless of who pays for them. What causes the signals to become suspect? We argue that the reliance on them by regulators combined with an increase in the demand for "safe" assets relative to the supply are important factors in explaining the evolution of the industry and the informativeness of ratings.

II. Environment

We begin by studying the problem of a firm that wants to sell a contingent claim on the output of a production project. The attributes of the claim can be learned

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3) Many reasons have been offered for this evolution but a prominent one is that the advent of the Xerox machine undermined the rating agencies' intellectual property protection and that there was a collective action problem for the many investors that made it easier for the ratings agencies to turn to the issuers.

4) It is important to recognize as well that the "investor pays" model would also be subject to conflicts. Currently debt markets are dominated by a few very large firms which have significant market power.

with costly effort. Our goal is to understand the role that independent assessments – by rating agencies – play in the market for these claims. To do that, we present a model that includes firms, investors, and providers of signals (rating agencies). We start by analyzing the behavior of the firms and investors, leaving aside the role of ratings agencies. We consider first a one period model with two subperiods. Later we describe a model in which the period is infinitely repeated and where we can consider the behavior of ratings agencies.

Consider an economy where there is a single final or consumption good in each subperiod. Investors are endowed with a storable consumption good in the first subperiod. Firms are endowed with a Lucas fruit tree which produces output in the second subperiod. In the first subperiod the firms sell their claims on the tree to investors. The firms care only about consumption in the first subperiod and eat the proceeds of their sale right away. The investors care only about second subperiod consumption. They invest some of their endowment good in claims on the trees of the firms. Their consumption is the sum of the payouts of their acquired claims and the amount of their endowment good that they stored.

We assume that there is a unit measure of firms. Each firm starts out owning a Lucas fruit tree which produces a stochastic dividend y. There are N different types of trees. The output of a tree of type n is the common draw of a lognormally distributed random variable with mean ϕ_n and s.d. σ_n. The measure of each type is given by μ_n for $n = 1, ..., N$. We normalize the total number of firms to 1 (i.e. $\sum_n \mu_n = 1$). We will assume that ϕ_n and σ_n are both increasing in n, so firms with higher index trees are riskier but promise a higher expected return $(e^{\phi_n + \sigma_n^2/2})$. We could think of the firms of a given type as also being subject to an idiosyncratic shock but, because there are a continuum of each type, the investors can diversify away this idiosyncratic risk. Hence, we will ignore it.

We assume that there are also a continuum of investors, but that the number of investors is large relative to the number of firms. This will lead the price of any individual firm's security to be high enough that an individual investor can only accumulate a small number of claims on any one firm. We will assume that these investors are risk averse, have CRRA preferences, and we denote their initial wealth as W. We will assume that there are I different types of these investors, where types

differ in terms of their risk aversion. We let α_i denote the risk aversion of a type i investor and g_i their measure. We denote the total number of investors by $G = \sum_{i=1}^{I} g_i$. We will assume that the investors cannot sell insurance to each other and cannot short sell claims on the firms. As a result of this, and of the fact that investors have different degrees of risk aversion, there can be an efficiency gain to acquiring knowledge about the risk-type of the firms so as to get the right allocation of claims among the investors.

We assume that a fraction of the firms' types are known, and that a firm or an investor can get more information about a firm whose type is unknown by acquiring a signal at a cost c. For simplicity, we will assume that the signal is perfect and completely reveals the type of a tree (and hence of the firm). We assume that the purchasing of signals cannot be observed. We also assume that an investor cannot bond its actions by showing its portfolio (because, for instance, they can change their position afterwards). We denote by $\gamma \in [0, 1]$ the fraction of firms whose type is automatically known. So long as $\gamma > 0$, the structure of asset markets is not determined by information acquisition and revelation decisions since all asset types are automatically in positive net supply. However the supply of each of these assets will be affected. So long as $\gamma < 1$, there is a potential role for information acquisition because there are firms whose types are not known.

1. No Information Acquisition

We first consider the case in which there is no additional information acquisition and hence the fraction of known firm types is γ. All firms whose type is unknown are ex ante identical from the perspective of an investor, and hence will trade at the same price. In addition, the firms whose type is unknown are distributed the same as in the overall population, and hence the fraction of type n is given by μ_n given our normalization that the total measure of firms is one. An investor will find it efficient to spread his claims in this fashion since he has no information about these firms. Hence, an investor who acquires q^U evenly distributed claims on these firms is getting a claim on their average output which we denote by Y^U. Hence-

forth, we will assume that investors always efficiently diversify their holdings of unrated firms.

An investor of type i can be thought of as choosing a vector of investment quantities $\{q_n^i\}_{n=1}^N$ in known firm types and $q^{i,U}$ of the unknown firm types, given the vector of prices $\{p_n^i\}_{n=1}^N$ of the known firms and p^U of the unknown firms. The problem of a type i investor is given by

$$\max_{\{q_n\},q^U} E\left\{u^i\left(x + \sum_n q_n y_n + q^U Y^U\right)\right\} \quad \text{subject to} \tag{1}$$

$$x = W - \sum_n q_n p_n - q^U p^U \geq 0 \quad \text{and} \tag{2}$$

$$q_n \geq 0 \quad \text{and} \quad q^U \geq 0, \tag{3}$$

and given that

$$Y^U = \sum_n \mu_n y_n. \tag{4}$$

The market clearing conditions are

$$\sum_i g_i q_n^i = \gamma \mu_n \quad \text{for each } n = 1, ..., N, \tag{5}$$

and

$$\sum_i g_i q_i^U = (1 - \gamma). \tag{6}$$

An equilibrium here consists of quantities $\{q_n^i\}$ and $q^{i,U}$ for each i and prices $\{p_n\}_{n=1}^N$ and p^U such that (i) the quantity choices are optimal for each investor i, and (ii) markets clear.

Proposition 1. *So long as $\gamma \in (0,1)$,*

$$p^U \leq \sum_n p_n \mu_n. \tag{7}$$

Proof. To see this, assume otherwise. Then, note that some investors must be holding a positive quantity of the unknown firms (i.e. $q^{i,U} > 0$). Then these investors could reduce this quantity by ε, s.t. $q^{i,U} - \varepsilon > 0$, and acquire claims directly through purchasing $\varepsilon \mu_n$ on each firm of type n. This would replicate the pattern of claims on firms while increasing his storage level. This would raise the investors' payoff. Hence, no one would be willing to hold a claim on a firm whose type was unknown, which contradicts market clearing.

Remark 2. *The reverse arbitrage may not hold, and hence (7) can hold as a strict inequality. This is because reverse arbitrage would require that there be an investor i who is not at a corner with respect to his direct holdings of each type of firm (i.e. $q_n^i > 0$ for all n). This may not occur in equilibrium. As a result claims on the unknown firms can trade below their arbitrage values.*

Remark 3. *If $\gamma = 0$ and there is no information about the different firms, then each investor is only investing a positive quantity in storage or in the unknown type. In this case, the marginal valuation of the different firm types $1, ..., N$ will not be equalized across investors and the price p_n will correspond to the highest marginal valuation across the investor type i for a firm of type n. This will ensure that all of the investors will optimally choose to invest 0 at these prices. It will also reflect the price that a firm should anticipate receiving if it could issue a security of type n and sell it competitively to this highest valuation investor type. Given this, it would not be surprising that (7) held as a strict inequality.*

2. Full Information

Consider next the case in which $\gamma = 1$ and there is full information about all of the firms. This is simply a special case of the prior model where $q^{i,U} = 0$ for each

investor. Denote by $\{p_n^{FI}\}$ and $\{q_n^{FI,i}\}$ the full information equilibrium prices and quantities. From this full information equilibrium we can always set the price of the unknown firm claims equal to their arbitrage price, or

$$p^U = \sum_n p_n^{FI} \mu_n, \tag{8}$$

since at this price all of the investors weakly prefer holding a composition of claims on known firms – with weights μ_n – to holding a diversified claim on the unknown firms. Hence, we are free to set $q^{i,U} = 0$.

The full information outcome can be supported without any information (i.e. $\gamma = 0$) if there are no short sale constraints. To see this, conjecture that the price of an unknown firm, p^U, is given by (8) and that the price of a type n firm is still p_n^{FI}. If each investor acquires its per capita share of the unknown firms, $q_i^U = 1/\sum_i g_i$, and $\{q_n^i\}$ of the various types, then

$$q_i^U \mu_n + q_n^i = q_n^{FI,i}. \tag{9}$$

Given these quantities it follows that all investors will hold the same set of underlying claims on the different types of firms, and hence have the same level of consumption and storage. It also follows that all markets clear since

$$\sum_i g_i q_i^U = 1,$$

and

$$\sum_i g_i q_i^U = \sum_i g_i \left[q_n^{FI,i} - q_i^U \mu_n \right] = \sum_i g_i q_n^{FI,i} - \mu_n = 0.$$

Thus, the full information equilibrium is always an equilibrium of an economy without short-sales constraints. This highlights the critical role of short-sale constraints in generating a motivation to acquire information about the types of the firms.

The full-information can also be supported so long as there is sufficient infor-

mation. To be precise, so long as there exist quantity vectors $\left[q^{i,U}, \left\{q_n^i\right\}\right]$ such that (i) (5) and (6) hold, and (ii) $q_n^i \geq 0$ for each i and n, then we have supported the full information equilibrium allocation at prices $p^{FI,i}$ and with p^U given by (8). The key requirement here is that we do not violate the short sales constraint. It is trivial to see that so long as $q_n^{FI,i} > 0$ for all i and n (i.e. each investor holds a strictly positive quantity of each asset) then there will exist $\gamma < 1$ such that, so long as $\gamma \geq \underline{\gamma}$, we can support the full information outcome. To understand this result note that we need to have assets of type n in sufficiently positive supply and the unknown asset in sufficiently small supply that each investor can adjust its overall distribution of fundamental claims so as to replicate the distribution under full information. Note also, that so long as γ is below this threshold, there is a potential gain to information acquisition.

3. Household Information Acquisition

Here we examine an investor who is considering buying information about the unknown firms. The advantage of doing so is that the investor can buy claims on this firm at the price of an unrated firm, p^U. The disadvantage is that it must pay the information cost. If the investor gathers no information then its payoff is still given by the solution to (1) subject to (2-4). While if she acquires one signal, then its expected payoff conditional on drawing a signal for the firm of type n is given by the solution to the equation

$$\max_{\{q_n\}, q^U, \tilde{q}} E\left\{u^i\left(x + \sum_n q_n y_n + q^U Y^U + \tilde{q} y_n\right)\right\} \text{ subject to}$$

$$x = W - \sum_n q_n p_n - q^U p^U - \tilde{q} p^U - c \geq 0 \quad \text{and}$$

$$q_n \geq 0, q^U \geq 0, \text{ and } \tilde{q} \geq 0,$$

where Y^U is still given by (4). Hence, the unconditional payoff is given by the sum of its conditional payoffs weighted by their probabilities, or

$$V^{1,i} = \sum_{j=1}^{N} \left\{ \begin{array}{c} \max_{\{q_n\},q^U,\tilde{q}} Eu^i \left(\begin{array}{c} W - \sum_n q_n p_n - q^U p^U - \tilde{q} p^U - c \\ + \sum_n q_n y_n + q^U Y^U + \tilde{q} y_j \end{array} \right) \\ \text{subject to} \\ W - \sum_n q_n p_n - q^U p^U - \tilde{q} p^U - c \geq 0 \quad \text{and} \\ q_n \geq 0, \; q^U \geq 0, \; \text{and} \; \tilde{q} \geq 0 \end{array} \right\} \mu_j.$$

When we consider how the investor decides on buying more than one signal, we will assume for simplicity that its decides the number of signals to buy ex ante and not sequentially. With this simplification the payoff from buying two signals is given by

$$V^{2,i} = \sum_{k=1}^{N} \sum_{j=1}^{N} \left\{ \begin{array}{c} \max_{\{q_n\},q^U,\tilde{q}1,\tilde{q}2} Eu^i \left(\begin{array}{c} W - \sum_n q_n p_n - q^U p^U - (\tilde{q_1} + \tilde{q_2}) - 2c \\ + \sum_n q_n y_n + q^U Y^U + \tilde{q} y_j + \tilde{q_2} y_k \end{array} \right) \\ \text{subject to} \\ W - \sum_n q_n p_n - q^U p^U - \tilde{q} p^U - c \geq 0 \quad \text{and} \\ q_n \geq 0, \; q^U \geq 0, \; \text{and} \; \tilde{q} \geq 0 \end{array} \right\} \mu_j \mu_k.$$

Continuing in this fashion we can define $V^{l,i}$ for l =1, 2, 3, ... up to the limit implied by the wealth constraint, which is $l \leq W/c$. Denote by $V^{0,i}$ the value of the solution to (1) where the investor does not buy any signals. Because investors are small relative to firms, once an investor has acquired a signal for each type of tree, there is no further gain to more signals. Since the probability of I distinct signals in I trials is positive, it follows that the value of more signals goes to zero with probability one in a finite number of draws.

We will assume that the opportunity cost c of buying a signal is large relative to an individual investor, and hence that

$$V^{0,i} > V^{l,i} \quad \text{for} \quad l \leq \frac{W}{c} \quad \text{and for all} \quad i = 1, \dots, I.$$

As a result of this, no investor wants to buy a signal just for himself. (Note that the presence of idiosyncratic risk would make purchasing a signal about a finite number of firms even less valuable.)

In equilibrium no investor will be able to buy a signal and then sell the information to other investors at profit. There are two basic arguments for why this is so. First, we assume that the investor who buys a signal from another investor cannot verify whether or not the selling investor has actually bought the signal. Hence the seller of information would have an incentive to sell information when they have not bought it, and to sell more information than they have bought. Second, since information can be costlessly duplicated and resold, this implies that if the information was sold to more than two investors its price must be zero by Bertrand competition.

4. Signal Buying and Revealing

Consider an arrangement in which a firm whose type is unknown pays some intermediary to buy a signal as to their type and then make it public if the firm so chooses. Remember that these signals are perfect and assume for now that rating agencies will only report honestly or not at all. A firm will want to make its reported type public so long as this will raise its price relative to a firm with no reported type, or $p_n \geq p^U$. To determine the firm's optimal reporting decision, let $I\{\}$ denote the indicator function which takes on a value of 1 if the statement is true and 0 if false. Then we can express the firm's expected payoff from buying a signal and employing the optimal revelation rule is

$$\sum_n \left[p_n I\{p_n \geq p^U\} + p^U I\{p_n < p^U\} \right] \mu_n - c. \tag{10}$$

The firm's payoff from not buying the signal is simply p^U. It will choose to buy a

signal or not depending upon which of these two payoffs is larger.

Under this arrangement an investor is choosing how much to buy of each type of firm whose type is known – either because they were initially known or bought a rating and choose to report it – and those whose type is unknown. The firms whose types are unknown consist of firms who did not buy ratings or bought ratings and chose to not report them. Hence the composition of these firms will be subject to adverse selection arising from the firms' reporting decisions. So, to construct the output of a diversified claim to all of the unknown firms we need to determine their type composition. To do so, first denote by κ the fraction of firms whose type is initially unknown and choose to buy a signal. Second, note that the number of firms of type n who have no reported rating is $(1-\gamma)\mu_n\left[I\{p_n < p^U\}\kappa + (1-\kappa)\right]$; i.e. the firms of type n that bought a rating and did not report it plus those who did not buy a rating and hence cannot report one. This implies that the output of a diversified claim will be given by

$$Y^U = \sum_n \frac{\left[I\{p_n < p^U\}\kappa + (1-\kappa)\right]\mu_n}{\sum_n \left[I\{p_n < p^U\}\kappa + (1-\kappa)\right]\mu_n} y_n, \tag{11}$$

where

$$\frac{\left[I\{p_n < p^U\}\kappa + (1-\kappa)\right]\mu_n}{\sum_n \left[I\{p_n < p^U\}\kappa + (1-\kappa)\right]\mu_n}$$

is the fraction of firms of type n in the pool of firms whose type is unknown. It is easy to see that if $\kappa = 0$ then the composition will be determined by the pure type distribution, μ_n, and adverse selection will not play a role. However, as κ increases, then the composition will be increasingly sensitive to the reporting decisions of the firms. When $\kappa \to 1$, the unknown firms will only consist of types who do not choose to report a rating.

Proposition 1 implies that the price of a firm whose type is unknown will satisfy

$$p^U = \sum_n \frac{\left[I\{p_n < p^U\}\kappa + (1-\kappa)\right]\mu_n}{\sum_n \left[I\{p_n < p^U\}\kappa + (1-\kappa)\right]\mu_n} p_n,$$

and must be strictly equal if there is any investor type who holds a strictly positive quantity of claims on all types of firms.

The problem of a type i investor is very similar to the no information acquisition case, with the only difference coming from the need to take account of the impact of adverse selection on the composition of firms who do not have a known type. Their problem still involves maximizing (1), and is still subject to the budget constraint (2) and the short-sales constraint (3), but now the output of a diversified claim to the unknown firms is given by (11).

Taking as given the fraction of firms whose type is initially known, γ, the price of reports, c, and that all reports are accurate, we can define an equilibrium here as consisting of prices $\left[\{p_n\}_{i=1}^N, p^U\right]$, quantities $\left[\{q_n\}_{i=1}^N, q^{i,U}\right]$ for each investor type $i = 1, ..., I$, and the fraction of κ firms which buy signals. For these objects to be an equilibrium:

1. $\left[\{q_n\}_{i=1}^N, q^{i,U}\right]$ must solve investor i's problem given the prices,

2. The firm's signal buying choice must be optimal, so

$$\text{if } 0 < \kappa < 1, \text{ then } \sum_n \left[p_n I\{p_n \geq p^U\} + p^U I\{p_n < p^U\}\right]\mu_n - c = p^U,$$

$$\text{if } \kappa = 0 \text{ then } \sum_n \left[p_n I\{p_n \geq p^U\} + p^U I\{p_n < p^U\}\right]\mu_n - c \leq p^U,$$

$$\text{if } \kappa = 1 \text{ then } \sum_n \left[p_n I\{p_n \geq p^U\} + p^U I\{p_n < p^U\}\right]\mu_n - c \geq p^U.$$

3. The prices must clear the markets

$$\sum_i g_i g_n^i = \left[\gamma + (1-\gamma)\kappa I\{p_n \geq p^U\}\right]\mu_n \text{ for each } n = 1, ..., N$$

and

$$\sum_i g_i g_i^U = (1-\gamma)\left[\kappa I\{p_n < p^U\} + (1-\kappa)\right]\mu_n.$$

Note that in the market clearing conditions, the claims on a firm of type n

where $p_n < p^U$ consist solely of those firms whose type was initially known. Hence, these types of firm are in zero net supply if the fraction of firms whose type is initially known is zero. Note also that the supply of claims on firms who did not report a rating depends both on how many of the firms bought ratings and on the extent to which these types choose to report those ratings.

Example 4. *Assume that there are just two types of agents with CRRA coefficients 0 (risk neutral) and greater than 0 (so risk averse). Assume that the risk neutral investors are in large enough supply that they determine all prices. So*

$$p_n = e^{\phi_n + \sigma_n^2/2}.$$

and

$$p^U = \sum_n \frac{\left[I\{p_n < p^U\} \kappa + (1-\kappa) \right] \mu_n}{\sum_n \left[I\{p_n < p^U\} \kappa + (1-\kappa) \right] \mu_n} p_n.$$

Assume that $\gamma > 0$ so that all types are in positive supply. Assume that there are three kinds of assets/firms with (ϕ_n, σ_n) given by $n = l, m,$ and h meaning low, medium and high risk/return. Assume that the expected returns are such that

$$p_m < \mu_h p_h + \mu_m p_m + \mu_l p_l, \tag{12}$$

so that the price of the middle type is lower than population weighted expected type. There are three cases:

    1. If c is so high that no firm chooses to become informed, then $\kappa = 0$. In which case p^U is given by the expected payoff given that the composition of firms is determined by μ_n, or (8).

    Finally, it must be the case that the expected return from buying a rating is nonpositive, or

$$[p_n - p^U] \mu_n \leq c.$$

2. If c is low enough then $\kappa > 0$. Given (12), only firms of type h report their type. In which case

$$p^U = \frac{(1-\kappa)\mu_h p_h + \sum_{n=l,m} [\kappa + (1-\kappa)] \mu_n p_n}{(1-\kappa)\mu_h + \sum_{n=l,m} [\kappa + (1-\kappa)] \mu_n} < \mu_h p_h + \mu_m p_m + \mu_l p_l.$$

Since p^U is declining in κ, to rationalize this reporting strategy we need κ to be small enough that $p_m < p^U$. Since this inequality holds at $\kappa = 0$, this is trivially possible. Finally, we need c to be such that

$$[p_n - p^U] \mu_n = c.$$

3. $\kappa > 0$ and both firms of type h and m report their types. In which case

$$p^U = \frac{\sum_{n=m,h} (1-\kappa)\mu_n p_n + [\kappa + (1-\kappa)] \mu_l p_l}{\sum_{n=m,h} (1-\kappa)\mu_h + [\kappa + (1-\kappa)] \mu_l},$$

and to rationalize this reporting strategy we need κ to be big enough so that $p_m > p^U$. This is possible since as $\kappa \to 1$, $p^U \to p_l$. Finally, we need c to be such that

$$[p_h - p^U] \mu_h + [p_m - p^U] \geq c.$$

Since in case 3, $p_m \geq p^U$, it follows that the unrated price is lower than in case 1 or 2 and therefore the upper bound on c for case 3 is strictly higher than the value required for case 2. Hence this simple example trivially admits multiple equilibria coming through the strategic externality created by the adverse selection effect. If we compare case 1 and 2, then the composition of the unrated pool is the same, and the fraction of firms that buy a rating rises as the cost falls. When we compare case 2 and 3, the composition of the pool changes and this can lower p^U and thereby raise the incentive to buy a rating. As a result, there may not be a simple monotone relationship between κ and c.

5. The Ratings Agencies

We will now analyze the behavior of ratings agencies that specialize in rating firms. To do so, assume now that the periods are repeated over and over with new investors and firms in each period. Assume that the type of a firm's tree is publicly observable at the end of each period. Assume that there exist infinitely lived agents who can become a ratings agency by paying a fixed cost f and that upon doing so, the cost of producing a rating for a firm is e. We will assume that the maximum number of ratings that a ratings agency can produce is capped by $\bar{x}$.

There always exists a zero-reputation equilibrium in which no one buys a rating because no one believes that the ratings firms issue accurate reports. Given that it doesn't expect anyone to buy a rating in the future, any ratings agency would optimally choose to shirk and produce an inaccurate rating. In light of this no investor would change their demand in response to a ratings report and hence no one will choose to pay the cost of becoming a ratings agency. However there exist other reputational equilibria in which reputations have positive value. We turn next to them.

We want to construct a reputational equilibrium in which ratings firms issue accurate reports and hence their reports have positive value. To do so, start by considering the net benefit from becoming a ratings agency, let c denote the amount a ratings agency charges a firm to rate it. Then the payoff to becoming a ratings agency that *accurately* produces x reports is given by

$$\frac{x\left(c-e\right)}{1-\beta} - f$$

where β is the agency's discount factor. The payoff to a ratings agency who shirks and simply issues random ratings without paying the cost to produce accurate ratings is

$$xc - f.$$

This is because with $x > 0$, the agency is rating a positive measure of firms, and

hence they will only be able to do this once before being detected. The ratings agencies will always prefer to produce accurate ratings so long as

$$\frac{(c-e)}{1-\beta} > c.$$

The equilibrium can be one of two types depending upon whether the capacity constraint or the incentive constraint binds in equilibrium. In a **type 1 equilibrium**, the ratings agencies just break even and weakly prefer to issue accurate ratings. Since the agency will always want to lower its price by a tiny amount if this will enable it to sell at capacity, it follows that all rating agencies will be at capacity. Since consumers are indifferent over agencies, so long as they think that they are producing accurate reports, all ratings agencies will have to charge the same price. This implies that $x = \bar{x}$, and the equilibrium charge, c^*, is such that

$$\frac{\bar{x}(c^*-e)}{1-\beta} = f,$$

and

$$\frac{(c^*-e)}{1-\beta} \geq c^*.$$

The equilibrium number of ratings agencies, X, is given by

$$X = \frac{\kappa(1-\gamma)}{\bar{x}},$$

where $\kappa(1-\gamma)$ is the measure of firms who buy a rating in equilibrium.

In a **type 2 equilibrium**, the requirement that the ratings agencies prefer to issue accurate reports binds. In this case,

$$\frac{(c^*-e)}{1-\beta} = c^*$$

and the quantity that a ratings agency produces, x, must satisfy $x \le \bar{x}$ and

$$\frac{x(c^{*}-e)}{1-\beta} \ge f.$$

In a type 2 equilibrium the ratings agencies can earn positive rents. They do not compete away these rents because lowering their prices will remove their incentive to produce accurate reports. The number of reports that each agency produces is indeterminate, modulo the fact that their scale has to be large enough to ensure that they break even.

The fact that the ratings industry has long been dominated by three firms suggests that the minimum size criterion for either the type 1 or type 2 equilibrium must be fairly big to account for this. One of the main cost factors for the ratings agencies is the need to maintain a staff of analysts with detailed knowledge of specific industries and able to manage the large quantities of data and other information necessary to accurately assess creditworthiness of individual firms and securities. Depending on whether one thinks of these costs as being fixed or variable with the scale of reports, it is plausible to believe that f is large and hence the minimum size for the type 1 equilibrium is large, or that e is large, and hence the rents per report are small, and this necessitates a large size for the type 2 equilibrium. In recent years, there has been some entry though the industry continues to be dominated by a few firms. This fact suggests that the most plausible interpretation is that e is large and that the type 2 equilibrium may be the most accurate description of the outcomes we observed.

A. Reporting Incentives

We have assumed that investors are free to buy assets in whatever proportion they desire consistent with their budget constraint. As we detailed in the introduction, government regulation frequently acts to limit regulated investors like banks, insurance companies and company retirement funds on their asset choices or to impose penalties for more risky ones. At the same time, because of regulatory features like deposit insurance or pension guarantees (via Pension Benefit Guaranty

Corporation), these investors often have a strong incentive to engage in risky investments. To capture the impact of these sorts of incentive distortions in our model, assume that the government decides to restrict type I investors who are the least risk averse to only buying firms who have signaled that their type is 1 (the safest).

In this case, if these investors utilize ratings from an accurate agency, their payoff is

$$V^{I*} = \max_{q_1} E_{y_1} \left\{ u^I (W - q_1 p_1 + q_1 y_1) \right\}.$$

However, imagine that there was a ratings agency that would rate some collection of types as type 1. Denote the set of types that it so rates by J, and since all these firms are ex ante identical, they trade at the same price, p_1^J. Assume that everyone knows how this "inaccurate" agency is behaving, so they will correctly realize that a diversified claim to the assets in set J will yield

$$Y_1^J = \sum_n \frac{I\{n \in J\} \mu_n}{\sum_n I\{n \in J\} \mu_n} y_n, \tag{13}$$

given the ratings agency randomly chooses some fraction of initial firms to rate in this fashion and hence the composition of the pool is the same as in the population.

Assume that arbitrage holds, and that the price of these securities is given by

$$p_1^J = \sum_n \frac{I\{n \in J\} \mu_n}{\sum_n I\{n \in J\} \mu_n} p_n. \tag{14}$$

If the set J consists of a single type of asset, then arbitrage must hold. For this to hold, it must not only be the case that the set J is not "too large", but also that the number of type I investors is not too large, and they may end up trading above their arbitrage price if the supply constraint binds. Given this arbitrage assumption, the payout to an I type investor who holds a diversified set of claims to the firms that this rating agency has rated type 1 is given by

$$\max_{q_1} E_{y_1} \left\{ u^I (W - q_J p_J + q_J Y_J) \right\} \text{ s.t. (??)}.$$

It is easy to construct cases in which the type I investors are better off buying the assets rated type 1 by the "distorted" rating agency than buying accurately rated assets. Since agencies can compete over which set J they might offer, competition will lead this special agency to choose the set J so as to maximize the payoff of the I type investors. Denote this optimum set by J^*.

The "distorting" agency has an incentive to distort its ratings to help the type J investors undo the impact of regulation on their investment choices. However, there is no such incentive with respect to all of the other assets that the agency rates. Hence, the price of the firms rated type 1 by the "distorting" agency will differ from those rated by the accurate ratings companies. However, the price of their other ratings will be the same and hence $p_n^J = p_n$ for all $n > 1$.

The other types of investors will not want to acquire firms rated type 1 by our special rating agency since arbitrage will imply that there is no price advantage, and they can always do better by using the ratings of an accurate agency because it will enable them to obtain their desired portfolio. However, they will be indifferent between any firm rated $n > 1$ by our "distorting" agency vs. that rated by a regular completely accurate agency. The type I investors will be (weakly) worse off under this arrangement than the one in which they are unrestricted (taking the prices $p_1, ..., p_n$ and p^U as given) while the other investors will be indifferent.

III. The Demand for Ratings and the Supply of Safe Assets

The example just cited is pertinent to the issues that arose during the financial crisis. The problems arose when the ratings agencies rated bundles of credit instruments that had been assembled in the form of Residential Mortgage Backed Securities (RMBS) or CDO's based on them. As argued in Acharya et. al.(2009) the key ingredient in the financial crisis was the fact that financial firms were happy to

retain highly rated tranches of mortgage backed securities they created in special purpose vehicles because of the yield they offered. In the context of our model the type J investors actually leveraged their securities while meeting the quality requirements imposed by the government. This was how they managed to manufacture the tail risk that eventually caused the financial system to nearly collapse.

The increasing reliance on ratings in order to risk weight assets for prudential regulation purposes increased the demand for "safe" assets – assets that met the regulators' standards. At the same time the growth of shadow banking and the increased use of derivatives and repo markets dramatically increased the demand for safe assets as collateral for repo transactions and derivative positions. Repo and derivative transactions increased sharply in the 1990s and through 2007 and this increased demand for safe assets as collateral for short-term funding ran up against a limited supply of government issued safe assets. In 2001 the Bank for International Settlements pointed out that the increase in collateralized transactions – that required collateral with inherently low credit and liquidity risks – had outstripped the supply of safe assets (Gorton and Ordonez 2012).

What has happened to the supply of safe assets and investment grade securities over time? In earlier periods, the private sector and The Treasury supplied the needs of markets quite well. But, over time, the supply of investment grade debt from the corporate sector declined relative to the demand (Gorton and Ordonez, 2012) and the supply of Treasury debt has fluctuated over time.

Between fiscal 1992 and fiscal 1997, strong economic growth and rising tax receipts pushed the deficit down from $290 billion to $22 billion. In fiscal 1998 the federal government recorded a surplus of $70 billion for the first time in almost thirty years. The Congressional Budget Office at the time predicted that the surplus would increase steadily over the next ten years and would reach $381 billion in fiscal 2009. The shrinking deficit, and subsequent surplus, led to a concomitant decline in Treasury financing needs. Treasury officials reduced their monthly offerings of 2-year notes from $181.2 billion in 1996 to as little as $12 billion in 1998. Over the same interval, quarterly offerings of 3-year notes fell from $19 billion to $10 billion and weekly offerings of 13-and 26-week bills fell from around $14 billion each to $5.4 and $7.4 billion, respectively.[5]

The demand for safe assets has led to financial innovation and the development of privately created "nearly riskless" assets that can fill the role of government backed safe assets and investment grade corporate debt.

Figure 1 shows issuance of coporate debt by rating category. Over time the new issuance declined in relative quality with the number of AAA rated coporations declining from 60 in 1980 to 4 presently.

## Figure 1: Issuance of Corporate Debt By Rating
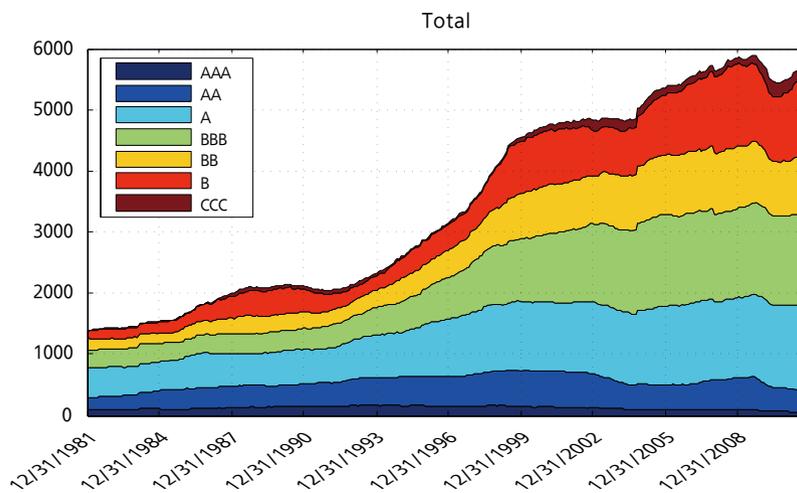
Gorton, Llewellen and Metrick (2010) showed that privately issued substitutes for government debt and highly rated privately issued debt, together, are a roughly constant fraction of all debt since the 1950s. Krishnamurthy and Vissing-Jorgenson (2012) also document the relationship over time between government debt and private issued asset-backed near riskless private debt. They show that the net supply of privately issued debt is negatively correlated with the net supply of government debt.

Figure 2 shows the dramatic growth in the issuance of AAA and investment grade rated RMBS backed debt:

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5) There is currently concern over a similar shortage of safe debt because the Fed is buying over 90% of new issuance by the Treasury.

Figure 2: Issuance of RMBS Backed Debt By Rating
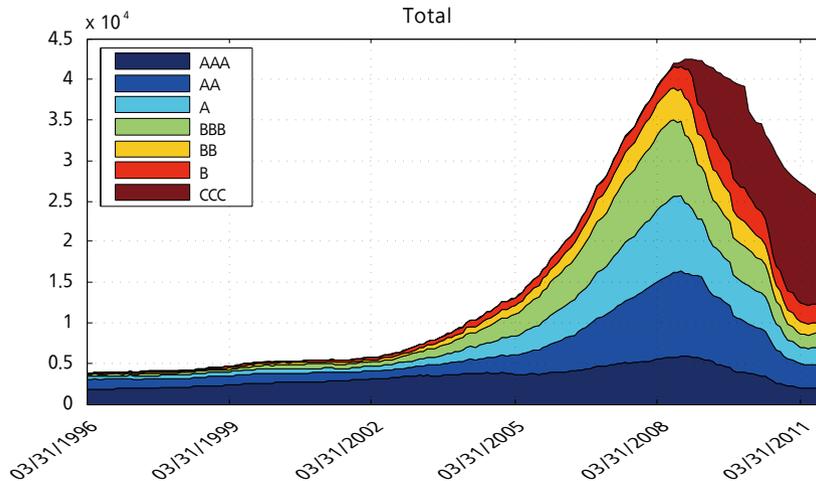
Many have argued that it was the complexity of the CDO's of RMBS that enabled the agencies to rate collections of securities of different risks as being of high quality even though the returns reflected higher risks. Skreeta and Veldkamp (2009) argue that it was the complexity of these securities that facilitated ratings shopping by the financial institutions that were issuing them. It is also important to note that the regulated investors had access to inexpensive capital through the Federal Reserve if the inaccurately rated securities created liquidity problems for them. In addition it is obvious ex-post that they had access to unpriced too big to fail insurance that made it even more attractive to hold assets of higher risk but certified quality.

It is important to note that, as in the model, the ratings agencies continued to rate literally millions of more plain vanilla securities, corporate debt, sovereign debt and so on, where inaccurate ratings would be far more apparent.

IV. Conclusion

Much of the academic and policy discussion of the problems with credit ratings focuses on the potential distortion created by the "issuer pays" structure of the industry. In this paper we have argued that the issuer-pays structure is a natural outcome given the inherent problems with an investor-pays model. We also show that reputational concerns can overcome the issuers incentives to have biased ratings. There will always be a distortion in this environment that arises from the fact that purchasers of ratings can choose not to reveal them. The inneficiency results because information is being produced that is not being used.

The significant problems with credit ratings arose as government regulation became binding on a large investor class and constrained their holdings of risky assets. At the same time the supply of traditional safe assets declined, leading to newly created private sector versions of safe assets and the ratings agencies were called on to rate a richer variety of securities.

These privately created assets were both more complex and opaque making it more difficult to rate them accurately. Our model suggests that investors in this restricted class would have been interested in holding riskier securities that passed the threshold because they would provide ex-post higher returns. The experience of 2007-2009 suggests that restricted investors continued to invest in the claims rated by "inaccurate" ratings agencies even after it became clear to them that this was the case.

A key insight of our analysis is that regulatory reliance on ratings and prudential regulation based on risk weighting is a major culprit. Without eliminating that reliance it will be difficult to overcome the preference of regulated investors to hold assets with upwardly biased ratings. This suggests that the usual characterization of the credit rating industry as being primarily distorted by the incentives of the "issuer pays" model is wrong.

The regulatory reforms embodied in the Dodd-Frank Act aim to remove regulatory reliance and put the onus on investors to certify the safety of the assets they hold. The time horizon for implementation of this is very long and it is not clear how investors are going to replace the services of ratings agencies. Earlier attempts to replace the reliance on CRAs and put the burden on investors met with strong resistence from the securities industry.

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\<Abstract in Korean\>

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글로벌 금융위기 이전 수십 년간 신용평가회사는 기업신용도를 평가하여 왔으며 동 평가결과는 투자자가 위험을 관리하는 데 크게 기여하였다. 그러나 글로벌 금융위기를 경험하면서 신용평가회사의 신뢰성에 대해 의구심이 제기되었다. 특히 채권을 발행하는 기업이 평가 수수료를 지급하기 때문에 신용평가가 제대로 이루어질 수 없었다는 견해가 대두되었다. 이 논문은 기업가, 투자자, 신용평가회사로 이루어진 경제모형을 설정하고 이 경제에서 신용평가가 어떻게 가치(value)를 가지게 되며 신용평가의 신뢰성에 영향을 주는 것이 무엇인지 살펴본다. 특히 평가대상자인 기업이 평가 수수료를 지급하는 것이 신용평가의 신뢰도에 악영향을 미치는지 아니면 다른 문제가 있을 수 있는지에 대해서도 분석한다. 분석결과 평가대상자인 기업이 수수료를 지급하더라도 신용평가회사가 평판(reputation)에 대해 고려하고 할인된 미래수익까지 감안한다면 신용평가의 신뢰도 저하 문제는 극복 가능한 것으로 나타났다. 오히려 일부 투자자를 대상으로 특정 등급 이상의 평가를 가진 기업가가 발행하는 채권을 보유하도록 하는 정부의 규제가 신용평가의 신뢰도 저하를 초래할 수 있는 것으로 분석되었다. 이러한 점에서 최근 평가대상자가 평가비용을 지급하는 것을 문제 삼고 이를 규제하려는 시도는 올바른 방향이 아니라고 볼 수 있다.

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