2013

Government-run Credit Rating Agency and Social Welfare

Dong Woo Noh
UPenn/Wharton

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Keywords

credit rating agency, government-run, social welfare

Disciplines

Business

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January 10, 2014

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*I am grateful to Professor Christian Opp of the Finance Department of the Wharton School for his advice. I would also like to thank Professor Martin Asher, Bethany Schell, and the Social Impact Research Experience Program for support.

1 Introduction

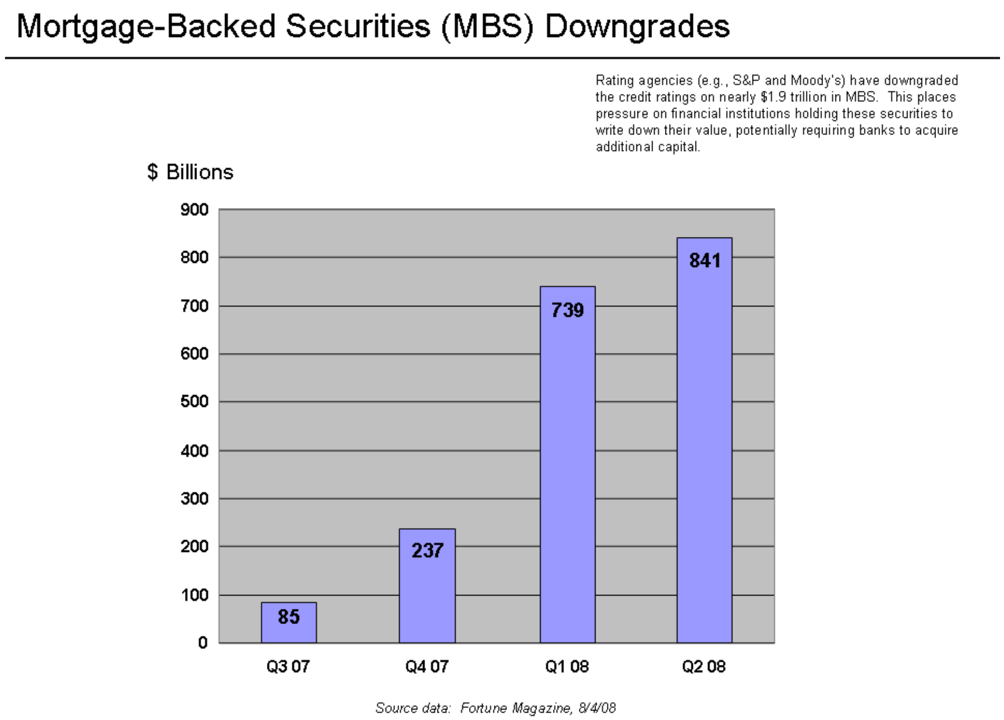
For nearly a century, the credit ratings industry has produced and disseminated information about the creditworthiness of issuers of financial products including corporate bonds and structure products. Starting with the ratings on railroad bonds in the early 1900s, credit ratings began to be assigned to specific securities and soon John Moody's company started to provide a subscriber based service of credit ratings which signaled the inception of a new industry. (Cantor and Packer (1994)) Since its modest beginnings, the ratings industry has grown incredibly and so has the its role in the financial system. Nowadays, rated products include corporate and government debt, preferred stocks, and various other structured products. The ratings are widely used to guide investment decisions and even serve regulatory purposes such as capital requirements for financial institutions. Due to the growing influence of credit ratings on the entire financial system, we can venture to say that the credit ratings agencies' (CRAs) responsibilities are no longer purely private, but are quasi public. [1] Thus, the proper regulation of the rating agencies and of the ratings quality has become an issue of public interest.

During the recent financial crisis, people were reminded once more of the importance of the sound oversight of the ratings industry. Leading up to 2007 a major CRAs rated nearly or more than half of the mortgage backed securities (MBS) as triple-A, (Financial Crisis Inquiry Commission (2011)) many of which were downgraded with the subsequent downturn of the housing market.[2] When highly correlated structured products were downgraded at the same time, many of the investors adjusted their valuations of these securities. Many of the downgraded assets no longer complied with the capital restrictions for investors and some of the downgrades triggered ratings clauses in collateral agreements, both of which forced institutions to liquidate their posi-

[1]See Hearings on the Current Role and Function of the Credit Rating Agencies in the Operation of the Securities Markets available at http://www.sec.gov/news/extra/credrate/credrate111502.txt.

[2]The figure shows a surge of downgrades in MBS credit ratings.

tions. A massive sell-off of securities followed and the result was a system-wide liquidity crunch. Although the 2007–2009 Financial Crisis stemmed from a multiplicity of factors rather than a single flaw in the system, The Financial Crisis Inquiry Commission emphasizes the role of the CRAs during the Financial Crisis by stating that *"the failures of credit rating agencies were essential cogs in the wheel of financial destruction... The mortgage-related securities at the heart of the crisis could not have been marketed and sold without their seal of approval."*[3]



The above chain of events highlights a couple of worrisome issues in the ratings industry. First, the brief history of the MBS credit ratings suggests that certain assets could be "overrated" in a particular point in time. As discussed above, this may result in an systematic underestimation of risk from the investors' side and opens up a possibility for severe liquidity crunches that is caused by subsequent downgrades in downturns. Second, the conflicts of interest that

[3] See Financial Crisis Inquiry Commission (2011)

are inherent in the business models of "originate-to-distribute" and "issuer-pays" raised serious doubts about self-regulation of this industry (FCIC 2011). Unsurprisingly, the issuer-pays business model is under scrutiny of regulators and various policy alternatives are under consideration. As a first degree response to the financial crisis, the Dodd-Frank Act includes clauses that call for a more stringent oversight of the micro-prudential aspects of ratings process. It mandates stricter rules regarding the separation of the ratings division and advisory division within the CRAs, enhanced public disclosure of ratings performance, and provisions regarding employment transitions. [4] Most of the rules regarding the CRAs address the possible conflicts of interest problems within the CRAs but does not mandate any changes to the business model itself.

To this end, a report from the Financial Services Authority summarizes some of the possible alternatives to the issuer-pays regime. (Medvedev and Fennell (2011)) Namely, the report provides a brief overview of the (1) investor-pays model, (2) platform model, and (3) public model. Under the investor-pays model investors will access ratings information on a subscription basis, which enables the ratings agencies to publish ratings without having to worry about appeasing the issuers in any way. However, this regime would be difficult to enforce due to free-riding problems among investors and also has the disadvantage of not having widely published public credit ratings. Critics point out that because of subscription fees, ratings information would be more readily available for large institutions rather than small, less resourceful investors. Another alternative is the platform model. In this regime, there will be a central clearing party through which issuers and raters will be matched, thereby eliminating the possibility for shopping around for better ratings. Although there are diverging opinions about the details regarding the actual matching criteria that would not create any perverse incentives for the CRAs, this regime is indeed a popular option in that it will be selecting among the existing CRAs. The last alternative introduced in the report is a public ratings agency that is run under public provisions.

[4] Visit http://thomas.loc.gov/cgi-bin/bdquery/z?d111:H.R.4173: for more details on the Dodd-Frank Act.

The advantages and disadvantages of the public model will be discussed further in Section 2.

This paper attempts to shed light on the implications of a public agency among the above alternatives. The remaining of the paper proceeds as follows. Section 2 provides a brief background on the ratings process and the aforementioned public ratings agency. Section 3 considers relevant studies that address the issue of ratings inflation and conflicts of interest. zSection 4 introduces a model of the public ratings agency and studies its social welfare implications relative to the private ratings agency. Section 5 discusses the implications, shortcomings, and possible improvements of the said model.

2 Background

2.1 The Ratings Process and Issuer-pays Model

It is necessary to understand the ratings procedure in order to identify the aspects of the business model that are leading to perverse incentives. Moody's lays out the ratings process on their website. [5] According to the company, an analyst is assigned to each issuer or product of interest and the issuers provide the analyst with the necessary information to carry out an assessment. Based on the information put together by the analyst, a rating committee meets to discuss the rating recommendation made by the lead analyst. Once the committee arrives at a rating decision, the issuer decides whether to publish the rating. One aspect of the ratings process that should be noted is that "typically the rating agency is paid only if the credit rating is issued."[6] This is particular practice opens up a possibility for the CRA to give a more favorable rating to the issuer in order to increase the chance of a rating being issued. Due to this specific aspect, The Financial

[5] See https://www.moodys.com/Pages/amr002001.aspx

[6] From the SEC (2008) report, as cited by Bolton et al. (2008).

Crisis Inquiry Commission criticized the major CRAs, claiming that "flawed computer models, the pressure from financial firms that paid for the ratings, the relentless drive for market share, the lack of resources to do the job despite record profits, and the absence of meaningful public oversight."[7]

2.2 Dual Role of Ratings

Along with the fact that the final issuance decision of credit ratings are made in conjunction with the issuers, the dual role – (1) provide information about creditworthiness and (2) serve as a regulatory benchmark – of credit ratings exacerbates the ratings inflation problem. The primary role of credit ratings is to provide meaningful information about the creditworthiness of issuers in order to protect the investors. Thus, as a reliable third party the CRA relieves information asymmetry, thereby allowing more valuable investment opportunities to be funded. As credit ratings gained reliable reputations and wide public usage, regulators started to implement ratings standards in regulations regarding capital requirements for financial institutions.[8] Consequently, the ratings themselves, rather than the information embedded in them, began to carry a significance for the investors' portfolio decisions. This may distort the CRAs' incentives by making high ratings more attractive to investors. Because investors find highly rated assets more valuable *ceteris paribus*, issuers will attempt to extract higher ratings for their products, which together with the problem mentioned in Section 2.1 may exacerbate the ratings shopping problem.[9] The Dodd-Frank Act attempts to ameliorate this problem by eliminating the ratings contingent clauses from regulations regarding capital requirements and other compliance clauses. It instead mandates use of proprietary risk management models and risk assessments rather than explicitly

[7]See FCIC 2011

[8]See White (2010) for a more detailed explanation of regulatory usage of credit ratings.

[9]Opp, Opp, and Harris (2013) explains a detailed mechanism through which regulatory advantage of highly rated assets translates to ratings inflation.

using credit ratings as standards. It is yet unclear how the new standards will be entirely independent of the widespread conventional credit ratings, but it is generally expected that this will reduce the aforementioned “regulatory advantage” of high ratings.

2.3 Public Rating Agency

As discussed in the Introduction, this paper examines the implications of having a public rating agency. Lynch (2010) lays out the basic characteristics of a public rating agency. Specifically, the paper considers a rating agency that is funded by the tax-paying public rather than the issuers. His version of the public rating agency would have the power to request non-public information from issuers and would have to be protected from political pressures through a legal framework as are The Federal Reserve or the Supreme Court (Lynch (2010)). Main advantages of such an agency would be increased transparency, elimination of the problems that stem from the issuer-pays model, and freely disseminated public ratings.

The model developed in this paper explores the social welfare implications of such a public rating agency. In specific, the public ratings agency in the model pays a fixed compensation that is insensitive to the amount of business that the rater attracts. This allows the rater to be independent of the issuers' preferences, but also may cause the problem of shirking from the analysts' side. Critics also argue that it may be difficult to attract talented professionals unless a substantial amount of funding is allocated to this public agency. These tradeoffs are incorporated in the model and the prediction is that different levels of regulatory distortion may warrant different policy alternatives to be socially optimal.

3 Related Literature

As discussed in the Introduction, the major rating agencies came under fire of public criticism after the 2007–2009 Financial Crisis. As a response, various academics have developed theoretical models of the ratings game and have delved into the ratings data in order to identify evidence for deteriorating ratings quality. Some of the relevant works will be introduced in this section to provide a context.

Bolton, Freixas, and Shapiro (2012) models the CRA conflicts of interest that stems from the issuer-pays model. In this model, the fact that payments to the CRA are contingent on the actual issuance and the naïveté of investors are a motivation for ratings inflation. One interesting component is the model's incorporation of the "reputation costs" that the CRA faces. The model includes an exogenous reputation cost of misreporting that the CRA faces and this is the component that creates the tension between rent seeking and honest rating. In the model introduced in this paper, there is also a similar component for the public rating agency which is the cost of forgone wages when the rater gets fired from the public rating agency. This paper will attempt to endogenize this cost by considering the discounted value of the future fixed compensations. Similar to Bolton et al. (2012), Skreta and Veldkamp (2009) considers how the existence of naïve investors and the possibility for ratings shopping lead to ratings inflation. The basic idea is that even for unbiased rating agencies, accumulated error and upward biased selection in publication may lead to inflated ratings.

More recent papers like Sangiorgi and Spatt (2013) assume rational expectations of the investors rather than naïve expectations. Sangiorgi and Spatt (2013) show that even under rational expectations, the opacity of the ratings purchase decisions may cause an upward bias in the ratings. Opacity in this context is the fact that investors are unaware of firms' approaching the CRA for to obtain unpublished ratings. The main conclusion is that the fact that indicative ratings are private, as discussed in the prior Section, may be playing an important role in the current ratings market.

Kashyap and Kovrijnykh (2013) also provide an interesting insight. They analyze optimal compensation contracts that would yield the most desirable ratings outcome. They find that rating errors are larger when issuers order ratings rather than investors. In addition this study, a recent call for policy responses seems to suggest that many commentators believe that investor-pays model may be a possible alternative[10]. Putting aside whether or not this is a viable solution, it seems clear that the compensation scheme of the ratings market is a very important factor in deciding the rating agencies' behavior.

Opp, Opp, and Harris (2013) develops a rational expectations framework the regulatory use of ratings affect the ratings quality. The study takes into account the fact that ratings-contingent rules such as minimum capital requirements affect investors' taste for assets with different ratings. Kisgen and Strahan (2010) find empirical evidence that investors treat marginally different ratings holding risk constant, providing grounds for exposition about regulatory benefits and ratings. In Opp et al. (2013), the model's comparative statics enable it to explain the differing ratings quality across asset classes and economic environments as well.

Notably, Jiang, Stanford, and Xie (2012) attempt to evaluate the claim that the issuer-pays model leads higher ratings. They consider the brief period during the 1970s in which Moody's was charging the issuers while S&P was charging the investors. They consider a sample of 797 corporate bonds to see whether there was a significant difference between the two companies' ratings and conclude that Moody's ratings systematically exceeded that of S&P's. Xia and Strobl (2012) compare S&P ratings to Egan-Jones Rating Company which adopts an invest-pays model.

[10]See World Bank (2009)

They also find that the S&P ratings are significantly more likely to receive higher ratings.

This paper adopts the assumptions about regulatory benefits of high ratings as in Opp et al. (2013) and proceeds to consider how a public rating agency would perform under this assumption. In considering the social welfare implications of the private and public rating agencies, I take a similar approach to Bolton et al. (2012) and compare the average NPV of the projects that are financed under each equilibrium.

4 The Model

The agents of the model are 1 issuer, 1 private credit rating agency, 1 public rating agency, 1 rater with the information acquisition technology, and a continuum of investors. All agents are risk neutral and profit maximizing except for the public rating agency. The public rating agency interferes when there is room for improvement in the social welfare in case of intervention. The following subsections lay out the specifics of the model setup.

4.1 The Issuer

There is a single issuer/entrepreneur who maximizes profits. The issuer is endowed with a single risky project that requires an initial investment of 1, but does not have cash. Thus, the issuer must seek financing through the public debt market. The issuer has private information about the type of its risky project which can take on four possible types which is represented by a vector $\vec{n} = (n_v, n_d)$. This type vector is determined by two components: the "value" component and the "disaster" component. The value component can take on either the h-type ("high") or the l-type ("low"), while the disaster component can take on either the d-type ("disaster-prone") or the nd-type ("not disaster-prone"). The project's payoff is also dependent on the state of the world $s \in \{G, B\}$ where G is the "Good" state. p_G and p_B represent the probabilities of the state being $s = G$ and $s = B$ respectively. The project's payoff contingent on these types are summarized in the table below.

"Good" State

	n_v=h	n_v=l
n_d=nd	R_h	R_l
n_d=d	R_h	R_l

"Bad" State

	n_v=h	n_v=l
n_d=nd	R_h	R_l
n_d=d	0	0

The issuer's project has $n_v = h$ with probability π_h and has $n_v = l$ with probability π_l. Similarly, the disaster component takes on the two types with probabilities π_{nd} and π_d. These probabilities are common knowledge. Because disaster is a very rare event, let's assume for now that information about the value component is a more relevant information with regards to the NPV of the project.

In addition, the distributions of these types are such that without any information, the NPV of the project is negative. Denote $\overline{R} = \pi_h R_h + \pi_l R_l$, then this assumption can be written as below.

Assumption 1. *The average project cannot receive financing. That is,* $p_G\overline{R} + p_B\pi_{nd}\overline{R} < 1$.

This assumption introduces a demand for informative signals regarding the project's type and a room for the rating agency to facilitate financing. Once the issuers are provided with the necessary information, the issuer has to decide whether to publish the credit rating and pay the ratings fee, or to dispose of the rating received. Lastly, a firm with a project of type $\vec{n} = (h, nd)$ is assumed to have an alternative financing option so that the rating agency cannot extract all the surplus from the firm in this case. However, in order to signal its type the (h, nd)-type firm has to engage in inefficient signaling activity so that the social welfare is assumed to be zero in this case.

Assumption 2. *A firm of type* $\vec{n} = (h, nd)$ *can finance its project through an outside financing option which is equivalent to a debt financing with face value* $\overline{N}$. *In addition, the face value satisfies* $R_l < \overline{N} < R_h$.

Other typed firms must receive financing through the public debt market, thus needs to be rated in order to resolve the asymmetry of information. The specifics of the signaling mechanism is discussed in the following subsection.

4.2 The Rater

There exists a single rating agent who possesses a proprietary information acquisition technology. The technology produces a perfect signal $s \in \{A, B\}$ about one of the two components of the project type and requires a cost of amount c from the rater. At the same time, it is assumed that the rater is endowed with a resource of amount c and has to choose between one of the two components to investigate. The signals are perfect in a sense that the rater knows the type for sure if she decides to exert effort on that particular component. This information acquisition decision is represented by $\iota \in \{v, d, 0\}$ where v (d) signifies that the rater exerts effort on the value (disaster) component and 0 signifies that no effort is exerted. The signal mechanism can be summarized as

$$\Pr[s = A \mid \iota = v, n_v = h] = \Pr[s = B \mid \iota = v, n_v = l] = 1.$$

An analogous relation holds for the disaster component as well.

$$\Pr[s = A \mid \iota = d, n_d = nd] = \Pr[s = B \mid \iota = d, n_d = d] = 1.$$

Once the rating agent acquires a private signal s, she provides the issuer with an undisclosed indicative rating $\tilde{r} \in \{A, B\}$ which need not be the same as the private signal. This allows for the rating agent to misreport the acquired signal. It can be shown easily that the rater has no incentive to "underrate" a given project. Therefore, the probability of giving an indicative rating of $\tilde{r} = A$ when $s = B$ can incorporate the misreporting behavior entirely. Thus, in addition to the information acquisition decision, the rating agent also makes a disclosure decision $\varepsilon \in [0, 1]$ which is the probability of the rater's overrating of a given issue. The incentive to misreport stems from the fact that exerting effort to produce meaningful information is costly. Because the rater can report $\tilde{r} = A$ without acquiring any informative signal, she can save the cost c by misreporting.

Finally, the rater will choose to work for either the private or the public rating agency. The two rating agencies differ only by their compensation schemes. The private rating agency will compensate the rater proportional to the amount of fees received from the issuance of ratings. For simplicity, it is assumed that the rater extracts all the fees received by working for the private rating agency. This fee f is set by the rating agent at the beginning of the game. Hence, if the issuer decides to purchase the rating, a public rating $r = \tilde{r}$ is published and the fee set by the rater is paid. On the other hand, the public rating agency will pay a fixed compensation f' to the rater and dismiss the rater in case of misconduct. Specifically, the government cares about the public criticism it faces from failing to avoid an economic disaster. Hence, it will dismiss the public rating agent if the agent fails to forecast a disaster which happens to a project of type $\vec{n} = (\cdot, d)$ in the "Bad" state of the world. Because the rater and the investors are rational, the rater will consider the total compensation that she can extract from the private and public rating agencies and then decide where she will work together with the disclosure strategy – whether to report honestly or to misreport. Consequently, the investors' rational expectations and the information acquisition cost create a tension for the rater.

4.3 The Investors

The investors compete with each other and set the face value N_r of the bond of initial investment 1 contingent on the rating of the issuance. In order to take into account the regulatory benefit of high ratings discussed in Section 2, the model assumes that investors assign a certain value to higher ratings. For the ease of exposition, let the following assumption incorporate the price effects of all the various ratings related provisions.

Assumption 3. *The marginal investor assigns a relative value of amount y to an A-rated bond. y is assumed to be exogenous.*

Hence, the investors' investment decisions are not only dependent on the expected repayment of the bond but also dependent on the rating itself. Specifically, financing will be provided if the sum of the expected repayments and the regulatory benefit exceeds the sum of the initial investment and the rating fee set by the rating agency. Because the issuer is assumed to have no cash on hand, the rating fee should also be provided as part of the financing agreement. Hence, we can write the investors' participation constraint as below.

$$[N_r(1-d_r)+R_l d_r](1-\delta_r)+y\cdot 1_{r=A}\geq 1+f \tag{1}$$

where $1_{r=A}$ equals 1 when $r = A$ and 0 if $r = B$ or the issuance is unrated. Here, the r is the published rating, d_r is the probability of partial repayment, and δ_r is the probability of zero repayment. We have the arrive at the above constraint because in case the project pays out R_h, the whole face value can be paid back but otherwise only part of the face value, or none of it, can be paid back to the investors. We will later see that because of our assumption about the outside option for the (h, nd)-type firms, the face value will be set somewhere in the (R_l, R_h) region.

Thus, the order of the game can be summarized as below:

1. The public rating agency sets the fixed compensation f'.
2. The rating agent decides to work for either the private or the public rating agency.
3. The rating agent makes the disclosure and information acquisition decisions ε and ι (also sets the fee f if she decides to work for the private rating agency).
4. Signal s is acquired and an indicative rating $\tilde{r}$ is provided to the issuer.
5. The issuer decides whether to publish the rating $r = \tilde{r}$ and a rating is published if the issuer does publish the rating.
6. Investors make their investment decisions and the rating fees are paid if the investment is made.
7. The project's outcome is realized and repayments are made if there is sufficient cash flow.

5 Analysis

Because the agents are assumed to have rational expectations, the Perfect Bayesian Equilibrium is analyzed in this section. The equilibrium is defined as the following.

Definition 1. *Equilibrium*

1. *The issuer makes a rating purchase decision given its type $\vec{n}$, indicative rating $\tilde{r}$, rater's information acquisition decision ι, her disclosure decision ε, and the face value N_r. The*

decision $p_{\vec{n}}(\tilde{r}) \in \{0, 1\}$ *signifies that the issuer of type* $\vec{n}$ *decides to publish a indicative rating* $\tilde{r}$*.*

2. *Investors competitively set the face value* N_r *for each rating* r *to break even on their investments given the regulatory benefit* y*, information acquisition decision* ι*, disclosure decision* ε*, and the rating fee* f*.*
3. *The rater decides whether to work for the private or the public rating agency, sets the information acquisition and disclosure decisions* ι *and* ε *given the purchase decision* p *and the face value* N_r*. If the rater decides to work for the private rating agency, she also sets the rating fee* f*.*

Now, since it is assumed that the agents are have rational expectations, it is possible to separately analyze the rater's employment decision, the information acquisition decision, and disclosure decision. In other words, the following subsections will separately calculate the rater's profits for the four possible choices: (1) work for the private rating agency and investigate the value component, (2) work for the public rating agency and investigate the value component, (3) work for the private rating agency and investigate the disaster component, and (4) work for the public rating agency and investigate the disaster component. The following sections will extrapolate the profits for the rater in each of the four cases and find the optimal decision given these profit profiles. For each decision, the issuer problem, the investor problem, and the rater problem will be solved sequentially by assuming Bayesian updating and rational expectations. Furthermore, the social welfare will be calculated given each of the decisions in order to identify the optimal regulatory regime.

5.1 Case 1: Private Rating Agency & Value Component

5.1.1 The Issuer Problem

Before proceeding let's state an assumption about the issuer's decision to take on any project.

Assumption 4. *The issuer receives some non-pecuniary benefits from conducting projects, hence the issuer will take the financing when indifferent.*

By this assumption, any issuer of type $\vec{n} \neq (h, nd)$ will purchase a rating if the given indicative rating allows it to receive financing from the investors. An issuer of type $\vec{n} = (h, nd)$ will purchase a rating as long as $N_r \leq \overline{N}$. Given these conditions, we have the following Lemma.

Lemma 1. *In equilibrium, B-rated firms and unrated firms cannot receive financing as long as the regulatory benefit is low enough. A-rated firms will receive financing if* $p_{(h,nd)}(A) = 1$.

Proof. See Appendix. □

5.1.2 The Investor Problem

Since we have Lemma 1, the investors can set face values N_r while assuming that any typed firm will publish an A-rating while any typed firm will not publish a B-rating. The investors care about the probability of a firm being of h-type given an A-rating. [11] Since the rater can overrate a given project, the probability of a firm receiving an A-rating is given by

$$\pi_A = \pi_h + \varepsilon \pi_l. \tag{2}$$

[11] In other cases, the investors will care about the probability of a firm being nd-type given an A-rating. The analysis is identical otherwise.

Baye's Rule, together with the above, yields

$$\Pr[n_v = h \mid r = A] = \frac{\pi_h}{\pi_h + \varepsilon\pi_l}. \tag{3}$$

Thus, we can calculate d_A and δ_A in equation 1 to be $\frac{\varepsilon\pi_l}{\pi_h+\varepsilon\pi_l}$ and $\pi_d p_B$ respectively. The investors' participation constraint can be rewritten as

$$\left(N_A\frac{\pi_h}{\pi_h + \varepsilon\pi_l} + R_l\frac{\varepsilon\pi_l}{\pi_h + \varepsilon\pi_l}\right)(1 - \pi_d p_B) + y \geq 1 + f. \tag{4}$$

Competition among the investors forces this constraint to bind, and the inequality yields the condition on the face value

$$N_A = \left(\frac{1}{1 - \pi_d p_B}(1 + f - y) - R_l\frac{\varepsilon\pi_l}{\pi_h + \varepsilon\pi_l}\right)\frac{\pi_h + \varepsilon\pi_l}{\pi_h}. \tag{5}$$

Thus, the face value of an A-rated bond that the investors require is increasing in the rating fee and decreasing in the regulatory benefit of high rating.

5.1.3 The Rater Problem

As discussed in Lemma 1, investors will provide financing to A-rated bonds as long as the (h, nd) typed firm participates. This means that the face value of an A-rated bond must satisfy $N_A(\iota, \varepsilon, f, y) \leq \overline{N}$. Also, the rater's expected profit is equal to the probability of an issuer receiving an A-rating multiplied by the rating fee minus the information acquisition cost.

$$\Pi(\iota, \varepsilon, f, y) = f\pi_A - c \cdot 1_{\iota=v} \tag{6}$$

Profit maximization of the the rater will make the above constraint to bind and the rater's problem can be written as

$$\max_{\iota,\varepsilon,f} \Pi(\iota,\varepsilon,f,y)$$
$$\text{s.t. } f \leq f^* := \left(\overline{N}\pi_h + R_l\varepsilon\pi_l\right)\frac{1-\pi_d p_B}{pi_h+\varepsilon\pi_l} + (y-1).$$

Profit maximization implies that $f = f^*$ and substituting this into equation 6, we get

$$\Pi^* = \left(\overline{N}\pi_h + R_l\varepsilon\pi_l\right)(1-\pi_d p_B) + (y-1)(\pi_h+\varepsilon\pi_l) - c\cdot 1_{\iota=v}. \tag{7}$$

The above equation reveals that the optimal profit is dependent on a linear term of ε. Thus, with some work it can be shown that at optimum, ε is either 0 or 1. This makes intuitive sense because once the information is acquired, there is no benefit in partial misreporting. To see this, the above can be further simplified to

$$\Pi^* = \left(\overline{N}(1-\pi_d p_B) + y - 1\right)\pi_h - c + \left(R_l(1-\pi_d p_B) + y - 1 + \frac{c}{\pi_l}\right)\varepsilon\pi_l. \tag{8}$$

The last term above shows that it is optimal to set $\varepsilon = 1$ if $y > 1 - R_l(1-\pi_d p_B) - \frac{c}{\pi_l}$ and $\varepsilon = 0$ otherwise. In summary, we have the below for Case 1.

$$\Pi_1^* = \begin{cases} \left(\overline{N}\pi_h + R_l\pi_l\right)(1-\pi_d p_B) + (y-1) & \text{if } y > 1 - R_l(1-\pi_d p_B) - \frac{c}{\pi_l}, \\ \left(\overline{N}(1-\pi_d p_B) + y - 1\right)\pi_h - c & \text{otherwise .} \end{cases}$$

The above implies two things. First, if the regulatory benefit is perversely large, the rater will stop producing informative signals and simply cater to the investors by overrating. Second, if the information acquisition cost is too large, the rater will again stop acquiring costly information.

5.1.4 Social Welfare

With the above results, we see that it suffices to analyze the social welfare for the two possible disclosure choices $\varepsilon \in \{0,1\}$. As defined in the prior section, the social welfare is defined as the average NPV of the projects financed net of the information acquisition cost. Now, notice that if $\varepsilon = 1$ all projects are rated A and financed, while if $\varepsilon = 0$ only the h-typed firms will be financed regardless of their disaster component. Thus, the welfare in Case 1 is given as

$$W_1 = \begin{cases} \overline{R}(1-\pi_d p_B) - 1 & \text{if } \varepsilon = 1 \\ R_h \pi_h (1-\pi_d p_B) - \pi_h - c & \text{if } \varepsilon = 0. \end{cases}$$

Here, it should be noted that if the rater engages in misreporting, the social welfare is always negative by Assumption 1. On the other hand, for some parameter regions and a low enough cost c, the rater can contribute to the social welfare by producing useful information.

5.2 Case 2: Public Rating Agency & Value Component

Since the government rating agency is slightly different in terms of compensation, Case 2 will also be discussed, although with less details. However, only the results of the analysis will be presented for Cases 3 and 4 since the procedure is identical.

If the rater chooses to work for the public rating agency, she receives a fixed fee f for sure and is subject to dismissal in case of "misconduct." For ease of exposition, let's assume that the rater values her forgone expected future wages plus the reputation cost of misreporting at an amount

ρ. [12] Then, we can write the rater's profit as

$$\Pi(\iota, \varepsilon, f, y) = f - c \cdot 1_{\iota=v} - \rho \cdot \Pr[\text{misconduct}]. \tag{9}$$

For Case 2, the rater is investigating the value component and has no information regarding the disaster component. This implies that $\Pr[\text{misconduct}] = \pi_A \pi_d p_B$, where $\pi_A = 1$ if $\varepsilon = 1$ and $\pi_A = \pi_h$ if $\varepsilon = 0$. Consequently, we get the below results.

$$\Pi_2^* = \begin{cases} f - \rho\pi_d p_B & \text{if } c > \rho\pi_l\pi_d p_B, \\ f - \rho\pi_d p_B \pi_h - c & \text{otherwise.} \end{cases}$$

$$W_2 = \begin{cases} \overline{R}(1 - \pi_d p_B) - 1 & \text{if } \varepsilon = 1 \\ R_h\pi_h(1 - \pi_d p_B) - \pi_h - c & \text{if } \varepsilon = 0. \end{cases}$$

5.3 Case 3: Private Rating Agency & Disaster Component

$$\Pi_3^* = \begin{cases} (\overline{N}\pi_h + R_l\pi_l)(1 - \pi_d p_B) + y - 1 & \text{if } y > 1 - p_G(\overline{N}\pi_h + R_l\pi_l) - \frac{c}{\pi_d}, \\ (\overline{N}\pi_h + R_l\pi_l + y - 1)\pi_{nd} - c & \text{otherwise.} \end{cases}$$

$$W_3 = \begin{cases} \overline{R}(1 - \pi_d p_B) - 1 & \text{if } \varepsilon = 1 \\ \overline{R}\pi_{nd} - \pi_{nd} - c & \text{if } \varepsilon = 0. \end{cases}$$

[12] Bolton et al. (2012) also uses a similar approach in incorporating the discounted future income of the rating agency. In their discussion, a numerical variable is assigned to capture the forgone ratings fee that is incurred as a "reputation cost" when a rating agency misreports. In this model, this penalty may also include the psychological and job market related damage that the rater may face.

5.4 Case 4: Public Rating Agency & Disaster Component

$$\Pi_4^* = \begin{cases} f - \rho\pi_d p_B & \text{if } c > \rho\pi_d p_B, \\ f - c & \text{otherwise.} \end{cases}$$

$$W_4 = \begin{cases} \overline{R}(1 - \pi_d p_B) - 1 & \text{if } \varepsilon = 1 \\ \overline{R}\pi_{nd} - \pi_{nd} - c & \text{if } \varepsilon = 0. \end{cases}$$

5.5 Results

Now I present the results of the analysis as the following propositions. For convenience, let's first denote the thresholds of regulatory benefit as

$$\overline{y} = \max\left\{1 - R_l(1 - \pi_d p_B) - \frac{c}{\pi_l}, 1 - p_G(\overline{N}\pi_h + R_l\pi_l) - \frac{c}{\pi_d}\right\},$$
$$\underline{y} = \min\left\{1 - R_l(1 - \pi_d p_B) - \frac{c}{\pi_l}, 1 - p_G(\overline{N}\pi_h + R_l\pi_l) - \frac{c}{\pi_d}\right\}.$$

Then, we can state the following propositions.

Proposition 1. *For $y < \underline{y}$, the rating agent will produce valuable information and report truthfully. Also, in this region of the parameter y, the rating agent's decision yields the socially optimal outcome.*

Proof. See Appendix. □

It follows that when we are in a region where the rating agent is reporting honestly and maximizing social welfare as above, the government has not much to add to social welfare by intervening. However, when the regulatory benefit is large enough to distort the rater's incentives, social welfare may be improved by intervention. This is stated by the following proposition.

Proposition 2. *For $y > \overline{y}$, the rating agent will engage in misreporting and her optimal solution yields negative social welfare. In this case, the government can pay a large enough compensation and incur a large enough penalty to improve social welfare as long as the cost of information acquisition c is small enough.*

Proof. See Appendix. □

The above results are rather intuitive. If the regulatory benefit is below a certain threshold, the market will function well and useful information will be produced and the first best social welfare will be achieved. However, if the regulatory benefit is perversely high so that it distorts the rater's behavior, enforcing a new mandate to affect the rater's behavior may yield the second best social welfare.

5.6 Alternative Government Provision

In the setup introduced so far, the governments mandate regarding "misconduct" was arbitrary although with some rationale. This being said, it would be useful to consider other provisions that the government may mandate. In this section, for example, we will consider a different government mandate which can potentially achieve the first best social welfare in this particular model.

Before we go on, however, we see that in the current setup the government can always induce the rater to do whatever deemed necessary by paying an extremely high fixed compensation in desired cases. Hence, to introduce friction lets take into account an additional assumption about the government's budget constraint. [13]

Assumption 5. *The government faces a compensation cap of amount $\hat{f}$. In other words, $f \leq \hat{f}$.*

With this new constraint in mind, lets consider Cases 5 and 6 under a different government provision. Lets now assume that the government defines misconduct as A-rated firms experiencing default. Note that default in the second provision includes both partial repayment and disaster, which means it is better off for the rater to investigate the value component which allows her to avoid noncompliance with a higher probability than investigating the disaster component. However, in this case the rater cannot avoid the risk of experiencing noncompliance by not foreseeing disaster because she can only investigate one of the components.

We can see here that the above means the government will have to pay a higher salary to attract the rater to work under the new provision, but at the same time it will be able to achieve the first best solution which was not reached in the prior provision. Now I state the raters profits for Cases 5 and 6.

Case 5: rater works for the government rating agency under the new provision and investigates the value component.

$$\Pi_5^* = \begin{cases} f - \rho(\pi_l + p_B\pi_d - p_B\pi_l\pi_d) & \text{if } \varepsilon = 1, \\ f - \rho p_B \pi_h \pi_d - c & \text{otherwise}. \end{cases}$$

Case 6: rater works for the government rating agency under the new provision and investigates

[13]Bond and Glode (2013), which discusses the issue of public and private sector compensation, also uses a similar notion of "regulatory budget" that is assigned by the central planner. Still, this assumption should be justified more rigorously with further work.

the disaster component.

$$\Pi_6^* = \begin{cases} f - \rho(\pi_l + p_B\pi_d - p_B\pi_l\pi_d) & \text{if } \varepsilon = 1, \\ f - \rho\pi_l\pi_{nd} - c & \text{otherwise.} \end{cases}$$

Here, we see that whenever the cost of information acquisition is sufficiently low, the rater's optimal choice is to work on the value component under the new provision because π_d is assumed to be very small. This means that if the fixed compensation is high enough, the government can induce the rater to work for the value component which will produce the first best social welfare.

Now, denote the rater's profit under misreporting as

$$\Pi_m = \left(\overline{N}\pi_h + R_l\pi_l\right)(1 - p_B\pi_d) + (y - 1).$$

Then, we can state the following proposition in addition to the prior results.

Proposition 3. *If the rater is engaging in misreporting, and if the governments budget constraint* $\hat{f}$ *satisfies* $\Pi_m + \rho p_B\pi_h\pi_d + c \leq \hat{f}$*, then the the government can achieve the first best social welfare with the new provision. If* $\Pi_m + c < \hat{f} < \Pi_m + \rho p_B\pi_h\pi_d + c$*, then the government can achieve the second best social welfare with the original provision. For other values of budget, the government cannot deter the rater from engaging in misreporting.*

Proof. The proposition follows directly from comparing Π_5^*, Π_6^*, and Π_m. □

6 Discussion

The model predicts that the public rating agency may be beneficial if the regulatory advantage of high ratings is high enough so that the private rating agency would have an incentive to engage in regulatory arbitrage. However, it was assumed that the distribution of the type of the issuer's project as well as the impact of the regulatory benefit of high ratings are known. In reality, these variables are difficult to measure and even if they are known they may change with time and economic cycles. Thus, devising an optimal mandate for the public rater may be a big challenge. Because the public rater can only be incentivized by the penalty provision, an inappropriate mandate can lead to adverse results instead. Consequently, the model also reveals that the public rating agency's performance in terms of social welfare is sensitive to its penalty provisions and thus may create inefficiency under changing regulatory and technological environments.

There are few aspects of the model that call for further investigation. First, the disaster component and the value component in the context of the Financial Crisis does not make intuitive sense. For instance, the MBS securities that were rated triple-A during the crisis could be considered as an example of an asset class that is "high-value" but "disaster-prone." The consequences of the crisis imply that neglecting the disaster component could lead to a debacle, but the model predicts that overall it is socially optimal to choose to investigate the value component instead because the disaster probability is very small. A possible solution for this problem could be endowing the rater with more resource and allowing her to choose at the margin. Another problem that is yet to be addressed is the government budget constraint. It would be interesting to make this aspect of the model endogenous as well, but there were no simple yet intuitive mechanism through which this could be achieved.

Also, certain aspects regarding the public rating agency are rather arbitrary. For instance, the government mandate specific to this model could have been very different, which would have led to different results. The definition of a “disaster” in real life is at best vague in reality, thus making the mandate rather artificial. Furthermore, the cap on the government compensation is currently an exogenous variable. It is quite reasonable to assume that the public service sector has an implicit compensation cap due to political reasons, but it does add to the arbitrariness of the setup presented in the model. Future works may focus on these shortcomings to improve the results offered by the paper.

Appendix: Proofs

Proof of Lemma 1. Funding is possible if there exists a face value $N_r \leq R_h$ such that

$$[N_r(1-d_r) + R_l d_r](1-\delta_r) + y \cdot 1_{r=A} \geq 1 + f$$

Let's assume for now that the rating agent rates the value component. Hence, the “good” type would be a project with $n_v = h$ and the “bad” type a project with $n_v = l$. Let $p(r) = (p_h(r), p_l(r))$ then since $p(r) = (0, 0)$ implies that rating class r is irrelevant lets consider the other three cases.

Consider the decision to purchase a B-rating.

1. $p(B) = (1, 1)$: Recall that the signals produced by the agent is perfect. Hence, only the “bad” type firms can receive an indicative rating of B. Since the bad types are worse than an average project (which has negative NPV) by construction, the B-rated bonds cannot receive financing.
2. $p(B) = (0, 1)$: Investors infer that B-rated projects are bad and the projects will not receive financing.

3. $p(B) = (1, 0)$: Because of the perfect signal structure, no B-rating will be purchased in this case since no firm will receive an indicative rating of B.

Now consider the decision to purchase an A-rating.

1. $p(A) = (1, 1)$: Again, the signals produced by the agent is perfect. Hence, the A-rated projects are either of good type or a consequence of a bad type being misreported as good. This means without misreporting, A-rated projects are financed and with misreporting they are financed for high enough regulatory benefit y.
2. $p(A) = (0, 1)$: In this case, investors infer that A-rated firms are bad. As long as the regulatory benefit satisfies $y < 1 - R_l(1 - p_B\pi_d)$ the A-rated projects cannot receive financing. This is because the "bad" value type earns R_l but does so with probability $(1 - p_B\pi_d)$ since the disaster component is not assessed and because $f \geq 0$.
3. $p(A) = (1, 0)$: Investors infer that A-rated firms are good and A-rated projects will be financed. Now, from the bad types perspective, it has an incentive to change its behavior to $p_l(A) = 1$ since this would lead to Case 1. and would allow it to be financed. Because, even if the payout is equal to zero, the bad type does not have an outside option and enjoys taking on the project it has an incentive to deviate in this case. Hence, this case is irrelevant.

Since $p(B) = (0, 0)$, unrated firms are either of average risk if $p(A) = (0, 0)$ or worse than average risk if $p(A) = (1, 1)$. Therefore, unrated projects cannot receive financing. □

Proof of Proposition 1. The first part of the proposition follows from the previous sections showing the thresholds for y. The second part can be shown by considering the differences

$$\Delta\Pi^* = \Pi_1^* - \Pi_3^* = \pi_h\pi_d p_B\overline{N} + (1 - y)(\pi_{nd} - \pi_h) - R_l\pi_l\pi_{nd}$$

$$\Delta W = W_1 - W_3 = \pi_h\pi_d p_B R_h + (\pi_{nd} - \pi_h) - R_l\pi_l\pi_{nd}$$

We see that whenever $\Delta\Pi^*$ is positive, ΔW is positive as well but the converse is not necessarily true. Hence, when the rater opts to investigate the value component voluntarily (and reports honestly) it is the socially optimal decision. □

Proof of Proposition 2. The first part of the proposition follows directly from Assumption 1. For the second part, when the government induces the rating agent to report truthfully, the rating agent will automatically focus on the disaster component to produce information. In this case, we have

$$W = \overline{R}\pi_{nd} - \pi_{nd} - c.$$

Then, the social welfare is equal to which is positive for small c as opposed to being negative without intervention. □

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