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Incentive Provision in the Credit Rating industry

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1 Introduction

Since the start of subprime crisis, the failure of private credit ratings is identified as a major reason. With a large amount of subprime assets spread in the economy, those credit rating agencies apparently failed with respect to their function to aid risk management and to ring an alarm when the underlying risk is high. Much of the criticism concentrates on possible conflicts of interests caused by the so-called "issuer-pays model". Doubts are cast on whether the rating agencies can truthfully release the observed risk levels to the market. As indicated in a report by Securities Exchange Commission (SEC), evidence exists that some of the rating analysts were involved in the pricing of the rating service. This raises the concern that those rating agencies may compete for business with good ratings even if they know the true risk level is high. In other words, they may deliberately lie to the market. Since no great wall stands between those agencies' consulting and rating sectors, such a point of view gains support both in mass media and academic works.

The current paper, however, takes an alternative view to the observed "triple-A failure". It considers truth-telling credit rating agencies that chose endogenously their rating efforts, i.e. the accuracy of ratings. The possibility to lie to the market is therefore explicitly excluded. The motivation is rating agencies are subject to regulation and have to keep the documents and rating procedures upon which the published ratings are based. Since regulators can verify the rating results by repetition, the rating agencies may risk considerable penalties by lying. On the other hand, unlike corporate bonds, rating structured finance products is much like a statistical inference: The default rate is estimated by a statistical model. Naturally, the quality of such estimation can be improved if more data are available or more meticulous estimation methods are used. Given the rating failure is most prominent for such products, it is important to know whether the credit rating industry is well designed so that rating agencies are induced to put high effort on their job.

From a social point of view, credit ratings can be seen as a costly investigation which yields a better understanding of the risk of certain assets such that some inefficient investment can be avoided. Specifically, two types of inefficiency can emerge in the allocation of risky assets. One is investors underestimate the risk of the asset and make a loss due to their purchase. The other is the risk level is overestimated such that investors refrain from investments that are potentially profitable. As an accurate rating helps to avoid both types of inefficiency, when deciding the rating efforts, a social planner will take into account both the potential profits and the avoided loss. For private rating agencies, however, profits are derived only from the investors who buy the risky asset. Warning of the underestimated risk will discourage the purchase and reduce the revenue of the private agencies'. Since the avoided loss is not taken into account as private benefit, rating agencies may pay more attention to avoid the overestimation of risk than to the underestimation, leaving the rating efforts distorted below the social optimal level in certain circumstances. The inaccurate ratings in turn will increase the amount of risky assets sold in the markets, a pattern observed in the current subprime turmoil.

The rest of the paper is organized as follows. A brief literature review is presented in section 2. Section 3 sets up the formal model. To provide a benchmark, section 4 analyzes the social optimal effort provision and some comparative statics. In section 5, the agency problem is examined. The analysis mainly concentrates on possible reasons for rating effort underprovision and its impact on the amount of risky asset sold in the economy. Section 6 discusses the future extension of the model by allowing competition. Section 7 concludes and suggests some caveats.

2 Literature Review

(This part is not very well written yet. More papers and reports can be included. Also some of the reference papers have already had a newer version, which I haven't get a chance to review.)

Since the beginning of the crisis, private credit rating agencies are criticized for their generous ratings. Much attention is given to the possible conflict of interests and the "issuer-pays" model. Generally categorized as moral hazard, conflict of interests is also common to other financial institutions and draws attention from the academia even before the crisis, Mehran and Stulz (2007). Theoretical papers on the rating industry, however, prosper only recently.

Pagano and Volpin (2008) analyzes how liquidity consideration and asymmetric information influence the banks' decision on securitization, or the opaqueness of financial products. credit rating agencies are assumed to be an agency of issuing banks and just give rating schemes that maximize the former's profit. Partly sharing the same motivation, Farhi, Lerner and Tirole (2008) looks at various information intermediaries in general to explain why we may have an opaque/symbolic ratings instead of a finer partition. They also take one step beyond to endogenize the quality/riskiness of the concerned products. An unrealistic assumption in both papers, however, is the role of those rating agencies. While in Pagano and Volpin (2008) they are assumed to be inactive and only reveal the information to the extent that banks wish, in Farhi, Lerner and Tirole (2008), they are assumed to be in a competitive market and earn zero profit. Contrary to such an approach, Bolton, Freixas and Shapiro(2008) models explicitly the conflict of interests in an oligopolistic rating industry. In the model, the rating agencies may lie to the market and condition the service prices on rating results. In this sense, it is most relevant to the current paper in the sense that rating agencies play an active role in the financial system.

However, at least three major differences exist between the current paper and Bolton, Freixas and Shapiro (2008). First of all, credit rating agencies are assumed to be always truth-telling in the current paper. The presence of regulation will prevent them from free lying. Secondly, while rating agencies are assumed to learn the risk with some exogenous accuracy in their model. The precision of the rating is endogenized in the current paper. Last but not least, while the current paper also allows the payoff of rating agencies to be a function of released ratings, rating agencies do not condition their fee scheme on the rating outcome as in Bolton, Freixas and Shapiro (2008). While the SEC report (2008) found some evidence that analysts took part in the fee negotiation, direct evidence is still scare that the price scheme is explicitly conditional on the rating results. In this sense, the current paper may be more consistent with the general practice in the industry, that is, the rating agencies are paid with a fraction of the volume of the asset they rated. See White (2001).

3 Model Setup

In this section, a model is set up to formulate the idea outlined in the introduction. For simplicity, only two types of risky assets are assumed in the paper. They have a common expected return μ but differ from each other concerning the risk levels $\sigma^2 \in \{\sigma_1^2, \sigma_2^2\}$, with $\sigma_1^2 < \sigma_2^2$. Denoting the bad state of the world by B, i.e., $\sigma^2 = \sigma_2^2$, the prior belief in the absence of any rating is given by

$$Prob(B) \equiv Prob\{\sigma^2 = \sigma_2^2\} = P. \tag{1}$$

Similarly, with G denoting the good state of the world, I define

$$Prob(G) \equiv Prob\{\sigma^2 = \sigma_1^2\} = 1 - P. \tag{2}$$

Two types of investors are assumed in the economy. Some of them, of a fraction of $\beta \in (0, 1)$, are sophisticated investors who know the whole structure of the game. They can therefore solve the optimization program of rating agencies and perfectly infer the effort level chosen in equilibrium. The other type is more naive such that they will take the released rating only at their face value. Furthermore the expected utility function of investors is assumed to be of a mean-variance representation

$$E(u) = \mu - \eta\sigma^2, \tag{3}$$

where η measures the risk aversion level of the investors. The expected utility function can be rationalized either by exponential utility function and normal returns or the first order Taylor expansion of more general utility functions. The reservation utility, or the returns from a risk free asset, is normalized to zero. To make the analysis interesting, it is further assumed

$$s_1 \equiv \mu - \eta\sigma_1^2 > 0 \tag{4}$$

$$s_2 \equiv \mu - \eta\sigma_2^2 < 0. \tag{5}$$

That is, when the risk level is high, it is optimal to have the risk free asset and vice versa. Based on these, the willingness to pay of an investor conditional on the prior belief can be defined by

$$t \equiv \mu - \eta\left[P\sigma_2^2 + (1-P)\sigma_1^2\right] = Ps_2 + (1-P)s_1. \tag{6}$$

As mentioned before two types of errors are possible with respect to the investment decisions: Either (1) the risk is underestimated so that the risky asset is purchased while the true risk level is high or (2) the risk is overestimated such that the asset is not purchased even if the investment is profitable. Correspondingly, the economy will overinvest in the risky assets in case 1 and underinvests in the risky assets in case 2. It should also be clear that such two types of errors are mutually exclusive, because case 1 is possible only if $t > 0$ and case 2 is passible only when $t < 0$.

For rating intermediaries[1] to play a role, I assume they are able to investigate the risk level at a convex cost. Specifically, it is assumed that with a probability $q \in [1/2, 1]$ they can correctly infer the true value of σ^2. By $q \geq 0.5$, I exclude the case where the rating agencies'

[1]The term is loosely used here and can refer to either a public authority, or private rating agencies.

claims are totally uninformative. With g and b denoting good and bad ratings respectively, the assumption can be reformulated as

$$Prob(g|G) = Prob(b|B) = q. \tag{7}$$

Furthermore, when the rating agency is not able to give out a correct rating, it will give a wrong signal. Such refined information is of course not free. So ratings are assumed to be obtained only at a convex cost of $C(q)$, where,

$$C'(\cdot) > 0 \qquad C''(\cdot) > 0$$
$$C(.5) = 0 \qquad C'(.5) = 0 \quad \text{and} \quad C'(1) = +\infty$$

In this sense, credit ratings give the economy a chance to gain a better understanding of risk at some investigation cost. In other words, we spend the cost $C(q)$ to avoid both types of errors.

In the model, all the rent to be extracted comes from investors' willingness to pay. For simplicity, it is assumed that the three parties (banks, credit rating agencies and investors) divide the total rent according to some pre-specified fractions. As far as rating efforts is concerned, I assume the private rating agencies will get a fraction of $\alpha \in (0, 1)$ from the total rent.

To complete the model, I now formulate the timing of the game as follows:

- Nature chooses the states of the world $\{G, B\}$.
- Banks observe the realized state but the other players do not.
- Banks decide whether to apply for a rating or not.
- If banks apply, credit rating agency decides on effort q and obtain a rating g or b.
- The truth-telling rating agency reveals its inference to banks.
- Banks decide whether to publish the rating or not.

- Being aware of the game structure and observing the rating results, sophisticated investors make their purchase decision. On the other hand, naive investors make their decisions only by taking the ratings at their face values.

- Payoffs are realized according to the pre-specified fractions.

4 Second Best as a Benchmark

In this section, I characterize the belief update of investors in the dynamic game, showing how credit ratings and the underlying rating effort can influence their perceived risk levels and the willingness to pay. Based on this, I show formally the social optimal rating effort will be chosen to avoid both underestimation and overestimation of risk.

4.1 Belief Updates

For naive investors, the ratings are taken at their face values. So they will completely believing in the rating released and take it just as if it is the true risk level, i.e.,

$$Prob(B|b) = 1 \tag{8}$$

$$Prob(G|g) = 1. \tag{9}$$

Correspondingly, their willingness to pay becomes

$$t_g^n = s_1 \tag{10}$$

$$t_b^n = s_2. \tag{11}$$

For sophisticated investors, the situation becomes slightly more complicated. As implied by the assumption $q > 1/2$, the rating will always be informative for sophisticated investors, allowing them to make correct inference of the risk level with a higher probability. By the definition of conditional probabilities, investors' updated believes of risk can be derived as follows.

$$Prob(G|g) = \frac{(1-P)q}{(1-P)q + P(1-q)} \tag{12}$$

$$Prob(B|b) = \frac{Pq}{Pq + (1-P)(1-q)} \tag{13}$$

It is straightforward to show both expressions are increasing in the effort level q. Intuitively, when the rating efforts increase, i.e. rating becomes more accurate, the rating will becomes more useful to infer the true risk level. As a specifical case, when $q = 1/2$, we have

$$Prob(B|b) = P \tag{14}$$

$$Prob(G|g) = 1 - P. \tag{15}$$

Since the rating effort is zero, the prior believes do not update at all. Similarly when $q = 1$, we will have $Prob(B|b) = 1$ and $Prob(G|g) = 1$. That is, ratings perfectly indicate the underlying risk. The results are summarized in the lemma below.

Lemma 1. *When $q > 1/2$, the presence of ratings helps the sophisticated investors to improve their perception of the risk level of the asset in the sense that $Prob(B|b) \in [P, 1]$ and $Prob(G|g) \in [1 - P, 1]$. Furthermore, both conditional probabilities are monotonically increasing in q.*

Given the belief updates above, the sophisticated investors' willingness to pay for a given rating are defined as

$$t_g^s \equiv \mu - \eta\left[Prob(G|g)\sigma_1^2 + Prob(B|g)\sigma_2^2\right] = Prob(G|g)s_1 + Prob(B|g)s_2 \tag{16}$$

$$t_b^s \equiv \mu - \eta\left[Prob(G|b)\sigma_1^2 + Prob(B|b)\sigma_2^2\right] = Prob(G|b)s_1 + Prob(B|b)s_2. \tag{17}$$

For the future use, also note that $t_g^s > t_b^s$ always holds.

4.2 Second Best and Comparative Statics

In this subsection, the social optimal rating effort level is calculated to provide a benchmark. To isolate the social planner's effort provision decision, I assume banks are always required to apply for a rating at an information intermediary that maximizes social welfare. It is also assumed that banks do not have the chance to suppress the rating when it is obtained.

We have seen that in the case of sophisticated investors the credibility of a rating is increasing in the underlying rating effort. This indicates the rating effort has to be higher than certain threshold to be able to convince those investors to follow the ratings. For example, in case 1, when the released rating is bad, the investors will buy the asset if and only if $t_b < 0$, which in turn requires

$$q > \frac{(1-P)s_1}{(1-P)s_1 - Ps_2} \equiv q_1. \tag{18}$$

Similarly, in case 2, when the released rating is good, the investors will buy the asset if and only if

$$q > \frac{Ps_2}{Ps_2 - (1-P)s_1} \equiv q_2. \tag{19}$$

Lemma 2. *In the second best, the optimal effort level by a benevolent social planner is always high enough such that the rating is convincing for sophisticated investors, i.e.,* $q > q_1$ *in case 1 and* $q > q_2$ *in case 2.*

Proof. To see the point, note $\forall q < q_1$ in case 1 or $\forall q < q_2$ in case 2 will not cause any change to the ex post efficiency for sophisticated investors. The social planner then spend an investment of effort $C(q)$ in vain and receive a negative payoff. Therefore, $\forall q < q_1$ in case 1 and $\forall q < q_2$ in case 2 will not be chosen as social optimum. □

Proposition 1. *In the second best, the social planner faces a marginal benefit of* $(1-P)s_1 + P(-s_2)$*, taking into account both the potential profits and the avoided loss. The corresponding social optimal rating effort is* $q^* \equiv MC^{-1}\big((1-P)s_1 + P(-s_2)\big)$*, which remains the same in case 1 and case 2.*

Proof. As noted before, the benevolent social planner will maximize the social welfare improvement and will not discriminate between sophisticated and naive investors. Given the result from the last lemma and naive investors take the ratings at their face values, we know the investors will buy the asset if the rating is good and will not buy when the rating is bad. The social welfare conditional on the released rating and convincing effort levels will yield an expected surplus of

$$P\big[q \cdot 0 + (1-q)s_2\big] + (1-P)\big[qs_1 + (1-q)\cdot 0\big]. \tag{20}$$

Minus this by the social welfare obtained without ratings, the optimization programme for the social planner then becomes

$$\max_q \Big\{ \big[P(1-q)s_2 + (1-P)qs_1\big] - \big[Ps_2 + (1-P)s_1\big] - C(q) \Big\} \tag{21}$$

in case 1, and

$$\max_q \Big\{ \big[P(1-q)s_2 + (1-P)qs_1\big] - C(q) \Big\} \tag{22}$$

in case 2. By first order derivative, the social marginal benefit of extra rating efforts becomes

$$MB \equiv (1-P)s_1 + P(-s_2) \tag{23}$$

in both case 1 and 2. Given that $MC(\cdot)$ is invertible and $MC^{-1}(\cdot)$ is increasing, one can uniquely characterize the social optimal rating effort by $q^* \equiv MC^{-1}\big((1-P)s_1 + P(-s_2)\big)$. □

In addition, for obtaining ratings to be socially desirable, the investigation cost $C(q)$ cannot be too high, otherwise zero effort level will be preferred. Formally, the optimal choice q^* will be chosen if and only if

$$C(q^*) < \big[(1-P)q^* s_1 + P(1-q^*)s_2\big] - \big[P \cdot s_2 + (1-P)s_1\big]. \tag{24}$$

As it is interesting to know how the social optimal rating effort changes with informational asymmetry and the overall riskiness of the markets, two comparative statics are presented as below.

Corollary 1. *The second best effort q^* increases with the prior belief P if and only if the loss from underinvestment exceeds the loss from overinvesment in the risky assets, i.e., $-s_2 > s_1$.*

Proof. By chain rule,

$$\frac{\partial q^*}{\partial P} = \frac{\partial MC^{-1}(MB(P))}{\partial MB(P)} MB'(P)$$

By the second order condition of $C(\cdot)$, the first component is always positive. We will have

$$\text{Sgn}\,\frac{\partial q^*}{\partial P} = \text{Sgn}\,MB'(P) = (-s_2) - s_1,$$

which concludes the proof. □

The result is quite intuitive. When P increases, we are more likely to be in the bad state: underestimation of the risk becomes more likely. Therefore, we want to put on more effort if and only if the loss from underestimation is larger than that from overestimation. While how the social optimal rating effort change with P is contingent on the comparison between $-s_2$ and s_1, one can pin down the relationship by imposing more structures on the investors' utility function. When the utility is consumption based and displays a decreasing marginal utility, a loss will incur a larger decline in the utility level than that will be brought up by a profit of the same size. In this case, one can expect $-s_2 > s_1$ and the social optimal rating effort will increase with the overall riskiness of the market.

A key feature of structured finance products is its significant informational asymmetry. For one thing, it incurs more vague information on the default risk and allows possible manipulation by the informed party. For the other thing, the secondary market is not well developed, further aggravating the information problem. Following the literature like Rock (1986), the differential between the two risk levels, $\sigma_2^2 - \sigma_1^2$, is taken as a measurement of the information asymmetry. The corollary below shows formally that the chance to gain a better understanding of the risk level is more important when the the informational asymmetry increases.

Corollary 2. *Social optimal rating effort q^* is monotonically increasing in the informational asymmetry as measured by $\sigma_2^2 - \sigma_1^2$.*

Proof. Recall $q_s^* = MC^{-1}(MB)$. As $MC^{-1}(\cdot)$ is monotonically increasing, one needs only to prove MB increases with $\sigma_2^2 - \sigma_1^2$. To see the point, one can fix σ_1^2 and increase σ_2^2. It will be clear that the social optimal effort q^* increases in σ_2^2. And as a result, q^* increases with the risk differential. □

5 Agency Problems

This section shows formally two factors that can contribute to the low private rating benefit and therefore the low incentive to provide rating efforts. One is the presence of naive investors and the other is the rating agencies' inability to extract the full rent of the transaction.

5.1 Banks' Decision

Since issuing banks can suppress bad ratings without any cost, it should be clear from the timing of the game that to apply for a rating is a dominant strategy. Furthermore, given the market interprets no rating released as bad ratings, it does not make any difference for banks to suppress a bad rating or to release it. This is summarized in the following lemma.

Lemma 3. *In equilibrium, issuing banks will always apply for ratings and will be indifferent between suppressing a bad rating and releasing it.*

5.2 Private Incentive of Rating

As assumed before, banks provide the risky asset inelastically to the market and the private rating agency extracts a fraction α of the total rent generated in the sale. The objective function of the private rating agency then takes the form

$$\alpha\Big(Prob(b)\big(\beta\cdot\max\{0,t_b^s\}+(1-\beta)\cdot 0\big)+Prob(g)\big(\beta\cdot\max\{0,t_g^s\}+(1-\beta)\cdot s_1\big)\Big)-C(q). \quad (25)$$

Here I assumed all the rent from naive investors, s_1, is extractable, which in turn requires banks to be able to discriminate between the two types of investors. This strong assumption might be rationalized in the sense that big institute usually have more favorable trading terms than small investors.

From the expression, one can also see some intuition why the private rating agencies might underprovide rating efforts. First of all, note sophisticated investors' willingness to pay, t_b, decreases with the rating effort at a bad rating. When the chance is high to reach a bad rating, private rating agencies might want to lower the effort level to avoid bad ratings. Furthermore, naive investors will not buy the asset if the rating is bad. So the same mechanism works to reduce rating efforts. In both cases, the prior belief P plays an important role. The subsections below formulate the idea. Since that case 1 and 2 are mutually exclusive, they are analyzed respectively in the paper.

5.3 Possible Effort Underprovision and Overinvestment in Risky Assets

Clearly, case 1 is more interesting in terms of explaining the risk management failure in the current crisis. After all, a key fact is too many risky assets are sold in the economy. Readers may find it useful to know the main result before the detailed proof.

Proposition 2. *For $t > 0$ and $t_g^n = s_1$, $P > 1/2$ is a sufficient condition (though unnecessary) for the private optimal rating effort q^{**} to be lower than the social optimal level q^*.*

Furthermore, when the cost is high, q^{**} will be zero even if it is still socially optimal to have $q^* > 0$.

Proof. I now prove the proposition by several steps and each of them copes with a special case of the objective function.

First of all, notice that when $q = 1/2$, both t_b^s and t_g^s reduce to t. Given $t > 0$, we will have $t_g^s > 0$ always holds because t_g^s increases in q. The maximization programme of the private rating agency will reduce to

$$\max_q \left\{ \alpha\big(Prob(b)\big(\beta \cdot \max\{0, t_b\}\big) + Prob(g)\big(\beta \cdot t_g^s + (1-\beta) \cdot s_1\big)\big) - C(q) \right\}. \tag{26}$$

Then another two cases rise depending on whether the private rating agency have an effort level higher than q_1. When the rating is bad and $q > q_1$, the risk free asset is strictly preferred by investors, i.e. $t_b < 0$. The objective function further reduces to

$$\alpha \cdot Prob(g)\big(\beta \cdot t_g + (1-\beta) \cdot s_1\big)\big) - C(q). \tag{27}$$

The first order derivative with respect to q will yield a marginal benefit of

$$\alpha\Big[\beta\big[(1-P)s_1 + P(-s_2)\big] + (1-\beta)\big[(1-2P)s_1\big]\Big]. \tag{28}$$

(The calculation is a bit lengthy and will be put into an appendix.)

The correspondent rating effort is denoted by

$$q^{**} = MC^{-1}\Big\{\alpha\big[\beta\big[(1-P)s_1 + P(-s_2)\big] + (1-\beta)\big[(1-2P)s_1\big]\big]\Big\} \tag{29}$$

Notice that the term $\big[(1-P)s_1 + P(-s_2)\big]$ is exactly the the social marginal benefit in the second best. Given $MC^{-1}(\cdot)$ is increasing, the optimal choice of q will be distorted down both because of the rating agency's inability of to extract all the rent, $\alpha < 1$, and the presence of naive investors, $\beta < 1$. The condition $P > 1/2$ will suffice to guarantee the private rating efforts to be below the social optimum.

When $q < q_1$, the objective function will take a form

$$\alpha\Big(Prob(b)\big(\beta \cdot t_b\big) + Prob(g)\big(\beta \cdot t_g + (1-\beta) \cdot s_1\big)\Big) - C(q). \tag{30}$$

or equivalently

$$\alpha\Big(\beta\big(Prob(b) \cdot t_b + Prob(g) \cdot t_g\big) + Prob(g) \cdot (1-\beta) \cdot s_1\Big) - C(q). \tag{31}$$

With similar calculation for $q > q_1$, the first order derivative of $\big(Prob(b) \cdot t_b + Prob(g) \cdot t_g\big)$ with respect to q can be shown to be zero. So the total marginal benefits reduces to

$$\alpha(1-\beta)(1-2P)s_1. \tag{32}$$

When $P > 1/2$, the expression becomes negative and indicates zero rating efforts.

The choice between $q = 1/2$ and q^{**} depends on the convexity of the cost function. When $C(q^{**})$ is not too high, the positive effort level q^{**} will be chosen. Otherwise, zero effort $q = 1/2$ will be chosen. Also the cutoff level of $C(q^{**})$ will be lower than the social cutoff level $C(q^{*})$. □

The result can be relevant to the recent failure of private rating agencies in the structured finance product. Conceivably the risk of such products is more complicated to evaluate than that of corporate bonds or other traditional finance products. In this case, it will be more costly to generate an accurate rating. As the cost function becomes more convex, we are likely to have zero effort outcome even though it is still socially desirable to have positive rating efforts.

Corollary 3. *The underprovision of private rating effort becomes more severe when (1) the fraction of naive investors becomes higher, i.e., a decrease in β, (2) the rating agencies extract a less fraction of rent from the sale, i.e., a decrease in α, and (3) the prior belief of high risk becomes higher, i.e., an increase in P, for a small β.*

Proof. To see the point, recall $MC^{-1}(\cdot)$ is monotonically increasing. Therefore, one needs only to verify the private marginal benefit increases with α, β and decreases in P, which is straightforward. □

Among the three comparative statics, the most interesting one might be the one with respect to P. When the fraction of sophisticated investors are sufficiently small, the private optimal rating effort shows exactly the opposite change than in the case of second best. The intuition is rating agencies then find a chance to fool the market by lowering the effort level to cover the possible bad news.

The risk evaluation will, of course, influence the amount of risky assets in the economy. In the absence of ratings and updated belief, investors will buy the risky asset according to their prior belief even if the underlying true risk level is high. With social optimal rating effort q^*, however, the high risk asset is going to be sold only with a chance of $(1 - q^*)$. The same logic also applies to the case where private rating effort is nonzero. When the rating becomes less accurate, that is, q^{**} is chosen instead of q^*, the high risk asset will be sold with a higher chance $(1 - q^{**})$. The results are summarized in the corollary below.

Corollary 4. *With suboptimal rating efforts $q^{**} < q^*$, investors will not be able to update their prior belief as effectively as in the second best case. This leads to more frequent overinvestment in the risky assets when the underlying risk level is high.*

Please note that exerting the optimal effort level also involves a chance of false alarm $(1 - q^*)$ when the underlying risk level is low. But this is a price that the social planner has to pay to prevent the investors overinvest in the risky asset.

5.3.1 Effort Provision and Underinvestment in Risky Assets

In case 2, the inefficient allocation can rise when the investors tend to not buying the asset while the true risk level is low. Intuitively, if the prior belief is good, i.e. $P < 1/2$, putting more efforts in this case will convince the investors and promote the sale of the risky asset. So the private rating agency will have less incentive to underprovide rating efforts.

Proposition 3. *When $t < 0$, $P < 1/2$ is sufficient for the the underprovision problem to be mitigated.*

Proof. Again we prove the result by analyzing different cases of private rating agency's objective function. When $q = 1/2$, both t_b and t_g reduce to t. In case 2, we will have $t < 0$. Together with the properties that t_b decreases in q, $t_b < 0$ will always hold. The optimization programme of the private rating agency, therefore, reduces to

$$\max_q \left\{\alpha \cdot Prob(g)\big(\beta \cdot \max\{0, t_g\} + (1-\beta) \cdot s_1\big) - C(q)\right\}. \tag{33}$$

First note that when $P < 1/2$, $\forall q < q_2$ will not be optimal effort level, because in that case, sophisticated investors will not buy the asset despite of the released ratings. For that segment of the market, the private rating agency will earn a negative payoff of $-C(q)$. If we confine ourselves to $q > q_2$, the objective function then becomes

$$\alpha \cdot Prob(g)\big(\beta \cdot t_g + (1-\beta) \cdot s_1\big) - C(q). \tag{34}$$

It follows immediately from the proof of the last proposition that the marginal benefit of extra rating efforts will be

$$\alpha\Big[\beta\big[(1-P)s_1 + P(-s_2)\big] + (1-\beta)\big[(1-2P)s_1\big]\Big]. \tag{35}$$

For given α and β, the private marginal benefit will indicating less underprovision of effort when are kept constant. □

As a final remark on the private incentives, it can be shown that the second best can be perfectly restored with $\alpha = 1$ and $\beta = 1$. Therefore, the main distortion in the current model comes from the presence of naive investors and the rating agencies' inability to extract all the rent of the transaction. While only the naive investors can be fooled with lower rating efforts, the inaccurate ratings also influence negatively the sophisticated investors, making it harder for them to make well informed decisions.

(If it can be shown that the presence of naive investors is necessary to generate any under- or overprovision of effort[2], the above property will be quite interesting.)

6 Competition as a Remedy

As far as policy implications are concerned, it is interesting to know how the situation will change with increased competition, a proposed reform for the rating industry.

Specifically, two cases can be considered. One is to introduce more competition by allowing more private rating agencies in the industry. The other is to introduce a social rating institute that is not profit driven. Intuitively the second solution may be more attractive. As we have seen, the inability of private rating agencies to extract the full rent will reduce investigating efforts, the competition among private agencies may dissipate even more rent and aggravate the underprovision problem. On the other hand, the presence of a social rating agency explicitly includes credit ratings, an integral part of risk management, into the regulation framework of a financial system. As the rating effort is conceivably higher at the social agency, issuing banks may even self-select between private and social agencies, with the low risk type applying at the social agency and the high risk type applying at the private rating ones.

7 Conclusion and Future Work

This preliminary paper concentrates on possible incentive distortion of private rating agencies in their investigating efforts. It presents some cases where the private and social incentives

[2] I am inclined to think it is. Actually I doubt if the lying-to-market result in Bolton, Freixas and Shapiro(2008) can still hold when all the investors are sophisticated.

can considerably differ. And the resulting inaccurate ratings will lead to excessive amount of risky assets in the economy. The point is to show even without conflict of interests, the effort level of a truth-telling rating agency can still be distorted downward under the “issuer-pay model”.

In the end of the draft, I would like to call attention to three caveats in the paper, which may lead to considerable revision of the model in the future. First of all, the underprovision of rating effort is not generated in an entirely satisfactory way. It will be ideal to generate the distortion only with the different ways of response of social and private rating agencies at the two different types of errors. In the paper, the reasons of underprovision is the rating agencies' inability to extract all rents and the existence of naive investors. But the first argument is not something new. The same incentive distortion also happens in managerial effort provision when the manager does not hold all the equities of the firm. Secondly, the current results are not robust to the way that the issuing banks charge the investors. In the current version, it is assumed that all the rent of both types of investors are extractable. In particular, the naive investors pay according to their ex ante surplus s_1. But if the bank cannot discriminate between sophisticated and naive investors, it is not clear how the contract will look like and how this will influence the effort provision. Last but not least, the issuing banks behave in a rather passive way in the current model. When the model is generalized to allow two or more rating agencies, the model apparently needs to be revised considerably to model the so-called “rating shopping” effects.

In a nutshell, the current draft is a preliminary attempt to attack the problem and far more work is required in the future. The draft, however, lays the foundation for future work in the sense that it brings up a very tractable framework and some basic properties for future extensions.

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