Alternatives for issuer-paid credit rating agencies

Dion Bongaerts†

February 28, 2014

Abstract

This paper investigates the welfare contribution and economic viability of alternatives to issuer-paid credit rating agencies (CRAs). To this end, it introduces a heterogeneous competition model for lending and ratings markets. Frictions among issuers or investors induce rating inflation from issuer-paid CRAs. Investor-paid CRAs suffer from three sources of free-riding and are generally not economically viable when competing with issuer-paid CRAs. Only for very limited parameter ranges can investor-paid CRAs thrive and counter rating inflation. Other proposed alternatives such as investor-produced ratings and CRA co-investments employ skin-in-the-game to induce proper accuracy. However, as traditional issuer-paid CRAs cater better to issuers, such alternatives generate little demand or are implemented ineffectively. Hence, this paper provides an explanation for the evolution, dominance and resiliency of issuer-paid CRAs.


Keywords: Credit Rating Agencies, Competition, Reputation, Regulation

*I would like to thank Mark Van Achter, James McAndrews, Marc Arnold, Bo Becker, Mathijs van Dijk, Sarah Draus, Joost Driessen, Andrei Dubovik, Felix Flinterman, Andrea Gamba, Rob Jones, Frank de Jong, Volker Lieffering, Arjen Mulder, Marcus Opp, Frederik Schlingemann, Joel Shapiro, Steffen Sorensen, Marti Subrahmanyam, Dragon Tang, conference participants at the NBER SI 2013 on CRAs, EFA 2012 Annual Meeting, ESSF Gerzensee 2012, 6th Swiss Winter Conference on Financial Intermediation and seminar participants at Erasmus University, The University of Hong Kong and WHU for useful discussions and helpful comments. This paper has been prepared by the author under the Lamfalussy Fellowship Program sponsored by the ECB. Any views expressed are only those of the author and do not necessarily represent the views of the ECB or the Eurosystem.

†Rotterdam School of Management, Erasmus University. e-mail: dbongaerts@rsm.nl
1 Introduction

After the sub-prime crisis of 2007-2009, credit rating agencies (CRAs), like Moody’s, S&P and Fitch, have come under increased public scrutiny. Globally, estimated losses on structured products such as sub-prime residential mortgage-backed securities (RMBSs) average $4 trillion\textsuperscript{1}. Since many of these losses were incurred on highly (often AAA) rated products by the major (all issuer-paid) CRAs, the accuracy of credit ratings has been severely criticized. The profitability of these products to the CRAs, has fueled this criticism even further and given rise to suspicions of intentional rating inflation\textsuperscript{2}. Several recent articles such as Griffin and Tang (2012) show that ratings on structured products were indeed inflated. Interestingly, recent research by He, Qian and Strahan (2012) shows that investors charged higher spreads on products with an inflated rating. Hence, their evidence suggests that investors were aware of misaligned rating incentives and priced these in.

The role CRAs played in the sub-prime crisis and their subsequent role in the sovereign debt crisis motivated politicians and regulators to reassess regulation concerning CRAs. Proposed regulatory measures include requiring investors to do their own credit assessments, encouraging the use of investor-paid ratings and stimulating competition among CRAs\textsuperscript{3,4}. However, the progress on this agenda is limited. Some new (primarily issuer-paid) CRAs have entered European and U.S. markets, but have failed to attract substantial market shares so far. Some initiatives that aligned well with regulatory ambitions were even withdrawn altogether. For example, Markus Krall, senior managing partner at Roland Berger has tried to set up an investor-paid, not for profit European CRA. This plan was abandoned due to insufficient interest from investors for such an initiative\textsuperscript{5}. Another initiative by the

\textsuperscript{1}IMF estimation. See \url{http://www.imf.org/external/pubs/ft/weo/2009/01/}

\textsuperscript{2}For example, anecdotal evidence reports rating fees of 2 to 4 bps on corporate bonds compared to fees of 13 to 16 bps on structured products in addition to surveillance fees. For Moody’s, these complex products had a profit margin of around 50% and generated about 50% of total profit by the end of 2006.

\textsuperscript{3}See, for example, the testimony by SEC deputy director John Ramsay: ”The Commission’s efforts in this area have been designed to [...] and promote competition among rating agencies that are involved in this business.” \url{http://www.sec.gov/news/testimony/2011/ts072711jr.htm}

\textsuperscript{4}Other measures include increased transparency requirements, legal liability for CRAs, hurdles to downgrade sovereigns and the instatement of a pan-European regulatory body, ESMA, that will supervise CRAs (primarily on a procedural basis). See among others \url{http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P7-TA-2013-0012+O+DOC+XML+V0//EN&language=EN}

\textsuperscript{5}See \url{http://www.spiegel.de/international/europe/plan-to-set-up-european-rating-agency-is-failing-827876.html} and \url{http://euobserver.com/foreign/120005}
French credit insurer Coface to sell investor-produced ratings to other investors also never got started.\footnote{See \url{http://www.coface.com/CofacePortal/ShowBinary/BEA%20Repository/HK/en_EN/documents/wwa_news_events/20100729CofaceCESR-HK_en}; When contacted, Coface was unwilling to motivate this decision.}

One could wonder why the reform of the CRA industry progresses so slowly. With the reputation of the major issuer-paid CRAs severely damaged, one would expect other parties to gain market share quickly. This paper answers this question by conducting a comparative analysis of alternatives to issuer-paid ratings. To this end, I introduce a heterogeneous competition model for credit and rating markets. To get rating inflation, I introduce a friction on the issuers’ side leading to demand for high instead of accurate ratings, despite the upward effect of rating inflation on interest rates.\footnote{This is a friction rather than a zero-sum effect as it stimulates the funding of socially wasteful projects.}

Such frictions could for example result from employment concerns of managers/investment bankers or compensation schemes that condition on successful placement of debt issues.

My first main finding is that several proposed alternatives such as investor-paid or investor-produced ratings may reduce rating inflation if imposed by regulation. However, welfare improvements (if any) are limited and may be hard to realize from a practical perspective. Take for example the investor-paid CRAs. A monopolistic investor-paid CRA will behave exactly the same as a monopolistic issuer-paid CRA, as there are no outside options. Hence, at least two investor-paid CRAs are required to generate any welfare improvements. Therefore, at least two investor-paid CRAs need to spend effort to produce identical information on each issue. Especially when rating effort is costly, this redundancy (partially) offsets welfare gains induced by higher rating accuracy. Moreover, free-riding concerns may even prevent equilibria with multiple investor-paid CRAs from materializing.

The second main finding is that, in a free market with issuer-paid CRAs, these proposed alternatives suffer from either insufficient demand or ineffective implementation. The reason is that issuer-paid CRAs have an incentive structure that allows them to cater well to issuer demands and hence, inflate ratings. In contrast, take for example investor-produced ratings. Those will be less inflated if (partially) funded by the rating party. However, issuers prefer inflated ratings and therefore either opt for issuer-paid ratings or pressure rating producing investor to reduce funding shares to the minimum. This undermines the disciplining incentive structure of investor-produced ratings. The adoption of a Franken rule (i.e. investor selects, issuer-pays...
model) leads to similar problems unless investors are completely insensitive to rating fees. In that case, investors would push for maximum rating effort, which generally leads to wasteful over-spending on rating effort.

My baseline model features issuers, issuer-paid CRAs and banks. All players are rational and know all parameters. Issuers have access to investment opportunities of unknown quality. Unconditionally these projects have negative NPV. However, CRAs can overcome this problem by exerting costly effort to generate informative signals about project qualities. CRAs charge fees for their services and compete among each other. Funding comes from banks that compete among each other for profitable investment opportunities. As CRAs are disciplined by reputation, they need reputational rents. These rents lower the quality demanded by issuers and hence, result in mild rating inflation (see also Shapiro (1983)). More severe rating inflation can however take place when issuers prefer high over accurate ratings as is described below.

The issuer preference of high over accurate ratings results from the main friction in the model, namely private benefits for the issuer of operating the firm. Absent private benefits, one would expect any gains from rating inflation to be (more than) offset by higher interest rates. However, private benefits increase issuer utility derived from high ratings disproportionately. If CRAs compete among each other, issuers will push for rating inflation (i.e. rating shopping by issuers that induces catering by CRAs; see also Griffin, Nickerson and Tang (2013)). Private benefits for investors instead of issuers have similar effects on the issuers’ desire for inflated ratings.

There are two other, less important frictions in the model that are mainly there for tractability reasons. The first is that issuers are unaware of their own quality. In an extension of the model, I relax this friction to show how selection effects can induce much higher ratings inflation in the structured product market than in the corporate bond market. The second is a fixed ex-ante budget for rating fees. This friction also makes the analysis for a monopolistic CRAs more interesting by preventing it from capturing all surplus generated by the projects.

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8As credit ratings are advertised as relative measures of creditworthiness, aggregate rating inflation may technically not be well defined. However, it is natural that the meaning of a rating is benchmarked to historical performance of identical ratings, possibly in other product categories. In the model, rating inflation refers to exerting lower than first-best rating effort.

9One could think about an investment banker that, for a largely fixed fee upon placement, structures a pool of mortgages with unknown documentation standards.

10Such a friction could be a result of limited debt capacity of a project (due to e.g. limited collateral value).
The model is then extended to allow for alternative business models and market structures. First, investor-paid CRAs are added to the baseline model. Investor-paid CRAs suffer from several forms of free-riding that undermine their competitiveness compared to issuer-paid CRAs. In the model, investor-paid CRAs sell their ratings to subscribing investors. These subscribers in turn use this information in quoting interest rates to issuers. From these quotes, issuers can learn the investor-paid rating they got. Naturally, issuers with a low investor-paid rating will not apply for funding from subscribing banks and hence do not generate income for subscribers; this is the first form of free-riding. Next, issuers can take credit from subscribing investors (conditional on a high investor-paid rating) or apply for an issuer-paid rating and get credit from non-subscribers. If applying for issuer-paid ratings is sufficiently costly, issuers that received a low investor-paid rating will not be inclined to apply for an issuer-paid rating. This leads to positive selection to issuer-paid CRAs that can then hand out high ratings with little effort cost that ex-post show high accuracy; this is the second source of free-riding. Because of this low effort cost, issuer-paid CRAs can price more aggressively. Finally, there is the traditional argument that intellectual property rights are hard to protect. As a result, a certain fraction of the ratings produced will not earn any revenue and hence, the total required rating fees need to be recovered from a smaller mass of issues (it is effectively like the production cost per revenue-generating rating is higher); this is the third type of free-riding. These types of free-riding all lead to higher fees and hence lower competitive power compared to issuer-paid CRAs.

An investor-paid CRAs can only gain market share if their ratings are more accurate and lead to much lower interest rates than issuer-paid ratings. In such situations, separating equilibria can arise in which high quality issuers cluster around subscribers to investor-paid CRAs. These separating equilibria can only arise when issuer-paid CRAs cannot commit to exert sufficiently high effort. Exerting high rating effort is under certain parameter ranges incentive incompatible for issuer-paid CRAs when they compete among each other, as future profits are limited. A monopolistic issuer-paid CRA however, stands to lose such a valuable position that it can always commit to match effort at lower fees and compete the investor-paid CRA out of the market. In practice, this will yields the result for competing issuer-paid CRAs irrelevant. After all, successful entry of an investor-paid CRA would drive issuer-paid CRAs out of the market until only one remains that in turn can commit to ruining the investor-paid CRA.

Next, investors could be allowed to produce ratings for projects they partially
fund. Skin-in-the-game would then induce them to exert high rating effort (in line with e.g. Grossman (1981)). Rating effort is then increasing in the funding share of the rating party. However, if issuers prefer high over accurate ratings and funding shares can be freely set by banks, issuers would select banks that solicit low funding share in order to maximize rating inflation. Because banks compete for projects, they will solicit only low funding shares. This effectively undermines the disciplining effect of skin-in-the-game. To protect bank incentives, a regulator could bound funding shares for banks from below. However, in this case, issuer-paid CRAs act as outside options that can cater better to issuer preferences and hence banks lose all rating business. Providing CRAs with skin-in-the-game (e.g. by requiring a mandatory co-investment by the CRA in issues that receive high ratings) yields similar results.

Even the introduction of a Franken rule under which issuers pay for ratings but investors select the CRAs offers little solace. If issuers can (indirectly) influence the CRA selection process, for example by the choice of banking syndicate, banks can maximize market share by making a credible commitment to catering to issuers. As a result, the Franken rule would be ineffective in countering rating inflation. Only when investors are completely insulated from issuer influence can a Franken rule induce accurate ratings. Yet, in such situations banks to opt for CRAs that provide maximum accuracy. Typically, maximum accuracy exceeds first-best accuracy and hence socially wasteful over-spending on credit assessment takes place. This result corroborates findings by Kashyap and Kovrijnykh (2013).

To my knowledge, this paper is the first to develop a heterogeneous competition model of the credit ratings industry. Furthermore, it is also one of the few -if not the only- papers that, using rigorous economic modeling, explains why the market structure for CRAs has evolved as it has. As such, it contributes to the growing literature about role and functional design of CRAs and the market structure CRAs operate in.

My results relate and contain smaller contributions to a variety of sub-fields of this literature. For example, the paper contributes to results by Bar-Isaac and Shapiro (2013) and Mathis, McAndrews and Rochet (2009) by highlighting different channels from theirs through which rating inflation can arise. Rating inflation in

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11Investors such as large banks also have the technology to do this readily available due to the requirements for Basel II IRB-Advanced. Of course, banks may have their own frictions that may induce rating biases, especially when leverage is high and the effective skin-in-the-game is limited. This issue is addressed in Section 6.
this paper arises even in a fully transparent and rational setting without business cycle fluctuations. Similarly, while several papers have linked rating inflation to regulatory importance (e.g. Bongaerts, Cremers and Goetzmann (2012), Kisgen and Strahan (2010), Ellul, Jotikasthira and Lundblad (2011) and Opp, Opp and Harris (2013)), I show that rating inflation can arise even in the absence of regulatory importance. My findings also add to earlier empirical (Becker and Milbourn 2011) and theoretical (e.g. Bolton, Freixas and Shapiro (2012), Sangiorgi, Sokobin and Spatt (2009), Skreta and Veldkamp (2009), Camanho and Liu (2012)) research on competition among CRAs. These existing papers focus on the detrimental effect of rating shopping within the class of issuer-paid CRAs. I show that rating shopping across business models can impede the adoption of alternative, welfare enhancing business models. While this paper agrees with Pagano and Volpin (2010) that the adoption of investor-paid ratings might improve rating accuracy, it questions the size of these gains. Moreover, it also question the viability of the investor-paid CRAs under heterogeneous competition, because an issuer-paid CRA can deter entry using an effort-matching strategy. This protective behavior of issuer-paid CRAs aligns with empirical findings by Xia (2012). However, my findings suggest that the behavior documented by Xia (2012) takes place 'off the equilibrium path' and is unsustainable in the long run.

Methodologically, the model used is rather close to the model employed by Opp et al. (2013). The main difference between their model and my baseline model is that I model the interactive aspects of competition, whereas Opp et al. (2013) model competition by a static outside option. My model also shares similarities with Kashyap and Kovrijnykh (2013). Yet Kashyap and Kovrijnykh (2013) use a single period model and hence can only capture reputational concerns in reduced form. Both Kashyap and Kovrijnykh (2013) as well as Opp et al. (2013) do not allow for heterogeneous competition, which is crucial for my results.

Finally, this paper also relates to the body of literature analyzing the effects of regulation on the performance of CRAs. Several papers written from a legal perspective suggest regulatory fixes for the apparent dysfunctionality of CRAs, for example by paying CRAs in bonds rated by themselves (Listokin and Taibleson 2010). In contrast to those more qualitative papers, my study provides rigorous economic analyses of some of the proposed solutions and thereby highlights potential caveats. For example, I show that the skin-in-the-game proposed by Listokin and

\[\text{In fact, the main result obtained in Opp et al. (2013) can be obtained as a special case of my model with investor private benefits.}\]
Taibleson (2010) may have to be enlarged to unrealistic proportions in order to be sufficiently effective.

The remainder of the paper is structured as follows. Section 2 describes the model, introduces the players, sets a time line and derives the first-best solution as a benchmark for model outcomes with respect to social welfare. Section 3 analyzes base case equilibrium. In section 4, I derive equilibria under different alternative market structures such as investor-produced and investor-paid ratings in a free market. Section 5 analyzes the performance of such business models in a market where issuer-paid CRAs are banned. Section 6 shows robustness of the results to for example a setting in which banks instead of issuers have a private benefit of operating. Finally, section 7 concludes.

2 Model setup and socially optimal outcomes

The baseline model consists of an infinitely repeated game. All players in this economy, are risk-neutral and all model parameters are known by all players. Moreover, at time $t$, the complete history of all actions and realizations, denoted by $\mathcal{F}_{t-1}$ is observed by all players. Finally, I assume that a player chooses randomly among equally valued alternatives. Below I describe the players, their action spaces and a detailed time line of each stage game.

The game has three player types, issuers, banks and CRAs. To start with, there are $Q$ issuers in every stage game, where $Q$ is large. Each issuer $j$ lives for one period and has one project available. For a project to be undertaken, a unit capital investment is needed. The project has a quality $q_j \in \{G, B\}$, where $P(q_j = G) = \theta$. Hence, $\theta$ measures market-wide average credit quality. If $q_j = G$ the project has a payoff $R > 1$, while if $q_j = B$, it has a payoff of zero. Unconditionally, the project has a negative NPV, that is $\theta R < 1$. Each issuer has an initial cash budget $\zeta$, from which it can pay rating or transaction fees. After fees have been paid, the issuer pays out the residual endowment to its shareholders as a dividend, such that it is not pledgable in case an issuer defaults. As in e.g. Mathis et al. (2009), the issuer does not know the quality of its own project. Finally, the issuer has a private benefit $\beta \geq 0$ of operating. This private benefit is assumed to be a welfare loss to unmodeled parties in the economy (e.g. an inefficient compensation contract of an

\footnote{The budget $\zeta$ will limit the surplus a (monopolistic) CRA can extract from a good project. Collateral considerations could for example limit the debt capacity expressed as a percentage of assets employed by the issuer, hence giving rise to $\zeta$.}
investment banker). $\beta$ is the main source of ratings inflation in the model and can have many different causes. One can think about inefficient compensation plans for investment bankers, job-security concerns of issuer employees or regulatory benefits of having high ratings.

Second, there are $N$ identical, and infinitely lived CRAs. I assume that this number is fixed due to entry barriers. Each CRA $c$ can exert effort $e_c \in [0, 1]$ to obtain a signal $s_{j,c} \in \{G, B\}$ about issuer $j$, such that $P(s_{j,c} = G|q_j = G) = 1$ and $P(s_{j,c} = B|q_j = B) = e_c$. That is, a good project is always correctly identified, but a bad project is only identified correctly with probability $e_c$. Hereafter the CRA can truthfully issue this signal as a rating. The CRAs experience a quadratic effort cost $Ce_c^2$, where $C > 0$. The number of defaulted issuers with a high rating is perfectly observable at the end of each stage game. Each CRA $c$ charges a rating fee $f_c$ for its rating efforts, which it quotes publicly. Rating fees are paid irrespective of the rating outcome. Each CRA discounts future payoffs with a discount rate $r \in (0, 1)$ and maximizes the present value of its contemporaneous and future expected cash flows.

Finally, each stage game, there are $W > 1$ banks. Each bank has unlimited capital at its disposal to lend out and there are no (dis)economies of scale. This way, there is an over-supply of funds and as a consequence banks compete. Each bank $b$ lives for one period and maximizes its own expected profit.

Each stage game $t$ then proceeds as follows.

1. Short-lived players are added and everyone observes $\mathcal{F}_{t-1}$

2. Each bank publishes CRA blacklisting criteria $Z_b$ and quotes interest rates $\iota_c^s_b$ for funding conditional on a rating $s_c = G$ from an accepted CRA

3. Each CRA $c$ publicly quotes a rating fee $f_c$ and privately determines effort plans $e_c$

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14As producing the signal is costly, signals of low project quality will always be truthfully reported even if lying is allowed (it would be irrational to exert costly effort if one wants to inflate the result anyway). The truth-telling assumption is required to prevent situations with zero rating effort and only $B$ ratings. This is particularly important for investor-produced ratings which are introduced later on.

15And hence, when each issue is rated accuracy can be (almost) perfectly observed due to the law of large numbers.

16In reality, rating fees are not quoted publicly, but this assumption may be less problematic than it seems at first glance. First, issuers can in reality obtain price quotes for having their issue rated. Second, many of the largest investors also issue a diversity of products themselves and are therefore well aware of prevalent rating fees.

17Most results are qualitatively the same when the rating fee is due only for high ratings.
4. Issuers select CRAs and banks

5. Ratings are produced and issued, rating fees are paid and residual endowment is paid out, loans are granted and investments are made

6. Projects are realized, interest is paid, project and rating performance is observed

7. Start period \( t + 1 \)

In step 2, conditional on the information set \( F_{t-1} \) each bank selects and announces the criteria \( Z_b \) for CRAs to be banned. Hence, banks can play strategies that condition on future actions of CRAs, such as the rating fees \( f_c \). Each bank \( b \) also quotes interest rates \( \iota^c_b \) at which it commits to fund projects with a rating \( s_{j,c} = G \). Each CRA also plans to exert effort \( e_c \) to issue a rating \( s_{j,c} \) for each issuer \( j \) that selects CRA \( c \).

In step 3, CRAs publicly quote rating fees \( f_c \) conditional on their information set \( F_t^C = \{ F_t, \iota^c_b, Z_b \ \forall b,c \} \). Each CRA also plans to exert effort \( e_c \) to issue a rating \( s_{j,c} \) for each issuer \( j \) that selects CRA \( c \).

In step 4, each issuer selects one single CRA and any number of banks conditional on the information set \( F_t^F = \{ F_t^C, f_c \ \forall c \} \). That is, each issuer \( j \) chooses \( I_{j,c}^C \in \{0,1\} \) and \( I_{j,c,b}^B \in \{0,1\} \) such that \( \sum_c I_{j,c}^C = 1 \), \( \sum_{c,b} I_{j,c,b}^B = 1 \) and \( \sum_{c \in Z_b} I_{j,c,b}^B = 0 \) \( \forall (j,b) \).

### 2.1 First best outcome

In this sub-section, I derive the first best outcome, that is, the outcome that a social planner would choose if he could control actions of all market participants perfectly. In the model, social welfare is created by implementing high quality projects (i.e. \( q_j = G \)). Social welfare is destroyed by defaults and rating effort exerted. Naturally, the first best outcome is dependent on parameter values. Typically, if rating production costs are relatively low, producing ratings causes little social welfare loss. In that case, a social planner would let a CRA produce ratings with high accuracy. Thereafter, it would mandate investment in all highly rated projects (i.e. \( s_{j,c} = G \)). If credit assessment technology is very expensive compared to welfare gains to be realized, it may not be worthwhile to produce any ratings at all.

**Proposition 1.** If \( \frac{(1-\theta)^2}{4C} \geq (1-\theta R) \), the first best outcome generates a social welfare of \( \min \left( \frac{(1-\theta)^2}{4C} - (1-\theta R), \theta(R-1) - C \right) \) and is attained by letting a CRA \( c \) rate all debt with effort \( e_c = \min \left( \frac{1-\theta}{2C}, 1 \right) \) and let banks fund all projects with rating \( s_{j,c} = G \).
If \( \frac{(1-\theta^2)}{4C} < (1 - \theta R) \), the first best outcome generates a social welfare of \( \theta \) and is attained by conducting no ratings at all and making no investments whatsoever.

**Proof.** See Appendix.

The intuition behind Proposition 1 is relatively straightforward. It is only worthwhile producing ratings when conducting ratings is sufficiently cheap and the social value of a rating is sufficiently high. Naturally, the unit support for probabilities binds exerted effort by \( 1 \) from above. Thus, with very low production costs relative to the social value of ratings, it is optimal to produce fully revealing ratings.

## 3 Basic equilibrium analysis

In the rest of the paper, I will explore equilibria under different types of market organization. However, before doing so, I need to define the type of equilibria I will look at.

### 3.1 Equilibrium definition

Because the game is strategic in nature, I will look at Nash equilibria. Under this definition, we have an equilibrium if every player’s strategy is (weakly) optimal given the strategies of all the other players. Additionally, I will look for equilibria that do not differ from one period to the other, in other words, that are steady state. Hence, the equilibria I look at can be characterized by a set of strategies over one stage game. Moreover, by studying steady-state equilibria, I can focus on long run effects of policy measures, which should be the focus of most regulations. Finally, I focus on sub-game perfect equilibria to avoid equilibria involving threats that are not credible.

In the process of exploring equilibria, I will as much as possible try to derive general results that hold broadly and build towards more specific equilibria.

To establish a benchmark to compare the alternative business models to, I first explore a base case equilibrium.

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\(^{18}\)Including the players that have only participated or will only participate in previous or subsequent stage games respectively
3.2 Base case

In this section, I derive the base case equilibrium involving banks, issuers and CRAs. Moreover, I show that social welfare in the base case can be negative if private benefits for issuers are large. In other words, if issuers want the ‘wrong things’, financial intermediation destroys more value than it creates.

Any equilibrium that involves the three basic players needs to satisfy three basic conditions or constraints. These are zero bank profit, pledgeability and CRA incentive compatibility.

Let us start with zero bank profit. As banks have a short horizon, have constant returns to scale and an over-supply of capital, they compete on an equal basis for profitable deals. Standard economic results then apply and banks must make zero economic profit.

Lemma 1. (Zero bank profitability): Given sufficiently high equilibrium effort level \( \tilde{e}_c \), each bank \( b \) quotes interest rate \( \tilde{\iota}_{b,c} = \frac{(1-\theta)(1-\tilde{e}_c)}{\theta} \) and breaks even in expectation.

Proof. See appendix.

Given that banks must break even in expectation, not all effort levels can be sustained in equilibrium. After all, the (limited) surplus generated by good projects is the only source of interest payments. Therefore, only effort levels that generate sufficiently low expected default losses to be covered by maximum pledgeable interest can be sustained in equilibrium.

Lemma 2. (Pledgeability): Any strictly positive equilibrium effort level \( \tilde{e}_c \) must exceed \( \frac{1-\theta R}{1-\theta} \).

Proof. See appendix.

Finally, in equilibria with investment, CRAs need to exert strictly positive effort. As contemporaneous CRA profits are negatively related to exerted effort, such discipline can only be achieved through reputation. The threat of banks blacklisting CRAs in the future (and hence take away all demand for that CRA’s services) can contemporaneously discipline the CRA. In order for reputation to be effective, the potential contemporaneous gain from misbehaving should be more than offset by the expected loss of future cash flows. To maximize the disciplining effect of reputation, I focus on grim-trigger punishment strategies.
Lemma 3. (Incentive compatibility): Any equilibrium with positive investment must have that contemporaneous production costs are smaller than the present value of future expected profits. If grim-trigger punishment strategies are employed by the banks, this gives rise to the following incentive compatibility condition

\[ Ce_c^2 \leq \frac{f_c - Ce_c^2}{r}. \]  

(1)

Proof. See appendix.

Having established basic conditions for any equilibrium in this economy to hold, we can now derive the base case equilibrium in full. In order for an equilibrium to be a steady state equilibrium, the rating fees need to be incentive-compatible. Making equation (1) bind and solving gives the lowest incentive compatible rating fee (and hence the fee that materializes with competition among CRAs, i.e. when \( N > 1 \)). This fee must always strictly exceed information production costs, hence leaving economic profits for CRAs (otherwise there is no future value to be lost). Moreover, with competition issuers optimize over CRA effort, while a monopolistic CRA with fixed fees would minimize production costs. Therefore, reputation based discipline dictates that if first best effort is strictly smaller than 1, equilibrium effort levels must fall short of the first-best effort level (see also Shapiro (1982)). A much larger shortfall in effort can materialize in the presence of issuer private benefits as in that case, issuers gain an additional and potentially large benefit from low effort.

Proposition 2. If \( \sqrt{\frac{\xi}{C(1+r)}} \geq \frac{1-\theta R}{1-\theta} \), the following strategies constitute an equilibrium:

1. Each CRA \( c \) is added to the blacklist \( Z_b \) by every bank \( b \) if it ever exerted an effort level \( e_c < e^* \) or has ever quoted a fee \( f_c < f^* \),

2. Every bank \( b \) commits to fund any issuer \( j \) with a rating \( s_{j,c} = G \) from any CRA \( c \) not on \( Z_b \) at an interest rate

\[ \iota_c^b = \iota^* = \frac{(1-\theta)(1-e^*)}{\theta}, \]  

(2)

3. Every issuer \( j \) selects a combination of a non-blacklisted CRA \( c \) and a bank \( b \) that minimizes the sum of rating fees and expected interest payments, i.e.

\[ \min_{(c,b)|c \notin Z(b)} f_c + \theta \iota_c^b \]  

(3)
4. Every CRA $c$ exerts effort $e_c = 0$ for a fee $f_c = \zeta$ if it has ever exerted effort $e_c < e^*$ or ever quoted a fee $f_c < f^*$ and otherwise quotes a fee $f_c = f^*$ and exerts effort $e_c = e^*$.

5. If $N > 1$, $e^*$ and $f^*$ are given by

$$f^* = C(1 + r)(e^*)^2, \quad (4)$$

$$e^* = \max \left( \frac{1 - \theta R}{1 - \theta}, \min \left( \frac{(1 - \theta)(1 - \beta)}{2C(1 + r)}, 1, \sqrt{\frac{\zeta}{C(1 + r)}} \right) \right). \quad (5)$$

6. If $N = 1$, $e^*$ and $f^*$ are given by

$$f^* = \min(\zeta, \theta(R - 1) - (1 - \theta)(1 - \beta)(1 - e^*)), \quad (6)$$

$$e^* = \max \left( \frac{1 - \theta R}{1 - \theta}, \min \left( \frac{(1 - \theta)(1 - \beta)}{2C}, 1, \sqrt{\frac{\zeta}{C(1 + r)}} \right) \right). \quad (7)$$

Proof. See appendix.

The equilibrium in Proposition 2 highlights some interesting features. First, we see that in the absence of private benefits for the issuer ($\beta = 0$), a monopolistic CRA can lead to first best outcomes if it can capture all generated surplus. However, it exerts too low effort if the amount of surplus it can capture is limited by a low initial endowment $\zeta$. Competing CRAs can never generate the first-best outcome, because they need reputation rents to commit to work but also provide the issuers with outside options for each other. When private benefits are introduced, large inefficiencies can show up, first best can never be attained and welfare can even turn negative. This happens for example, when the pledgeability constraint binds (i.e. $e^*_c = \frac{1 - \theta R}{1 - \theta}$). In that case, all surplus from good projects is used as interest to compensate banks for default losses, while resources are spent on credit assessment.

4 Alternative market structures

4.1 Investor-paid CRAs

The most prominently proposed solution to the problem of low ratings accuracy is to stimulate investor-paid CRAs, such as Egan-Jones Ratings (see e.g. Pagano and Volpin (2010)). The idea here is that the conflict of interest in screening that CRAs
have is reduced while limiting potential conflicts of interest that can arise in the monitoring stage (e.g. catering to investors with established portfolios). Below, I analyze the economics of investor-paid ratings in my model. The best an investor-paid CRA can hope for is to provide the market with all the information it needs and thereby remove the need to use issuer-paid ratings. As I show below, several sorts of free-riding make this hard to achieve in a cost-efficient manner.

The traditional competitive disadvantage of investor-paid CRAs is a free-riding concern related to the difficulty to protect intellectual property. As a result, some of the rating information produced may end up with investors that have not paid for it, while production costs have been incurred on those. Hence, the total required compensation for producing ratings needs to be covered by fees on a smaller mass of ratings that will generate revenue. Therefore, the effective cost per produced rating is likely to be higher for investor-paid CRAs than for issuer-paid CRAs. This could be modeled by simply increasing the rating production cost with a factor $(1 - \psi)^{-1}$, where $\psi$ is the fraction of produced ratings that leak away without being paid for.

In the remainder of this section, I abstract from this type of free-riding to highlight two other types of free-riding. The first type is free-riding by issuers that only pay a transaction fee to a subscriber bank if they are funded. The second type concerns free-riding by issuer-paid CRAs that can exert low effort and charge high fees when it is sufficiently costly for issuers with a low investor-paid rating to apply to an issuer-paid CRA.

In the model, I introduce an investor-paid CRA in the following way. Between steps 1. and 2., two extra steps are inserted. In step 1.a, an investor-paid CRA $m$ using the same technology as issuer-paid CRAs spends effort $e_m \in [0, 1]$ to generate signals $s_m$ for all issuers and quotes a fee $f_m$ to banks. In step 1.b banks decide to purchase ratings from $m$ at $f_m$ or not. Step 2. stays the same, but additionally, each subscribing bank $h$ can quote an issuer-specific interest rate $\iota^m_{h,j}$ to each issuer $j$ using ratings from $m$ as well as a transaction fee $f_h$ (this way, rating fees can be passed on to issuers). The interest rate quotes offered by subscriber banks can inform an issuer about the rating $m$ assigned to it and hence about its own quality.

An investor-paid CRA can expect difficulties in competing with issuer-paid CRAs. Similar to issuer-paid CRAs, it needs to play a strategy that satisfies incentive compatibility and hence generates rents. Moreover, it rates all issues in the market (by assumption). However, only issuers that receive high ratings can be expected to pay transaction fees with which subscribing banks can recover rating fees, leading to free-riding of low quality issuers. Therefore, given an effort level, subscribing banks
need to charge transaction fees that strictly exceed the fees required to purchase these ratings. High transaction fees give subscribing banks a competitive disadvantage when faced with banks that rely on issuer-paid ratings. Hence, investor-paid CRAs have a cost disadvantage compared to issuer-paid CRAs.

**Lemma 4.** *(Cost disadvantage):* Given effort plans $e_m$, the lowest incentive compatible transaction fee an investor $h$ subscribing to investor-paid CRA $m$ can quote is given by

$$f_h \geq \frac{f_m}{\theta + (1 - \theta)(1 - e_m)},$$

$$f_m \geq (1 + r)Ce_m^2.$$  \hspace{1cm} (8) \hspace{1cm} (9)

**Proof.** See Appendix. \hfill \square

In view of its cost disadvantage, an investor-paid CRA $m$ can only hope to compete with issuer-paid CRAs if it can somehow change issuer preferences. Moreover, $m$ should also make it impossible for issuer-paid CRAs to cater to the (changed) issuer preferences. By (indirectly) informing issuers about their own type, investor-paid CRAs can change issuer preferences towards higher effort levels as is explained below. Those higher effort levels may not be committable for issuer-paid CRAs if $N > 1$. For a monopolistic CRA however, it is always possible to commit to pushing investor-paid CRAs out of the market. The reason for this is that the threat of losing the valuable monopoly position is so big.

**Lemma 5.** *(Limits to CRA effort levels):* If issuer-paid CRAs compete, the maximum effort they can commit to at any point in time is bounded from above and equals the base case equilibrium effort multiplied with either $1$ or $\frac{1}{\theta + (1 - \theta)(1 - e_m)}$.

**Proof.** See Appendix. \hfill \square

Lemma 5 suggests that if there is a role to be played for investor-paid CRAs, then investor-paid CRAs must exert higher effort levels than those exerted by issuer-paid CRAs in the base case. Moreover, as $\frac{1}{\theta + (1 - \theta)(1 - e_m)} \geq 1$, the presence of investor-paid CRAs may put upward pressure on issuer-paid CRA effort. These results are in line with recent empirical findings by Xia (2012). Hence, investor-paid CRAs may be able to provide effort levels closer to first best, especially when $\beta > 0$. The question however is whether issuer-paid CRAs can commit to deterring investor-paid CRAs from entering.
Proposition 3. $N > 1$ issuer-paid CRAs can collectively deter entry to an investor-
paid CRA $m$ if for all $e_m \in (e^*, 1]$ we have that either

$$
\frac{C(1 + r)e_m^2}{\theta + (1 - \theta)(1 - e_m^2)} \geq \beta(1 - \theta)(1 - \hat{e}_c), \quad \text{or}
$$

$$
0 \leq -C\hat{e}_c^2 + \frac{C(1 + r)e_m^2 + (1 - \theta)(\hat{e}_c - e_m)}{\theta + (1 - \theta)(1 - e_m)}, \quad \text{where}
$$

$$
\hat{e}_c = \arg \max_{e_c \in \left[\frac{1 - \theta R}{1 - \theta}, e^*\right]} -C\hat{e}_c^2 + \frac{C(1 + r)e_m^2 + (1 - \theta)(e_c - e_m)}{\theta + (1 - \theta)(1 - e_m)},
$$

$$
e^* = \max \left(\frac{1 - \theta R}{1 - \theta}, \min \left(\frac{(1 - \theta)(1 - \beta)}{2C(1 + r)}, 1, \sqrt{\frac{\zeta}{C(1 + r)}}\right)\right).
$$

Proof. See Appendix.

The intuition behind the proof of Proposition 3 is as follows. Issuer-paid CRAs can exclude $m$ if after getting a rating from $m$, the highly rated issuers go for an issuer-paid rating. If the expected private benefit for issuers with a low rating from $m$ is sufficiently low to be unwilling to pay a rating fee, issuer-paid CRAs could exert lower effort than $m$ for a lower fee and still deliver the same interest rate to the issuers. In other words, if pooling is sufficiently costly for issuers with a low rating from $m$, issuer-paid CRAs can (indirectly) free-ride on investor-paid ratings and experience positive selection in their clientele. Therefore, issuer-paid CRAs will push for such separating equilibria. This can be done by 1.) setting high fees, but not higher than $f_h$ in order to stay competitive and ii) minimizing the expected private benefit for issuers with a low rating from $m$. This is reflected in condition (10). When (10) is not satisfied, issuer-paid CRAs can still be more attractive if the lower fee they offer more than compensates issuers with a high rating from $m$ for the higher interest costs. Condition (11) is satisfied when then most attractive combination of fee and expected interest rates from issuer-paid CRAs dominates the most competitive sustainable offer from $m$. Proposition 3 also gives guidance to the most competitive fee structure of issuer-paid CRAs. Fees that are due irrespective of the rating outcome make it less attractive for issuers with low (issuer-paid) ratings to apply for issuer-paid ratings as compared to fees that condition on obtaining high ratings. Summarizing, if $N > 1$, an investor-paid CRA might only be able to take over the ratings market in a very limited parameter range. In this case, an investor-paid CRA could capture the whole market at an effort level exceeding the base case.
effort level. With the threat issuer-paid CRAs trying to re-capture market share, social welfare would most likely increase. On the other hand, when \( N = 1 \), the CRA can always commit to any effort level and non-negative fee that is preferred by issuers that received a high rating from \( m \).

**Lemma 6. (Monopolistic power):** A monopolistic issuer-paid CRA can always deter entry to an investor-paid CRA, for example by matching effort at a lower fee.

**Proof.** See Appendix.

In practice, Lemma 6 in combination with fixed costs for market presence and entry makes it very unlikely that investor-paid CRAs ever gain meaningful market share, even when \( N > 1 \) initially. If \( N > 1 \) and issuer-paid CRAs lose market share, they will start to drop out until only one survives, which yields the situation where \( N = 1 \).

Taken together, these results indicate that there is little scope for investor-paid CRAs. The recent withdrawals of investor-paid rating initiatives of Roland Berger and Coface and the change of heart at Kroll Bond Ratings from investor-paid to issuer-paid\(^{19}\) are in line with this result.

In addition to the setting described above, there could be situations (outside of the model) such as segmentation under which investor-paid CRAs could attract some business, but would not become dominant. For example, there could situations in which investors are hit by random liquidity shocks inducing them to trade in the secondary market. Because issuers will have less or no influence on the selection of secondary market buyers, there is room for investor-paid ratings purchased by secondary market traders. This setting would be consistent with market segmentation findings reported by Cornaggia and Cornaggia (2011).

### 4.2 Investor-produced ratings

In the wake of the sub-prime crisis, several policy makers have called on (the larger) market parties to do their own credit assessment, instead of relying on CRA ratings. The hope is that investors will do a better job at conducting credit assessments than external CRAs because of their skin-in-the-game (in line with Grossman (1981)). In this subsection, I use my model to analyze a market structure in which investors can produce public ratings for a fee while committing to fund part of the project if the

rating turns out positive. Hence, one investor per issue can adopt the role of CRA. Later, I also look at the scenario in which CRA profits and losses are contingent on performance (in other words, where a CRA partially adopts the role of investor).

For this market structure, the model needs to be extended by giving banks the opportunity to also produce ratings. In particular, banks still only live for one period, but now possess the same technology as the CRAs. However, when a bank \( b \) is selected as a rater, it needs to fund a fraction \( \phi_b > 0 \) of the project upon issuing a high rating. Bank \( b \) can set and solicit the size of \( \phi_b \) as long as it remains positive. However, banks are less efficient at credit assessment, which is reflected in a higher effort cost parameter \( C_B > C \).

Each stage game is then adjusted as follows. In step 2., each bank \( b \) also quotes interest quotes for funding upon a high rating from each of the rating producing banks. In step 3., each rating producing bank \( b \) now publicly quotes a rating fee \( f_b \), solicits a funding fraction \( \phi_b \), and privately determines planned effort \( e_b \). In step 4., issuers can now select a combination of CRAs and/or banks.

The resulting equilibrium looks very similar as the base case, but with some notable differences. First, investor-produced ratings serve as outside options and hence, profits of a monopolistic CRA are constrained. Second, investors are disciplined by their funding shares and hence do not require reputation rents, but quote fees that equal production costs. Third, as issuers prefer high over accurate ratings, banks solicit lower funding shares as the private benefit \( \beta \) increases in order to gain market share. Finally, which party conducts ratings in equilibrium depends on parameters. These effects are summarized in the following proposition.

Proposition 4. If
\[
\sqrt{\frac{\xi}{C(1+r)}} \geq \frac{1-\theta R}{1-\theta}
\]
the following strategies constitute an equilibrium:

1. Each CRA \( c \) is added to the blacklist \( Z_b \) by every bank \( b \) if it ever exerted an effort level \( e_c < e_c^* \) or has ever quoted a fee \( f_c < f^* \).

2. A bank \( b' \) is added to \( Z_b \) by every bank \( b \) (except itself) if it quotes \( \phi_{b'} < \frac{2C_B(1-\theta R)}{(1-\theta)^2} \).

3. Every bank \( b \) quotes a rating fee \( f_b^* \) for rating an issue it solicits to fund with a funding share \( \phi_B^* \) and exerts effort \( e_B^* \). Moreover, each banks commits to fund any issuer \( j \) with a rating \( s_{j,x} = G \) from any rater \( x \) (CRA or bank) not on \( Z_b \).
at an interest rate of respectively

\[ \iota_b^c = \iota^* = \frac{(1 - \theta)(1 - e^*)}{\theta} \quad \iota_b = \frac{(1 - \theta)(1 - e_b^*)}{\theta} \]  \tag{14} 

4. Every issuer \( j \) selects a combination of a non-blacklisted rater \( x \) (CRA or bank) and bank(s) \( b \) that minimizes the sum of rating fees and expected interest payments, i.e.

\[ \min_{(x,b) \mid x \notin \mathcal{Z}(b)} fx + \theta \iota_b^x \]  \tag{15} 

5. Every CRA \( c \) exerts effort \( e_c = 0 \) for a fee \( f_c = \zeta \) if it has ever exerted effort \( e_c < e^* \) or ever quoted a fee \( f_c < f^* \) and otherwise quotes a fee \( f_c = f^* \) and exerts effort \( e_c = e^* \)

6. If \( N > 1 \), \( e^* \) and \( f^* \) are given by

\[ f^* = C(1 + r)(e^*)^2, \]  \tag{16} 

\[ e^* = \max \left( \frac{1 - \theta R}{1 - \theta}, \min \left( \frac{(1 - \theta)(1 - \beta)}{2C(1 + r)}, 1, \sqrt[4]{\frac{\zeta}{C(1 + r)}} \right) \right). \]  \tag{17} 

7. If \( N = 1 \), \( e^* \) and \( f^* \) are given by

\[ f^* = \min(\zeta, \theta(R - 1) - (1 - \theta)(1 - \beta)(1 - e^*) - u_b^*), \]  \tag{18} 

\[ e^* = \max \left( \frac{1 - \theta R}{1 - \theta}, \min \left( \frac{(1 - \theta)(1 - \beta)}{2C}, 1, \sqrt[4]{\frac{\zeta}{C(1 + r)}} \right) \right), \]  \tag{19} 

\[ u_b^* = \max(0, \theta(R - 1) - \theta \iota_b^* - f_b^*) \]  \tag{20} 

8. \( f_B^*, \phi_B^* \) and \( e_B^* \) are given by

\[ \phi_b^* = \min \left( 1, \max \left( (1 - \beta), \frac{2C_B(1 - \theta R)}{(1 - \theta)^2} \right) \right), \quad f_B^* = C_B(e_B^*)^2, \]  \tag{21} 

\[ e_B^* = \min \left( \frac{(1 - \theta)\phi_B^*}{2C_B}, 1, \sqrt[4]{\frac{\zeta}{C_B}} \right). \]  \tag{22} 

Proof. See appendix. \( \square \)

Even when a bank \( b \) has chosen its optimal \( \phi_b^* \), it may not attract any rating business if issuer-paid CRAs can cater better to issuers. On the one hand, as disci-
pline comes from the funding share $\phi_b$ rather than from reputation, banks will not earn rents in equilibrium, which lowers rating fees. On the other hand, banks are less efficient at producing ratings than CRAs because $C_B > C$. Which party ends up conducting the ratings depends on which of the two dominates.

**Corollary 1. (CRAs vs banks):** CRAs will not suffer from bank competition in rating business if their efficiency advantage is sufficiently high and their discount rates are sufficiently low. More specifically, this is true when $C(1 + r) < C_B$.

**Proof.** See appendix.

Proposition 4 and Corollary 1 have important regulatory implications. First, Corollary 1 tells us that there is only scope for investor-produced ratings (and hence potential welfare improvements) when those can be produced efficiently enough. Second, even if the efficiency hurdle is met, Proposition 4 shows that competition will drive down the potential of overcoming rating inflation caused by issuer private benefits. In other words, if issuers prefer inflated ratings, they will have little demand for ratings from parties that commit to issuing accurate ratings. Social welfare gains in that case will be small. Higher welfare can only be induced in this setting by 1.) banning issuer-paid CRAs and 2.) imposing a minimum on $\phi_b$. Merely imposing a minimum on $\phi_b$ in an otherwise free market would drive all rating business towards the CRAs, yielding the solution completely ineffective. When issuer-paid CRAs are banned, exogenously fixing $\phi_b = 1$ maximizes social welfare. However, first best is not attainable, as $C_B > C$.

### 4.3 Contingent CRA profits

In the previous subsection, I explored the option of a bank functioning as a rater. One could also do the opposite and give a CRA a similar role to that of an investor. This boils down to linking CRA compensation to rating accuracy. One could for example think about a mandatory co-investment, posting a bond, taking a first loss piece of a basket of issues or take short CDS position in products with high ratings. Outcomes may differ from the case with investor-produced ratings because of the reputational concern of the CRAs.

In the model, I achieve the incentive alignment of CRAs by adjusting each stage game in the following way (compared to the base case). In step 3, each CRA $c$ can take an exposure $\phi_c \in [0, 1]$ of its choice to the rated issue conditional on the issue.

\[\text{Note that this would defy the purpose of a public rating.}\]
receiving a high rating. The compensation received for taking on this exposure should conform to the interest rate quoted by the bank(s) selected by the issuer and is only paid in step 6 if a high quality project is realized. Let us call \( \phi_c \) a co-investment, irrespective of how exactly it is structured and assume that this co-investment carries a market-conform interest rate.

First, one should realize that CRAs are the most efficient producers of credit assessment in the model. If we have a monopolistic CRA \( (N = 1) \), we could perfectly align CRA welfare and social welfare by setting \( \phi_c = 1 \). However, in the credit market, the CRA cannot expect to earn positive profits on the co-investment because its returns are in line with market interest rates and hence yield zero expected profits. Therefore, it would never be sub-optimal for the CRA to set \( \phi_c = 0 \). In many cases, setting \( \phi_c = 0 \) would be even strictly optimal as a strictly positive co-investment would induce the CRA to exert costly effort while fees are bounded from above by \( \zeta \).

**Lemma 7.** *(Monopolistic independence):* If \( N = 1 \) it is always optimal for the CRA \( c \) to set \( \phi_c = 0 \). For wide parameter ranges, this optimality is strict.

**Proof.** See Appendix.

When \( N > 1 \), a similar situation would occur as with investor-produced ratings. That is, CRAs would not be disciplined by reputation, but by co-investments and fees would equal production costs (one could substitute the the rating-producing investors in Proposition 4 by the co-investing CRAs). However, as CRAs are the most efficient raters, now first best is possible if \( \beta = 0 \). In that case, \( \phi^*_c \) would equal 1. This is however highly unrealistic in practice as CRAs lack capital. If \( \beta > 0 \), competition among CRAs would drive down \( \phi^*_c \) as with investor-produced ratings and hence undermine its disciplining effect on CRAs. Because CRAs in this setting do not need reputational rents, social welfare improves slightly compared to the base-case, even when \( \beta > 0 \).

In contrast to the setting with investor-produced ratings, regulation imposed co-investments may also lead to unexpected problems if another type of equilibrium materializes. If a minimum were imposed on \( \phi_c \) by a regulator, reputational concerns of CRAs could still lead to sub-optimal (captive) equilibria. In such equilibria, issuers would pay a premium fee for ‘perverse incentive compatibility’ to hold. That is, CRAs pocket rents for exerting lower effort levels than those induced by \( \phi_c \). As before, \( r \) is a crucial component of the fee premium needed to seduce CRAs to
overcome their contemporaneous incentives. Hence, such an equilibrium would only be feasible if \( r \) is sufficiently small compared to \( \phi_c \).

4.4 Franken Rule

As a part of the negotiations concerning the implementation of the Dodd-Frank financial sector reform act, senator Al Franken has put forward an amendment for a so-called platform-pays rule as suggested in Mathis et al. (2009) accepted by congress. Under such a 'Franken Rule', issuers pay into a market-wide fund from which rating fees are paid to CRAs. The selection of CRAs in such a setup is done by some selection committee. Most likely the investment community would provide many of the committee members. For the moment, the Franken Rule has been postponed while the SEC investigates other solutions.

I work out this market structure in two ways, that differ by the way of (indirect) influence issuers have on the process.

In the first way (call this the 'pass-through' setup), the base case stage game is modified in the following way. In step 2., banks quote a transaction fee \( f_b \) along with their interest rates. In step 4. issuers select a (combination of) bank(s) and the bank with the highest funding share collects the transaction fee and selects and pays the CRA. The transaction fee is paid irrespective of the rating outcome.

The problem with this mechanism is that it will induce banks to spread funding among banks and keeping all funding shares relatively small as was the case with investor-produced ratings in Section 4.2. The bank that chooses the CRA will condition on the quoted transaction fee and opt for inaccurate ratings if its skin-in-the-game is only small. Ex ante, banks will anticipate this shopping behavior from issuers and cater by quoting low transaction fees to signal their willingness to comply. Hence, social welfare will not improve.

**Proposition 5.** Under a Franken Rule where banks pass through rating fees, it is optimal for issuers to quote low fees and allocate relatively small funding shares such that the resulting effort level reflects the issuer’s preference.

**Proof.** See Appendix.

Alternatively, one could consider a setup without pass-through of rating fees. In that case, each stage game is adjusted from the base case as follows. In step 4.

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As such a captive equilibrium is relatively unstable, has low tractability and is not a main result of the paper, it is not worked out here.
issuers again select banks and the bank with the highest funding share selects the CRA. However, now the issuer has to pay the selected CRA directly.

As the banks have no way to commit to go for inaccurate ratings, they will choose the CRA that can be expected to exert maximum effort. While this does prevent rating inflation, it is inefficient as too many resources are allocated to credit assessments. This result is similar to the result in Kashyap and Kovrijnykh (2013).

**Proposition 6.** Under a Franken Rule without fee pass-through, it is optimal for investors to push for maximum effort, which is likely to be socially sub-optimal due to over-investment in credit assessments.

*Proof. See Appendix.*

Propositions 5 and 6 make clear that a Franken Rule is very sensitive to its exact setup, but also that it tends to drift into extremes. In order to prevent over-spending on credit assessments, issuers should have influence in the CRA selection process. However, allowing for issuer influence in the selection process exposes the system to opportunistic behavior on the issuers’ behalf. In a model in which capital is in short supply, one might be able to make such a system work as investors would be able to capture almost all economic surplus. Hence, the banks’ optimization would be equivalent to the firm’s optimization problem with $\beta = 0$. Note that even then the outcome realized falls short of first best because CRAs are disciplined through reputation and ratings are mildly inflated.

## 5 Results when issuer-paid CRAs are banned

In the previous sections, I analyzed heterogeneous competition models in the market for credit ratings. One of the results was that competition from issuer-paid CRAs prevents any of the other business models to gain market-share, because issuer-paid CRAs can generally commit to better cater to issuers. This section investigates whether these alternatives would work well if issuer-paid CRAs were to be banned.

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22 As an alternative, one could think about passing through fees, but sharing transaction and rating fees proportionally among all participants is an issue. While this would make the system work, strategies could easily be devised to bypass the system. For example, one underwriter could take care of all fees and immediately after distribute issue shares among other syndicate participants. Because the underwriter endogenizes the redistribution of loan shares, it acts as in Proposition 5. For issuers, such a syndicate would be very attractive because it would cater well to their interests. The underwriter could also credibly signal commitment by quoting low transaction fees. Mild rating inflation induced by reputation as a disciplining mechanism would also persist under any implementation of the Franken Rule.
5.1 Imposing investor-paid ratings on the market

If issuer-paid CRAs were banned, one could also choose to only work with investor-paid CRAs. In this sub-section, I explore whether such measures could help to avoid social welfare losses imposed by ratings inflation. This section uses the setup as section 4.1 but with $M = 2$ and $N = 0$.

As investor-paid CRAs are disciplined by reputation, incentive compatibility needs to be satisfied. Moreover, a monopolistic investor-paid CRA will display similar behavior to a monopolistic issuer-paid CRA. Hence, the interesting case is when two investor-paid CRAs compete. As there is homogeneity within player types and there are no capacity constraints on investors and CRAs, only two types of equilibria can arise: a symmetric type in which investor-paid CRAs play identical strategies and an asymmetric type in which one investor-paid CRA becomes a monopolist (for the other one there is then insufficient room in the market). The reason that an asymmetric equilibrium is possible here is because in order to operate, each investor-paid CRA needs to rate all issues. This is like a fixed cost of operating. If there is insufficient surplus in the economy to cover the additional 'fixed cost' for a second investor-paid CRA $m$, non-participation is optimal for $m$.

For a symmetric competitive equilibrium, it should be optimal for both investor-paid CRAs to exert equal effort. Similarly to the case where an investor-paid CRA competes with issuer-paid CRAs, if $\beta$ is relatively low, issuers with one low rating may not find it worthwhile to apply for funding. Therefore, as long as one investor-paid CRA $m$ exerts effort $e_m > \frac{1-\theta R}{1-\theta}$, it is always optimal for the other CRA to free-ride and exert effort $\frac{1-\theta R}{1-\theta}$ at a fee slightly lower than $f_m$. This type of free-riding is similar to the free-riding of issuer-paid CRAs on the positive selection of issuers induced by investor-paid ratings. Issuers will not select $m$ because they can get identical private benefits and interest rates for a lower fee from the other investor-paid CRA. Hence, when $\beta$ is low, (pure strategy) symmetric equilibria cannot arise at high effort levels. When $\beta$ is sufficiently high, it is optimal even for low quality issuers to apply for funding. In this case, issuers with two high ratings condition on receiving $\beta$ and try to minimize interest expenditures, thereby pushing for higher effort as if $\beta$ equals zero. Hence, when $\beta$ is large, a competitive equilibrium with investor-paid CRAs may lead to higher rating accuracy. These effects are summarized in the propositions below:

**Proposition 7.** When $M = 2$ and $N = 0$, there can exist an equilibrium with
If more than one of such effort levels exist, an equilibrium will only materialize for the highest possible effort.

Proof. See Appendix.

The intuition behind the conditions in Proposition 7 is as follows. In order to avoid free-riding by positive selection, private benefits need to be sufficiently large and moreover, the fees for both CRAs should be affordable. These two requirement together give rise to condition (23). Next, $e^*_m$ is most competitive when when it maximizes demand. To this end marginal utility for issuers with high ratings up to $e^*_m$ should be positive and from $e^*_m$ onwards should be negative. Inequalities (24) and (25) give those conditions. Marginal utilities in the two regions differ because issuers with high ratings condition on the private benefits up to $e^*_m$ and realize that those can be lost when effort increases beyond $e^*_m$. Hence, up to $e^*_m$ (i.e. in (24)), the term $(1 - \beta)$ does not show up, but is does beyond $e^*_m$ (i.e. in (25)).

A competitive investor-paid equilibria only improve on accuracy when $\beta$ is sufficiently large and the base-case equilibrium generates low social welfare. However, higher exerted effort in this case is not guaranteed to lead to a welfare increase. The reason is that two investor-paid CRAs each rate all issues, and hence each dollar allocated to credit assessment only yields half its potential value because half of the produced ratings are redundant.

5.2 Requiring investor-produced ratings from all investors

In section 4.2 I showed that competition among investors allows issuers to put pressure on funding shares as to lower investor screening incentives, irrespective of the presence of issuer-paid CRAs. Important here was that screening was delegated to the party with the largest stake. However, if regulators would require each investor
to conduct credit assessment before funding an issue and ban issuer-paid CRAs, things change. In that case, lowering funding shares is expensive for the issuer, because it will have to compensate each investor for (fixed) screening costs. As a result, if private benefits are relatively small, it is optimal to use $\phi_b = 1$, that is, placing the loan privately with one investor and shunning public debt markets. If on the other hand private benefits are large, incentives are to minimize funding shares. In other words, when distortions due to issuer private benefits are largest, investor-produced ratings offer least solace.

**Lemma 8.** If in a setting with investor-produced ratings and $N = 0$ each investor with $\phi_b > 0$ needs to conduct a credit assessment, we have in equilibrium that $\phi_b = 1$ if $\beta < \frac{1}{2}$, $\phi_b = \frac{1}{W}$ if $\beta > \frac{1}{2}$ and can take on any value on the unit interval when $\beta = \frac{1}{2}$.

**Proof.** See Appendix.

### 6 Other robustness tests and extensions

In this section, I explore robustness and extensions to the base case model. In particular, I show that the results derived above hold true when investor rather than issuer private benefits are the source of rating inflation in the model. Moreover, I show how similar selection mechanisms similar to those that allow issuer-paid CRAs to free-ride investor-paid ratings can explain why rating inflation in the structured product market was much more prominent than in the corporate bond market.

#### 6.1 Private benefits of banks

In this robustness test, I show that private benefits of banks have in the base case a similar effect as private benefits for issuers. Moreover, I show that with private benefits of banks instead of private benefits for issuers, investor-produced ratings or a Franken rule will be even less helpful in overcoming rating inflation. Private benefits of banks arise from convex compensation schemes such as option and bonus plans, empire building concerns, but also the possibility to forward losses to debtholders or being bailed out under an implicit government put. The result for the base case presented here is similar to the one by Opp et al. (2013), except for the fact that

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23 Regulators also could put a floor to funding funding shares, but this method is less imposing and can reach the same goal if $\beta$ is sufficiently small.
regulatory importance here plays no explicit role. As is shown below, the presence of private benefits to bank managers or shareholders is sufficient to induce rating inflation.

The base case setting with bank private benefits is modeled the same as that with issuer private benefits, but now issuers have no private benefit of operating (i.e. \( \beta = 0 \)) and banks have (measured by \( \beta_B > 0 \)). The private benefits scale linearly with funding share \( \phi_b \). As was the case with \( \beta \), \( \beta_B \) is assumed to be either negligible in view of the economy at large or an unmodeled negative externality onto other players in this economy. As is shown by the lemma below, the private benefit for banks has two effects. First, banks will lower interest rates as competition dictates that banks have zero expected utility in equilibrium and the private benefits shift the expected utility of banks upwards. As a result, the pledgeability constraint is effectively relaxed, allowing for more extreme forms of rating inflation (i.e. lower effort) in equilibrium (this gives rise to the first occurrence of \( \beta_B \) in equation (27)). Second, as the private benefit is conditional on funding the issue, the preference of the bank for high accuracy is lowered and rating inflation will only be partially reflected in higher interest rates. As a result, issuers will prefer high over accurate ratings as before (this gives rise to \( \beta_B \) showing up in the coefficient on \( e^* \) in equation (27)).

**Lemma 9.** Given \( \beta_B > 0 \) and an equilibrium effort level \( e^* \) from CRAs, banks charge an equilibrium interest rate of

\[
\iota^* = \min\left(\frac{R - 1}{\theta}, \frac{1 - \theta - \beta_B - (1 - \theta)\theta e^*}{\theta}\right).
\]

(27)

**Proof.** See Appendix.

One can see from Lemma 9 that most of the suggested solutions are unaffected by the exact source of rating inflation; what matters is that rating inflation is not fully endogenized by setting higher interest rates. On top of this, investor-produced ratings and the Franken rule without pass-through are also affected by the exact source of rating inflation. As before, when banks conduct ratings, they can condition their rating effort on the interest rate quoted. When banks have private benefits of operating, their expected utility losses due to rating inflation are partially offset by their private benefits. Hence, even when rating production technology equals that owned by CRAs (i.e. \( C_B = C \)) and even with unit funding shares, banks will inflate ratings.
Lemma 10. Given $\beta_B > 0$ an interest rate quote $\iota_b$ and a funding share $\phi_b$, it is optimal for a bank $b$ to exert effort

$$e_b = \min \left( \frac{\phi_b (1 - \beta_B) (1 - \theta)}{2C_B}, \frac{1 - \theta R - \beta_B}{(1 - \theta)(1 - \beta_B)}, 0 \right).$$

(28)

Proof. See Appendix.

As one can see, the shortfall of rating effort is even larger than in the base case with investor-produced ratings. Hence, in the presence of investor private benefits of operating, rating inflation cannot be avoided.

6.2 Noisy self-knowledge and different markets

One can wonder why issuer-paid credit ratings showed such low accuracy in structured product markets, but performed reasonably well in other markets such as the corporate credit market. Opp et al. (2013) even argue that any model that wants to explain rating inflation should be able to explain such difference. The mechanisms underlying the analysis on heterogeneous competition among investor-paid and issuer paid CRAs provide additional insights to this question. For this analysis, I extend the model by giving issuers noisy knowledge about their own quality. More concretely, a low quality issuer is aware about being of low quality with probability $\xi$.

Suppose that corporates have a reasonably good idea about their own quality (i.e. corporates have a high $\xi$), while managers of structured products are largely unaware about the real quality of their mortgage pool (i.e. structured products have a low $\xi$). Moreover, let us assume that private benefits of operating are identical across the two markets and not too large. Issuers that are aware of their own low quality in either market will be reluctant to spend money on rating fees if their businesses cannot generate substantial revenues in the future. This mass of informed low quality issuers is much larger (in relative terms) for corporates than for structured products. As a result, the expected ex-ante benefit of rating inflation is higher for structured products. Moreover, with relatively low effort, corporate ratings can reach high accuracy as many low quality issuers will not bother to solicit a rating. As fees are proportional to production costs, rating fees on corporates can be much lower than on structured products, as is observed empirically.

Alternatively, one could consider the situation where there is some degree of noisy self knowledge of issuers that is similar in both market segments (i.e. $\xi$ is
equal for both market segments). However, now private benefits of operating (i.e. \( \beta \)) are much higher for structured products compared to corporates. This is not an unreasonable premise in view of extremely generous short-term bonus plans for investment bankers putting these structured products into the market. The result is that even the structured product managers that are aware of their low quality apply for a rating and push for rating inflation as the private benefit of getting a high rating justifies the fees despite the low probability of actually getting this private benefit. Managers that are aware of their low quality in the corporate sector on the other hand, have little to gain from rating inflation as the potential gain of private benefits is insufficiently large to justify the rating fees. Once again, with relatively low effort, corporate ratings can reach high accuracy as many low quality issuers will not bother to issue. In contrast, structured product issuers will engage in maximum rating shopping and put pressure on CRAs to cater to their demands. Hence, rating inflation in the structured product market is much more prevalent than in the corporate market.

7 Conclusion

In this paper, I have explored the potential of different alternatives to issuer-paid CRAs to improve on the status quo with respect to rating accuracy and social welfare. Systems of investor-paid ratings, investor-produced ratings, and a Franken Rule all may have some limited potential to improve social welfare. However, for any of those to be effective, issuer-paid CRAs will need to be banned or very tightly regulated. These business models are unlikely to take hold by themselves as if there were an invisible hand leading all agents to socially sub-optimal outcomes.

While the model goes a long way in explaining why the issuer-paid CRAs have become and still are the dominant players in this market, some concessions to reality have been made. These provide avenues for further research. For example, one could verify how results change if exerted effort is not perfectly verifiable. In this context, it would be interesting to compare issuer-paid CRAs to investor-paid CRAs as issuer-paid CRAs would ex-post be more transparent by definition. Another way of extending the model is to increase granularity of quality and ratings. This could on the one hand reduce the severeness of ratings inflation. On the other hand however, increased granularity could also facilitate rating inflation as it is harder to detect it ex-post and therefore more likely to go unpunished.

The results in this paper suggest alternative avenues to explore in terms of ad-
dressing incentive-based problems with CRAs. The main drivers behind ratings inflation in this paper are the private benefits for issuers and investors. Measures that lower these private benefits, for example by reducing regulatory importance of ratings or by limiting bonus-based compensation schemes fall in this category.

Finally, one should note that the effort cost coefficient typically ends up in the expression for optimal effort and that social welfare is decreasing in this coefficient. This is true irrespective of the market structure. Hence, measures that could reduce effort costs such as standardized reporting requirements and technological and academic advances would help in increasing social welfare. Those could even help to get rid of ratings inflation because even with issuer private benefits a boundary solution of $e_c = 1$ might arise, which must in that case coincide with the first best outcome.
References


Kisgen, D. J. and Strahan, P. E.: 2010, Do regulations based on credit ratings affect a firm’s cost of capital?


Appendices

A Proofs

A.1 Proof of Proposition 1

Total welfare $W$ generated in this economy is given by

$$W = \theta(R - 1) - (1 - \theta)(1 - e_c) - Ce_c^2. \tag{29}$$

Equation (29) is a quadratic function that can be maximized by imposing a first order condition. As $C > 0$, a second order condition for a maximum is always satisfied. Taking the FOC of (29), setting it to zero and solving it towards $e_c$ yields

$$e_c = \frac{1 - \theta}{2C}, \tag{30}$$

which is always strictly positive. However, $e_c$ is also a probability and hence needs to lie in the unit interval: $e_c \in [0, 1]$. This results in

$$e_c = \min\left(\frac{1 - \theta}{2C}, 1\right). \tag{31}$$

Substituting (31) into (29) gives the welfare level corresponding to $e_c$

$$W = \min\left(\frac{(1 - \theta)^2}{4C} - (1 - \theta R), \theta(R - 1) - C\right). \tag{32}$$

It is trivial to see that it is only socially optimal to do any investing and produce any ratings if $W \geq 0$. This is exactly the case when

$$\frac{(1 - \theta)^2}{4C} \geq (1 - \theta R). \tag{33}$$

A.2 Proof of Lemma 1

All banks are identical, have constant returns to scale, no reputation considerations and unlimited capacity. Moreover, issuers have uniform preferences. Therefore, if there were any strategy with which a given bank could earn strictly positive profits, it would be optimal for one of the other banks to play the same strategy but quote marginally lower interest rates, hence lowering profits until zero profit is reached. As
the only losses banks can incur are default losses, expected revenues from interest rates on high quality projects must equate expected default losses on low quality projects. Hence we must have

\[ \tilde{\iota}_{b,c} = \frac{(1 - \theta)(1 - \tilde{e}_c)}{\theta}. \]  

(34)

A.3 Proof of Lemma 2

Projects of quality \( G \) generate a surplus of \( (R - 1) \) each. In order for interest rate quotes to be pledgable, we need to have that \( \tilde{i} \leq (R - 1) \). Substituting in equation (34), we have

\[ \theta(R - 1) \geq \theta \tilde{i} = (1 - \theta)(1 - \tilde{e}_c). \]  

(35)

Rewriting to \( \tilde{e}_c \) yields

\[ \tilde{e}_c \geq \frac{1 - \theta R}{1 - \theta}. \]  

(36)

A.4 Proof of Lemma 3

Let us assume a trigger level \( \bar{e} \) by all banks for their grim-trigger strategy. As CRAs optimize total value, it is only worthwhile for them to exert at least effort level \( \bar{e} \) if the value loss of not complying is larger than the value gain from slacking. This is particularly true because contemporaneous profits decline in \( e_c \). At \( \bar{e} \), the value gain from slacking is given by \( C \bar{e}^2 \). The value loss of slacking is given by the present value of all perpetual future expected cash flows: \( \frac{L - C \bar{e}^2}{r} \). Substituting gives (1).

A.5 Proof of Proposition 2

It is trivial to see that bank strategy 1. is optimal given CRA strategy 4. as slacking CRAs exert effort lower than the lower bound derived in Lemma 2. The optimality of bank strategy 2. follows trivially from Lemma 1. Given the expressions in 5. and 6., issuer strategy 3. is optimal by definition. Given bank strategy 1., Lemma 3 tells us that the fees in 5. and 6. are incentive compatible. By definition of incentive compatibility, it is optimal for a CRA \( c \) to stick to \( e^* \) and \( f^* \) as long as it is not blacklisted. Given bank strategy 1., it is optimal to never exert effort anymore for a blacklisted CRA as it cannot expect to gain any future profits while contempo-
raneous profits are decreasing in $e_c$. The expression for optimal fees in 5. follows from the fact that incentive compatibility has to bind due to competition. The optimal effort expression in 5. follows from maximizing the constrained optimization problem for issuers over $e_c$:

$$\max_{e_c} \theta(R - 1 - \nu) - f_c \rightarrow \max_{e_c} -(1 - \theta)(1 - e_c) - f_c,$$

(37)

Subject to

$$e_c \in \left[\frac{1 - \theta R}{1 - \theta}, 1\right]$$

(38)

$$\zeta \geq f_c \geq (1 + r)Ce_c^2.$$

(39)

Either an interior solution materializes or we have that the pledgeability constraint from Lemma 2, the issuer budget constraint or the natural bound upper bound of 1 binds. In 6., the fee level follows from the issuer budget constraint and maximal rent extraction by a monopolist while keeping issuer utility non-negative. The effort equation in point 6. follows from the constrained maximization of surplus that can be captured by the CRA.

$$\max_{e_c} f_c - Ce_c^2 \rightarrow \max_{e_c} \min(\zeta, (1 - \theta)(1 - \beta)(1 - e^*) + \theta(R - 1)) - Ce_c^2,$$

(40)

Subject to

$$e_c \in \left[\frac{1 - \theta R}{1 - \theta}, 1\right]$$

(41)

$$\zeta \geq f_c \geq (1 + r)Ce_c^2.$$

(42)

Again, we have an interior solution or that one of the same constraints as in 5. binds.

A.6 Proof of Lemma 4

As $m$ can only be disciplined by reputation, Lemma 3 applies and the fee charged to subscribing banks is bounded from below by $f_m \geq (1 + r)Ce_m^2$ as in Proposition
Because investors can only charge a transaction fee when they fund an issue, transaction fees are only paid conditional on high ratings. Hence, the rating fees \( f_m \) on every issue need to be recovered by transaction fees on a fraction \( \theta + (1 - \theta)(1 - e_m) \leq 1 \) of all issues. The lower bound then follows naturally.

A.7 Proof of Lemma 5

Let us assume \( N > 1 \) and all issuers apply for an issuer-paid rating in equilibrium. As a result, CRAs compete. Because of competition, the maximum contemporaneous profit CRAs could claim in any stage game is \( f^*_c - C(e^*_c)^2 \). The present value of this stream of profits in all future stage games is given by \( \frac{f^*_c - C(e^*_c)^2}{r} \). For any effort level in the presence of investor-paid CRAs to be committable, incentive compatibility needs to hold and hence,

\[
Ce^*_c \leq \frac{f^*_c - C(e^*_c)^2}{r}.
\]  

(43)

Because the regular IC condition binds in the absence of investor-paid CRAs, \( f^*_c \) is determined as such. Hence, the maximum effort level at which (43) still holds is \( e_c = e^*_c \).

When an investor-paid CRA is present, not all issuers may apply for an issuer-paid rating. This can either be because issue-paid CRAs can get no market share in equilibrium, in which case \( e_c \) is optimally set to zero. Alternatively, the issuers with \( s_m = B \) find it too costly to apply for an issuer-paid rating. Hence, contemporaneously only a fraction \( \theta + (1 - \theta)(1 - e_m) \) of the total market applies for issuer-paid ratings. Therefore, the maximum that could be lost in the future is a market that is \( \frac{1}{\theta + (1 - \theta)(1 - e_m)} \) times as large.

A.8 Proof of Proposition 3

In order for issuer-paid CRAs to deter entry to \( m \) from having market share, one of the following conditions need to be met:

1. Issuers that received a low rating from \( m \) can be discouraged to still apply to an issuer-paid CRA

2. Issuer-paid CRAs can commit to match \( e_m \) at lower fees

3. Issuer-paid ratings lead to fees that are so low that they justify the higher interest rate levels for issuers that received a high investor-paid rating

37
If condition 1. is met, issuer-paid CRAs could at a lower fee offer a rating that yields the same interest rate. If with any committable combination \( \{ e_c, f_c \} \) such a separating strategy can be played, it is optimal for an issuer-paid CRA to do so. In that case, it is optimal for all issuers that received a high rating from \( m \) to apply for an issuer-paid rating. As a consequence, it is optimal for all banks to not purchase any investor-paid ratings. The maximum possible discouraging takes place when expected private benefits are minimized, i.e. when committable effort is maximized and when fees are maximized to the level that those still attract issuers that have received a high rating from \( m \), i.e. that fees are marginally lower than \( f_h \).

If condition 2. is met, i.e. \( m \) were to exert effort that is committable by issuer-paid CRAs, then each of those could exert effort \( e_c = e_m \) and set \( f_c = C e_c^2 \), while \( m \), because it moves first, would have to set \( f_m = (1 + r)C e_m^2 \) every period in order to ensure incentive compatibility in the long run. But then, it is optimal for issuers to use ratings by issuer-paid CRAs. As a consequence, it would be optimal for banks never to purchase ratings from \( m \).

It is optimal for issuers to choose for issuer-paid ratings if the sum of rating fees and expected interest payments are lower than those resulting from getting funding from banks that get ratings from \( m \). In the latter case, (passed on) rating fees amount to \( f_h = \frac{f_m}{\theta + (1 - \theta)(1 - e_m)} = \frac{(1 + r)C e_m^2}{\theta + (1 - \theta)(1 - e_m)} \) and expected interest payments for issuers that got a high rating from \( m \) are given by:

\[
E(t_m) = P(q = G|e_m, s_m = G)t_m, \tag{44}
\]

where

\[
t_m = \frac{(1 - \theta)(1 - e_m)}{\theta} \tag{45}
\]

as before and

\[
P(q = G|e_m, s_m = G) = \frac{\theta}{\theta + (1 - \theta)(1 - e_m)} \tag{46}
\]

by Bayes’ Rule. Similarly, we have that

\[
E(t_c) = P(q = G|e_c, e_m = G, s_c = G, s_m = G)t_c, \tag{47}
\]
where

\[ \tau_c = \frac{(1 - \theta)(1 - e_c)}{\theta} \]  \hspace{1cm} (48)

as before and

\[ P(q = G | e_c, e_m, s_c = G, s_m = G) = P(q = G | e_m, s_m = G). \]  \hspace{1cm} (49)

The minimum fee that issuer-paid CRAs can afford in a strategy off the equilibrium path of a subgame perfect equilibrium equals their production cost. Therefore, for a given \( e_m \) and when conditions 1. and 2. are not satisfied, there is a committable \( e_c \) that detemrs entry to \( m \) when

\[ E(\tau_c) + f_c \leq E(\tau_m) + f_h \]  \hspace{1cm} (50)

\[ P(q = G | e_m, s_m = G) \frac{1 - \theta}{\theta} (e_m - e_c) - \frac{(1 + r)Ce_m^2}{\theta + (1 - \theta)(1 - e_m)} + Ce_c^2 \leq 0 \]  \hspace{1cm} (51)

\[ \frac{1 - \theta}{\theta + (1 - \theta)(1 - e_m)}(e_m - e_c) - \frac{(1 + r)Ce_m^2}{\theta + (1 - \theta)(1 - e_m)} + Ce_c^2 \leq 0. \]  \hspace{1cm} (52)

In condition 3., \( \bar{e}_c \) minimizes the LHS of the last expression over the support of \( e_c \). If such a value \( \bar{e}_c \) exists, issuer-paid CRAs can play it and \( m \) will have no market share.

A.9 Proof of Lemma 6

It is sufficient to show that there exists a strategy for issuer-paid CRA \( c \) that can drive investor-paid CRA \( m \) out of the market. This strategy does not need to be optimal for \( c \). If, whenever \( m \) is in the market, \( c \) matches \( m \) in effort (i.e. \( e_c = e_m \)) at a marginally lower fee (i.e. \( f_c < f_m \)), it is strictly optimal for all issuers to opt for an issuer-paid rating. When \( m \) is not present, \( c \) can play the same equilibrium strategy as in the base case. The only thing to show is that this strategy is committable for \( c \). Note that \( m \) also needs to quote an incentive compatible fee. If \( m \)'s IC constraint does not bind, \( c \) can quote a fee \( f_c \) that makes \( c \)'s IC bind and hence offer better value to the issuers. If \( m \)'s IC binds, \( m \)'s present value of future expected cash flow is a lower bound on \( c \)'s present value of future expected cash flow as \( c \) is a monopolist. Hence, \( c \) most likely has room to lower contemporaneous fees without violating
incentive compatibility. Even when the issuers’ budget constraint as well as \( m \)’s IC binds, \( c \) can commit to match effort at a strictly lower fee as the investor-paid CRA cannot (indirectly, through bank transaction fees) extract fees from issuers with a low rating. To compensate, transaction fees for investor-paid ratings need to be strictly higher than fees for issuer-paid ratings (given identical effort levels).

A.10 Proof of Proposition 4

Optimality of strategies 1. and 4. follows from Proposition 2, as do the equations in 6. The proof of the equations in 7. again follow the proof from Proposition 2 with the constraint that issuers should be granted at least the share of the surplus they could have gotten from opting for investor-produced ratings. Strategy 3. trivially follows from Lemma 1. Given the expressions in 6., 7. and 8., issuer strategy 4. is optimal by definition.

Because banks only have a short horizon, they cannot commit to any effort level ex-ante. Hence, conditional on the quoted interest rate and a funding fraction \( \phi_b \), and being selected by an issuer, a given bank \( b \) maximizes

\[
\max_{e_b \in \left[ \frac{1-\theta R}{1-\theta} \right]} - \phi_b (1 - \theta)(1 - e_b) - C_B e_b^2. \tag{53}
\]

If the solution to (53) is an interior solution, optimal effort is derived by imposing a FOC and solving towards \( e_b \). Hence, we have

\[
e_b^* = \frac{(1 - \theta)\phi_b}{2C_B}. \tag{54}
\]

Lemma 2 dictates that \( e_b^* \) should satisfy pleadgeability. Setting (54) equal to \( \frac{1-\theta R}{1-\theta} \) and solving for \( \phi_b \) yields the lower-bound \( \frac{2C_B(1-\theta R)}{(1-\theta)^2} \) for which it is still optimal for banks to trust a rating produced by \( b \). Hence optimality of strategy 2. is proven. Naturally, competition drives down to production costs. Ex-ante, in their selection phase, issuers optimize their own utility over \( b \) based on the solicited \( \phi_b \)s. The market share maximizing (and hence optimal) funding share \( \phi_b \) is then given by

\[
\phi_b^* = \arg \max_{\phi_b} - (1 - \beta)(1 - \theta)(1 - e_b^*(\phi_b)) - C_B(e_b^*(\phi_b))^2. \tag{55}
\]
Substituting (54), imposing a FOC with respect to $\phi_b$ and solving, yields

$$\phi_b^* = (1 - \beta).$$

(56)

Combination with constraints on rating budget and the support for $\phi_b$ being restricted to the unit interval yields 8.

A.11 Proof of Corollary 1

Issuers select their own rater, and hence, maximize their own expected utility over the two types of raters. If we are in the parameter range that for both types optimal effort yields an interior solution, we have that $\phi_b = (1 - \beta)$ by Proposition 4. Putting in $e^*_b$ and $e^*_c$ from Proposition 4, we have that CRAs are only chosen when

$$C(1 + r) \leq C_B.$$  

(57)

Because $\phi_b$ can be chosen freely, and because issuers effectively optimize over effort (by virtue of competition), the only material difference is the coefficient on the quadratic term in the issuer utility function. As this coefficient is always negative, it is trivial to see that CRAs are preferred when (the absolute value of) the coefficient on the quadratic term is smaller than those for banks. The lemma is only in one direction (i.e. if and not iff) because of the unit interval constraint imposed on $\phi_b$.

A.12 Proof of Lemma 7

The CRA $c$ needs to decide ex-ante on $\phi_c$. Because banks compete and the CRA needs to be price taker on the loan, the expected return on the co-investment $\phi_c$ equals zero. Moreover, with $\phi_c = 0$ $c$ can strictly optimize utility. Moreover, if anything, $\phi_c > 0$ will have an upward effect on effort levels because it gives rise to a positive linear coefficient on $e_c$ (conditional on the interest rate), while effort is costly. Hence, $\phi_c > 0$ cannot strictly increase returns while it can potentially increase effort costs. As a result, $\phi_c = 0$ is optimal.
A.13 Proof of proposition 5

Suppose the bank $b$ with the largest funding fraction $\phi_b$ is responsible for selecting a rater and can pass through (a part of) the rating fee to issuers. If selected, this bank can condition on quoted interest rate and quoted transaction fee. Moreover, due to short horizon, it has no reputational concerns that can affect current decision making. Hence, if CRAs compete, $b$ optimizes

$$
\max_{e_c \in \left[\frac{1-\theta R}{1-\theta}, 1\right]} - \phi_b(1-\theta)(1-e_c) - C(1+r)e_c^2. \quad (59)
$$

The solution follows from solving a FOC and imposing a boundary condition:

$$
e_c^* = \max \left( \frac{1-\theta R}{1-\theta}, \min \left( 1, \frac{\phi_b(1-\theta)}{2C(1+r)}, \sqrt{\frac{\zeta}{C(1+r)}} \right) \right). \quad (60)
$$

As in Proposition 4 issuers can optimize over $\phi_b$ ex-ante by setting it equal to $(1-\beta)$. As a result, $e_c^*$ under the Franken rule equals $e_c^*$ in the base case. Of course, banks would endogenize this behavior by issuers and set transaction fees and interest rates accordingly such that those respectively match rating fees and interest rates in the base case. This way, banks can commit ex-ante to do the issuers’ bidding.

A.14 Proof of proposition 6

Suppose the bank $b$ with the largest funding fraction $\phi_b$ is responsible for selecting a rater, while the issuer has to pay for the rating fee. Because, the CRA selection process can be conditioned on quoted interest rates, there is only upside for $b$ from higher effort and hence $b$ will choose CRAs as to maximize effort, for example by always choosing the CRA that exerted highest effort last period. Competition among CRAs then pushes $e_c$ up to its maximum feasible level in equilibrium. Hence, by definition, one of the upper bounds (bound of unity or the one implied by the budget constraint) on $e_c$ binds. If the first best effort level was an interior solution, then $e_c$ exceeds the first best effort level and hence, socially sub-optimal over-investment in credit assessment takes place.

A.15 Proof of Proposition 7

Let us assume that we have an equilibrium in which each of the two investor-paid CRAs exerts effort $e^*_m$. In order for such an equilibrium to exist, we need at least
the following.

1. Incentive compatible rating fees should not violate the budget constraint resulting from the initial endowment

2. For issuers with a low rating, it would be optimal to apply for funding when slightly less effort had been exerted and a high rating had been issued

3. Given the information issuers have obtained from observing an interest quote corresponding to \( e_m^* \), issuers with two high ratings have no demand for even higher effort

4. Given the information issuers have obtained from observing an interest quote corresponding to \( e_m^* \), issuers with two high ratings have no demand for lower effort

5. \( e_m^* \) should satisfy the pledgeability constraint and bounded from above by 1

Incentive compatibility is required as before since discipline is reputation induced. Because no transaction fees can be collected from issuers with a low rating, and only half of each CRA’s ratings are used, competitive incentive compatible fee levels are at

\[
f_m^* = 2C(1+r) \frac{(e_m^*)^2}{1 - (1 - \theta)e_m^*}.
\]

(61)

In order for condition 1. to hold, this fee cannot exceed \( \zeta \).

For condition 2. to hold, given \( e_m^* \), the equilibrium should not be separating at an effort level slightly below \( e_m^* \). Otherwise, given \( e_m^* \), there is a level \( e_m < e_m^* \) that provides issuers with a high first rating lower fees, equal private benefits and equal quoted interest rates. In that case, exerting \( e_m^* \) is not competitive and cannot be optimal. Equal interest rates can be offered with strictly lower effort because conditional on \( e_m^* \) issuers with a low first rating find the fees prohibitively high to apply for funding, even if private benefits were guaranteed. This is true when the expected utility of a firm with two low ratings turn positive when effort is slightly lowered, which is the case when

\[
\beta (1 - e_m^*) - f_m^*(1 - e_m^*) > 0,
\]

(62)

\[
\beta > f_m^*.
\]

(63)
Conditions 1. and 2. combined yield (23).

For condition 3. to hold, we need to have that the slope of the utility of the issuers with two high ratings is downward sloping in effort beyond effort level $e^*_m$. Because beyond $e^*_m$, an issuer still stands to lose $\beta$, its utility function is unchanged. Differentiating the original issuer utility function with respect to $e_m$ and requiring a strictly negative slope gives (25).

For condition 4. to hold, we need to have that the slope of the utility of the issuers with two high ratings is upward sloping in effort below effort level $e^*_m$. However, it is impossible for an issuer with two high ratings to lose its private benefits at an effort level below $e^*_m$ and hence, its utility function changes to

$$(1 - \theta)e_m - \frac{C(1 + A)e^*_m}{1 - (1 - \theta)e_m}.$$  
(64)

Differentiating with respect to $e_m$ and requiring strict positivity gives (24).

Condition 5. is required due to Lemma 2 and basic probability theory that precludes probabilities exceeding 1.

Finally, when a range of such values exists, the highest positive selection takes place when $e^*_m$ is highest. Hence, pushing for as high effort as possible leaves the other CRA with the low quality issuers and hence, the equilibrium should materialize at the upper end of this range.

A.16 Proof of Lemma 8

As before, banks will optimize (53), yielding (54). However, because each bank now needs to produce ratings and hence pass through these costs as transaction fees (competition ensures transaction fees will equal production costs). Hence, the issuer optimizes

$$\max_{\phi_b} \phi_b - (1 - \beta)(1 - \theta)(1 - e_b) - \phi_b^{-1}C_B e^2_b.$$  
(65)

Substituting (54) and simplifying, we obtain

$$\max_{\phi_b} \phi_b(1 - \theta)^2(2(1 - \beta) - 1)$$

$$\frac{4C_B}{4C_B},$$  
(66)

which is linear in $\phi_b$. Hence, we obtain a corner solution. Which corner solution we obtain depends on the coefficient in front of $\phi_b$. When $\beta < \frac{1}{2}$ this coefficient is
strictly positive, while it is strictly negative when $\beta > \frac{1}{2}$. Therefore, it is optimal to choose the maximal value $\phi_b = 1$ when $\beta < \frac{1}{2}$ and the minimal value $\phi_b = \frac{1}{w}$ when $\beta < \frac{1}{2}$. If $\beta = \frac{1}{2}$, coefficient on $\phi_b$ equals zero and the issuer is indifferent among all possible values of $\phi_b$.

A.17 Proof of Lemma 9

The equilibrium interest rate follows from the pledgeability constraint as before. However, now the pledgeability constraint reads

$$\theta(R - 1) + (\theta + (1 - \theta)(1 - e))\beta_b - (1 - \theta)(1 - e) \geq 0, \Rightarrow \quad (67)$$

$$\theta\tau + (\theta + (1 - \theta)(1 - e))\beta_b - (1 - \theta)(1 - e) \geq 0. \quad (68)$$

Because of competition this constraint binds. Rewriting then gives

$$\tau^* = \min \left( R - 1, \frac{(1 - \theta) - \beta_b - (1 - \beta_b)(1 - \theta)e^*}{\theta} \right). \quad (69)$$

A.18 Proof of Lemma 10

Each individual bank maximizes

$$\max_{e_b} = \phi_b(\theta\tau + (\theta + (1 - \theta)(1 - e))\beta_b - (1 - \theta)(1 - e)) - C_Be_b^2 + \beta_b + f_b. \quad (70)$$

Imposing a first-order condition and solving w.r.t. $e_b$ yields

$$e_b^* = \frac{\phi_b(1 - \beta_b)(1 - \theta)}{2C_B}, \quad (71)$$

if we have an interior solution. If we have a boundary solution than either pledgeability or the natural probability bounds bind. Pledgeability imposes that (70) can never fall below 0 in equilibrium. Setting equation (70) to zero and solving yields the optimal effort level when pledgeability binds

$$e_b = \frac{1 - \theta R - \beta_B}{(1 - \theta)(1 - \beta_B)}. \quad (72)$$

B Notation Summary

- $\beta, \beta_B$: private benefits for issuers and investors respectively
• $\phi$: funding share
• $C$: rating production cost
• $\theta$: fraction of high quality issuers
• $e$: effort
• $r$: CRA discount rate
• $R$: good project payoff
• $G, B$: Project outcomes
• $q$: project quality
• $s$: signal/rating
• $\psi$: leakage fraction
• $f$: rating fee
• $c, j, b, h, t, x, m$ indices for CRAs, issuers, banks, subscribers, stage games, raters and investor-paid CRAs respectively
• $Z$: blacklist
• $Q, N, M, W$: number of issuers, CRAs, investor-paid CRAs and banks respectively
• $F$: Filtration
• $\iota$: interest rate