Rating Agencies in the Face of Regulation: Rating Inflation and Regulatory Arbitrage

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Abstract

This paper develops a rational expectations framework to analyze how rating agencies' incentives are altered when ratings are used for regulatory purposes such as bank capital requirements. Regulations of this kind imply that the AAA label of a security is valuable to a regulated investor independent of the information it provides about the riskiness of the security's underlying cash flows. Our model predicts that a profit maximizing rating agency responds to this regulatory environment by partially inflating the AAA rating class and by reducing information acquisition relative to a (counter-factual) situation without regulation. The equilibrium precision of a rating trades-off two conflicting purposes: (a) the reduction of information asymmetries between issuers and investors, and (b) the support of "regulatory arbitrage". Rating inflation can be related to regulatory changes that increase the sensitivity of regulations to ratings. In our framework, the issuer-pays model does not cause harm to investors. They rationally anticipate the declining quality of AAA securities but are willing to hold these assets given their relative regulatory benefits. Based on our framework we also evaluate the effectiveness of current policy proposals to ban rating contingent fees and reduce rating agencies' market power. Our model predicts that none of these proposals increase the informativeness of ratings.

Keywords: Conflict of Interest, Rating Inflation, Regulatory Arbitrage, Market Discipline, Rating Agencies, Financial Intermediation

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1 Introduction

In public debate, rating inflation is often cited as one of the major catalysts of the financial crisis. Fueled by the emergence of collateralized debt obligations (CDOs), the volume of AAA rated securities skyrocketed during past years. In 2007 almost 60% of all CDOs received the prime rating of AAA (see Fitch (2007)). Coval, Jurek, and Stafford (forthcoming) find that these CDOs have commanded relatively low risk premia despite high systematic risk exposure. These facts together are frequently used as evidence for investor naïveté: Investors got fooled by high ratings as they did not appropriately correct their beliefs for rating inflation. Richardson and White (2009) voice a frequently issued concern that rating inflation is a direct consequence of the "issuer-pays" model, in which issuers "shop around" different rating agencies until they get the desired rating.

In this paper we attempt to challenge this view of rating inflation with an alternative, potentially complementary argument: We develop a theoretical framework in which rating inflation is an optimal response of a profit maximizing rating agency to regulatory distortions while rational investors account for the increased risk in the pool of AAA securities. A key ingredient of our model is that regulatory constraints are a first order concern to economic agents. While rating agencies themselves are not directly regulated, their ratings are widely used for regulatory purposes, in particular for bank capital requirements.[1] Over the last 20 years bank capital requirements (Basel I guidelines (1988) and Basel II guidelines (2004)) have been designed to become increasingly risk sensitive, where risk is measured by the rating label such as AAA. For example, the risk weight of capital that banks have to hold against AAA to $AA-$ securities is 20% vs. 100% against $BBB+$ to $BBB-$ securities (see Basel II guidelines). Since these regulations are of first order relevance for banks' capital management a AAA label is economically valuable (independent of the underlying risk).

Our model highlights the channels through which the rating agency can exploit the regulatory use of ratings. At the core of our model is a **conflict of interest** that extends to much more elaborate model settings than the one we consider. The rating agency's single product (the rating) provides two services to investors: In addition to reducing information asymmetries between issuers and investors (its historical purpose), the rating also determines regulatory cost to institutional investors. While the first source of revenue (providing information) is increasing in the precision of ratings the second source of revenue (regulatory arbitrage) is decreasing in precision. This trade-off results in a lower equilibrium level of information acquisition and a larger mass of AAA rated securities relative to the absence of the regulatory use of ratings. In our setup, investors correctly understand the increased risk in the pool of AAA securities, but are willing to hold these assets at a lower premium because of the relative

[1] In the United States 10 rating agencies are recognized by the SEC, the so called NRSROs. The use of the term NRSRO began in 1975 when the SEC developed rules regarding bank and broker-dealer net capital requirements. Sangiorgi, Sokobin, and Spatt (2009) provide an excellent summary of the regulatory use of ratings.

regulatory benefits they provide. This view is consistent with the observation that many financial institutions acted on both sides of the market: as issuer and investors. Hence, they should be aware of rating standards and quality.[2]

For expositional purposes, our analysis is split into two parts: First, we present a benchmark framework of the issuer-pays model, in the absence of regulation. Second, we consider the introduction of regulatory distortions. The benchmark model captures relevant characteristics of the traditional purpose of rating agencies: Issuers have private information about the default probability of projects, but require external debt financing. They can approach a monopolistic rating agency which possesses an information acquisition technology. This technology allows the rating agency to separate firm types with varying degrees of precision, depending on the information acquisition cost it is willing to incur. Consistent with practice, ratings reflect an assessment of the relative likelihood of default (see Fitch (2007)). In this environment, the sole source of revenue that the rating agency can extract results from reducing information asymmetries. Reputation ensures that the rating agency can effectively commit to acquire information in equilibrium. Reputation acquisition is facilitated by rating multiple issuers at the same time, a benefit of cross-sectional diversification in the spirit of Diamond (1984) and Ramakrishnan and Thakor (1984). Despite its monopoly, rating agencies are subject to **market discipline**.[3] Similar to Petersen and Rajan (1995) we analyze the effect of market power in a reduced form way by letting rating agencies only capture a fraction of the surplus. This reduces the marginal benefit of information acquisition and therefore diminishes ratings precision in equilibrium. This argument is similar to the positive role of patents in encouraging R&D investment.

Consistent with regulations observed in practice, our model incorporates the regulatory use of ratings by giving AAA securities a relative regulatory benefit, independent of the underlying risk. Institutional investors are assumed to be marginal in our analysis, so that these benefits matter for pricing. This creates an additional source of revenue for the rating agency which it can extract via increases in the equilibrium mass of AAA rated securities and hence reductions in the precision of ratings. The model predicts that an increase in the sensitivity of regulations to risk measures based on ratings, (as done in Basel II) has the unintended side-effect of reducing the informativeness of ratings. Likewise, our model predicts that as the cost of providing a certain rating precision increases (e.g. due to increased asset complexity), a larger fraction of profits is generated

[2] The size of the securities on banks' balance sheets cannot be explained by a pure inventory story (see Diamond and Rajan (2009)). Retail investors, who are realistically most susceptible to behavioral biases, held virtually none of these assets. Moreover, investors should have realized that changes in the distribution of ratings must reflect a change in the precision unless the underlying distribution of risks has changed dramatically as well.

[3] We define marked discipline as a decentralized commitment device in the theoretical context of our model. If the rating agency deviated from equilibrium play investors would not trust ratings going forward and thus not providing better financing terms for higher ratings. This in turn commits the issuer not to pay for ratings. Ex ante, this provides positive incentives for the rating agency. We believe that this is meaningful definition of the term "market discipline" (see Hellwig (2005) for a critical discussion of the notion of "market discipline")

through the support of regulatory arbitrage - the rating agency's traditional role of reducing information asymmetries becomes second order. Both of these factors, greater sensitivity of regulations to ratings and higher asset complexity imply that the business model of rating agencies potentially shifted over the past decade. In this sense our theory is directly linked to "economic observables" and generates testable predictions on the effects of changes in the regulatory environment.

Finally, we evaluate the effect of proposed policy changes on the equilibrium behavior of rating agencies. First, we show that restrictions on the fee structure of rating agencies (as planned by Andrew Cuomo, New York State Attorney General) may lead to dilution of already acquired information of the rating agency and contribute to financing of negative NPV projects. The intuition is that if surplus cannot be extracted efficiently due to restrictions on pricing, the rating agency may use an inefficient channel by pooling unworthy projects to NPV positive projects. Secondly, we show that the typical critique of the "issuer-pays" model relies on the assumption that a significant portion of investors is not fully rational. Without regulatory use of ratings rational investors would not care about uninformative ratings, so that firms would not be willing to pay fees for a rating. We also briefly discuss the effects of a platform-pays model, as advocated by Mathis, McAndrews, and Rochet (2008) and Richardson and White (2009).

Our paper is structured as follows. In the following Section 2 we relate our findings to the existing literature. The benchmark model is outlined in Section 3. The feedback effect of current regulations and planned policy prescriptions is presented in Section 4. Section 5 concludes. The Appendix features an overview of the notation as well as longer proofs which are removed from the main text.

2 Literature Review

Our paper shares main questions with recent papers by Skreta and Veldkamp (2009) and Bolton, Freixas, and Shapiro (2009). However, our modeling framework differs in two fundamental ways: a) investors are fully rational and b) ratings are influenced by the regulatory environment.[4] Rationality implies that investors do not take ratings at face value (as in Bolton, Freixas, and Shapiro (2009)) or get fooled by "rating shopping", which refers to the issuer practice of revealing only the highest rating (see Skreta and Veldkamp (2009)). Within a rational expectations framework the issuer-pays model, which allows for the possibility of rating shopping, does not enable the issuer to exploit the investor. Rating shopping and the winner's curse analogy is also studied in the model of Sangiorgi, Sokobin, and Spatt (2009) who develop an equilibrium interpretation for notching. Consistent with our paper, they document the practical importance of ratings for regulations (see also Coval, Jurek, and Stafford (2008)).

[4] The regulatory use of ratings has to be distinguished from the regulation of rating agencies which is the focus of Stolper (2009).

Finally, in contrast to the discussed literature, our model delivers testable predictions with regards to observable changes in regulations.[5]

Earlier theoretical contributions to this field such as Ramakrishnan and Thakor (1984), Lizzeri (1999) or Strausz (2005) have focused on broader issues of certification, rather than specifically on rating agencies.[6] While Strausz (2005) and Ramakrishnan and Thakor (1984) imply that certification providers are essentially natural monopolists, Lizzeri (1999) finds the opposite effect.[7] Recent empirical evidence by Becker and Milbourn (2008) indicates that competition decreases ratings precision, also consistent with predictions of our paper. Doherty, Kartasheva, and Phillips (2009) show that an entrant to the rating agency industry in the insurance market selectively targets firms within a rating pool and provides more information. Within the literature on investment banking Chemmanur and Fulghieri (1994) study the reputational concerns of an underwriter in equity markets. Problems of certification are also discussed within the literature on auditors (see Khalil and Lawarree (1995), Kofman and Lawarree (1993)). We believe that the role of auditors has various distinct features. While auditors check verifiable (ex-post) performance, credit rating agencies collect information ex ante about expected future performance. More broadly, we think that the auditors' role is primarily to mitigate moral hazard (cash flow diversion) rather than adverse selection (as in our paper). Credible auditing seems to be more important for equity holders (whose payoffs depends on earnings) rather than to debt holders as long as sufficient punishments can be imposed upon default (see Gale and Hellwig (1985)). In general, our paper can be related to the effect of information asymmetries in asset markets studied in classical papers like Admati and Pfleiderer (1986), Grossman and Stiglitz (1980) as well as Stiglitz and Weiss (1981).

Two recent empirical papers by Kraft (2008) and Tang (2006) shed more light on the work of rating agencies for corporate issues. Tang (2006) uses Moody's credit rating refinement from 9 to 19 categories in 1982 as a natural experiment. He documents that the associated increase in precision has significant economic implications for firms' credit market access and real outcomes. This is very much consistent with the role of rating agencies in reducing information asymmetries in our benchmark model. Kraft (2008) finds that ratings primarily

[5] It shares with Bond, Goldstein, and Prescott (2008) the notion that a regulator should anticipate mutual feedback effects between regulations that are based on market outcomes and the market outcomes themselves. Yet, they do not consider a rating agency (or any other financial intermediary) as the provider of the signals that are used as an input for a corrective action/regulation. Instead the authors consider equilibrium prices in a decentralized market. In their model, the distortions in signals are thus not the result of changed incentives for a financial intermediary, but a consequence of the fact that forward looking prices reflect expected market-based actions which in turn may diminish the informational content of the equilibrium price.

[6] Farhi, Lerner, and Tirole (2008) explore various strategic dimensions of the certification market such as the publicity given to applications, the coarseness of rating patterns, and the sellers' dynamic certification strategies.

[7] With regards to credit market competition, Petersen and Rajan (1995) provide theoretical and empirical evidence that banks' market power can positively impact the supply of credit, because market power enables them to extract future rents of currently constrained firms.

reflect adjustments to financial statements (by incorporating off-balance sheet items) rather than soft information.

With regards to structured finance products Benmelech and Dlugosz (2008) add another piece of evidence for rating inflation: in their sample roughly 70% of CDO issues were rated *AAA*. Coval, Jurek, and Stafford (2008) provide a comprehensive analysis of the economics behind structured finance. Rajan, Seru, and Vig (2008) point out that statistical models based on past data which do not account for changed incentives of economic agents are subject to a Lucas critique. In their setup, changed lender incentives are caused by the increasing degree of securitized loans. Keys, Mukherjee, Seru, and Vig (2008) document that securitization practices adversely affected the screening incentives of lenders.

3 Benchmark Model

3.1 Setup

Our model features three different groups of players: firms, investors and a rating agency. All players are risk-neutral and seek to maximize the present value of cash flows using a common discount factor δ. Firms and investors only live for one period, whereas the rating agency is a long-run player with an infinite horizon.[8]

Firms have access to a risky production technology which requires an upfront investment of 1 and yields a gross return of $R > 1$ or 0. Investment is publicly observable. Firms are endowed with initial funds, denoted by e, but require further capital to finance their project (i.e. $e < 1$). To obtain additional funds firms seek debt financing.[9] The default probability d – the probability that the gross return is 0 – is private information of the firm and fully characterizes the firm type.[10] Each period, there exists a continuum of firms of mass 1 drawn from a commonly known and stationary type distribution. There are three firm types – good (G), medium (M) and bad (B) – with respective default probabilities d_n and population proportion π_n where $n \in \{G, M, B\}$. It is

[8] This assumption completely eliminates reputational concerns of firms such as in Diamond (1989). However, even in more realistic scenarios, reputation acquisition of the rating agency will be more effective if either the firm has 1) a positive probability of default (effectively increasing the discount factor), 2) a finite horizon or 3) firm defaults are not perfectly correlated such that the precision of signals will benefit from diversification (see Diamond (1984) and Ramakrishnan and Thakor (1984)).

[9] The debt contract is optimal if output of firms is non-verifiable and lenders can commit to liquidate whenever the firm does not repay (see Gale and Hellwig (1985)). The liquidation technology is irrelevant in our setup because output is 0 in the default state.

[10] It would be interesting to consider different capital needs for each firm type (more capital for good firms). Bolton, Freixas, and Shapiro (2009) incorporate such an extension into their model.

assumed that both the good and the medium firms generate positive NPV:[11]

$$NPV_G > NPV_M > 0 > NPV_B \tag{1}$$

where $NPV_n = (1 - d_n)\,\delta R - 1$. Default realizations are assumed to be independent in the cross section. Thus, due to the law of large numbers exactly a fraction d_n of type n firms defaults (provided they get financing).

Investors simply require to break-even in expectation given all publicly available information, including ratings. Ratings may be produced by a monopolistic rating agency. The rating agency incurs a fixed per period cost f for acquiring the necessary information acquisition technology.[12] Using this technology the rating agency can acquire information $\iota \in [0,1]$ which governs the reliability of three possible signal realizations about each firm's type. The cost function for information acquisition per mass of rated firm is increasing and convex:[13]

$$C(\iota) = \frac{c}{2}\iota^2 \tag{2}$$

For ease of exposition, we label the signals AAA, BBB and J. The signal structure can be summarized in the likelihood rating matrix Φ_L where element (n, r) refers to the probability that a firm of type n is rated r:

$$\Phi_L = \begin{bmatrix} & \textbf{AAA} & \textbf{BBB} & \textbf{J} \\ \textbf{G} & 1 & 0 & 0 \\ \textbf{M} & 1-\iota & \iota & 0 \\ \textbf{B} & 0 & 1-\iota & \iota \end{bmatrix} \tag{3}$$

Thus, bad firms obtain the Junk-signal J with probability ι and a BBB signal with probability $1-\iota$. Likewise, medium firms obtain a BBB signal with probability ι and a AAA signal with probability $1-\iota$. Good firms always obtain a AAA signal. Consistent with reality, rating labels do not have a cardinal interpretation.[14]

For its services, the rating agency may charge a fee p_r that depends on the rating outcome r. This differentiation can be interpreted as a reduced-form way to model "consulting" services that rating agencies offer to firms they rate (see Bolton, Freixas, and Shapiro (2009)). We later consider the effect of banning

[11] The modeling environment (types, production technology) is similar to a sequence of papers by Diamond (Diamond (1989) and Diamond (1991b) and Diamond (1991a)).

[12] The fixed fee f is not crucial for most of our results. It provides a simple justification for the monopoly setup.

[13] Any increasing and strictly convex cost function with $\lim_{\iota \to 0} C'(\iota) = 0$ would produce qualitatively the same results.

[14] The fact that firms can only be sorted into a higher (but not a lower) tranche is irrelevant for our qualitative results, but generates a significant gain in tractability. The rating likelihood matrix has to ensure monotonicity: Better types obtain in expectation better signals and higher information acquisition separates types stronger. Our specification ensures this. For reasons of tractability, we also make the assumption that bad types could never obtain a AAA signal (at any level of information acquisition). Thus, the information technology generates some information (if all types were to get rated) even for $\iota = 0$. This justifies the fixed cost f.

rating contingent fees (see Section 4.2). In line with the business model of rating agencies, the rating agency is neither allowed to take a financial stake in the firm nor to offer a menu of contracts with different levels of information acquisition.

The logical order of events within each period is as follows:

1. Rating agency sets fee schedule p and announces ι
2. Firms decide whether to get a rating $\omega_n = 1$ or not $\omega_n = 0$
3. Rating signal r and required fee p_r is revealed to the public[15]
4. Investors decide whether to provide funding to firms
5. Firms pay the fee p_r and invest funds
6. Cash flows are realized at the end of the period and debt is repaid.

In order to simplify the exposition of our analysis in the subsequent section we make the following assumptions on the parameter domain:

Assumption 1 ***Parameter Domain:***
a) $\bar{d} = \pi_G d_G + \pi_M d_M + \pi_B d_B < 1 - (1-e)(\delta R)^{-1}$
b) $e < \delta(1-d_B)\left[R - \bar{N}\right]$
c) $NPV_M > \frac{c}{2}\left(1 - \frac{e}{V_M^{(P)}}\right)^2$
d) $f < (\pi_G + \pi_M)\,\delta\bar{N}\left(\bar{d} - \bar{d}_{GM}\right)$

Part a) of Assumption 1 implies that a pooled financing of all firms would be feasible, i.e. the average default probability $\bar{d}$ of all types is relatively small. Part b) ensures that firm type B would invest in its negative NPV project under a pooling equilibrium debt contract with face value $\bar{N} = \delta^{-1}\frac{1-e}{1-\bar{d}}$.[16] Assumption c) ensures that the net present value of the medium firm project NPV_M is sufficiently large to ensure that the rating agency finds it profitable to rate the medium firms.[17] The last assumption implies that the fixed fee is sufficiently small to allow for a profitable rating agency business.

3.2 Analysis

Formally, we consider an infinite repeated game between one long-run player – the rating agency – and a continuum of short run players (firms and investors). Due to independence of defaults in the cross section the information acquisition level is ex post perfect public information, yet it is assumed to be non-verifiable

[15] In our setup, firms always have at least a weak incentive to disclose the rating. Therefore, we do not separately model the disclosure decision.
[16] Due to the positive signaling effect of coinvestment we only consider equilibrium allocations with full coinvestment e.
[17] If we did not make this (relatively weak) assumption there would exist equilibria under some parameter settings in which only the good firm type gets rated.

by courts.[18] We describe stationary subgame perfect equilibria in pure strategies.[19] In equilibrium, it has to be ensured that each player maximizes the present value of payoffs given the behavior of all other players.

Definition 1 ***Equilibrium:***
1) Investors set face values N_r (financing terms) to break-even for each rating class r given the firms' participation decisions and the fee structure p.
2) Each firm makes a participation decision to maximize present value of its cash flows given the fee structure p, the rating precision ι, and the financing terms for each rating class.
3) The rating agency sets a fee p and a rating precision ι that maximizes its NPV given the firm's participation decision and financing terms required by investors.

The structure of the problem suggests that it is useful to split the analysis into two parts. First, we characterize the optimal decisions of firms and investors (1 and 2) conditional on a fixed level of ι and fees p. Secondly, we study the profit-maximizing behavior of the rating agency (ι, p) who treats the optimizing behavior of firms and investors as a constraint.

Conjecture 1 *The rating agency truthfully reveals the signal r to the public.*

For expositional purposes it is useful to make this conjecture at this point in the paper. We will validate the conjecture in the proof of Proposition 4.

Firm and Investor Problem

Investors set face values N_r to break-even given publicly available information. Thus, for each rating class r the amount of provided funds needs to be equal to the present value of repayment conditional on the rating signal r:

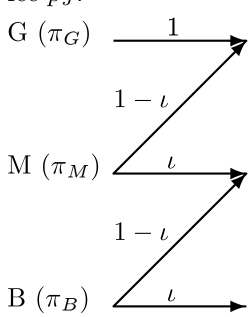
$$1 - e + p_r = (1 - d_r(\iota, \omega))\,\delta N_r \tag{4}$$

The posterior default probability $d_r(\iota, \omega)$ depends on the level of information acquisition by the rating agency ι and the participation decisions of firms $\omega_n \in \{0, 1\}$ where $\omega_n = 1$ if type n gets a rating. The face value of rating class r (N_r) does not only depend on the implied default probability d_r but also on the fee p_r which determines the effective funding needs of firms. Given the truthtelling conjecture and participation decision of firms ω, the posterior default probabilities d_r and the mass of firms in each rating class μ_r can be readily computed (see Figure 1 where $\tilde{\pi}_n$ represents the effective mass of firm

[18] The effect of cross-sectional diversification is largely unexplored in the certification literature. The extreme assumption of independence is solely chosen for analytical convenience and will not affect the qualitative results of our paper. If anything it makes it harder to achieve our results.

[19] Stationarity is without loss of generality because the environment is stationary and long term contracts cannot be implemented with short run firms and investors. (See Fudenberg and Tirole (1991) chapter 5.3.)

types upon participation: $\tilde{\pi}_n = \pi_n \omega_n$). Figure 1 also reveals that a junk-rated firm would not be able to obtain financing from the capital market because it is revealed to be of bad type. Such a firm would still have to pay a "break-up" fee p_J.



$$AAA: \begin{cases} \mu_{AAA}(\iota,\omega) = \tilde{\pi}_G + (1-\iota)\,\tilde{\pi}_M \\ d_{AAA}(\iota,\omega) = \frac{\tilde{\pi}_G}{\mu_{AAA}} d_G + \frac{(1-\iota)\tilde{\pi}_M}{\mu_{AAA}} d_M \end{cases}$$

$$BBB: \begin{cases} \mu_{BBB}(\iota,\omega) = \iota\tilde{\pi}_M + (1-\iota)\,\tilde{\pi}_B \\ d_{BBB}(\iota,\omega) = \frac{\iota\tilde{\pi}_M}{\mu_{BBB}} d_M + \frac{(1-\iota)\tilde{\pi}_B}{\mu_{BBB}} d_B \end{cases}$$

$$J: \begin{cases} \mu_J(\iota,\omega) = \iota\tilde{\pi}_B \\ d_J = d_B \end{cases}$$

Figure 1: Structure of Rating Process

Each firm can decide whether to get rated or not. If a firm asks for a rating its expected payoff conditional on a rating (indicated by superscript (R)) is:

$$\begin{aligned} V_G^{(R)} &= \delta(1-d_G)\left[R - N_{AAA}\right] \\ V_M^{(R)} &= \delta(1-d_M)\left[R - \iota N_{BBB} - (1-\iota)N_{AAA}\right] \\ V_B^{(R)} &= \delta(1-\iota)(1-d_B)(R - N_{BBB}) + \iota(e - p_J) \end{aligned} \tag{5}$$

A firm type n chooses to get rated if it is expected to be better off than its outside option $V_n^{(NR)}$:

Assumption 2 *The outside options for each firm type are:*

$$\begin{aligned} V_G^{(NR)} &= V_G^{(P)} = \delta(1-d_G)\left[R - \bar{N}\right] \\ V_M^{(NR)} &= V_B^{(NR)} = e \end{aligned}$$

The notion that good types have a better outside option than medium and bad types seems to be a realistic assumption: In practice, where firms have access to alternative costly signalling devices such as additional extensive information releases (which may be costly since they potentially reveal firm insider information), firms with high quality projects are likely to be able to reveal their type at cost that do not completely wipe out their positive NPV.[20] We choose the level of this outside option such that good types are at least able to obtain

[20] For simplicity, assume that each firm can release insider information that perfectly reveals its type, but imposes a cost ζ. We assume that $V_G^{(P)} = NPV_G - \zeta > 0$ and $V_n^* - \zeta < 0$ for $n \in \{M, B\}$.

the rents they would under pooled financing of all types.[21]

Rating Agency

Let V_R denote the value function of the rating agency. Using stationarity the rating agency problem can be written as:

$$V_R = \max_{\iota,p} \frac{\sum \mu_r p_r - \sum \pi_n \omega_n C(\iota) - f}{1-\delta} \text{ s.t.} \tag{6}$$

#	**Constraint**
PC_n	$\omega_n = 1_{V_G^{(R)} \geq V_G^{(NR)}}$
IR_r	$N_r(\iota, p, \omega) = \frac{1-e+p_r}{(1-d_r)\delta}$
FC_r	$N_r \leq R$
LC_J	$p_J \leq e$
IC_R	$V_R \geq \sum \mu_r p_r$

Constraints PC_n represent the optimal ex-ante firm participation decisions for each type n. A binding participation constraint of firm type n means that the firm just earns its outside option (see Lemma 2) and participates ($\omega_n = 1$). The constraints IR_r (investor rationality) and face value constraint FC_{BBB} imply that investors break-even for each rating class. The face value constraint on the AAA firms FC_{AAA} is automatically implied by the participation decision of the good firm ($\omega_G = 1$). Since Junk rated firms cannot access the capital market, the break-up fee p_J is naturally limited by their initial liquid funds (LC_J). Constraint IC_R ensures long-run incentive compatibility of the rating agency, i.e. present value of profits is greater than the best one period deviation.[22] We assume that the rating agency is sufficiently patient (and f sufficiently small) such that this constraint does not bind (see Proposition 3). The punishment mechanism is somewhat more subtle than in usual 2-player setups: If the rating agency deviates from equilibrium play, investors would not trust rating going forward. Hence, firms would not obtain better financing terms for a higher rating. This effectively commits the firms not to pay for ratings in the future; market discipline provides the monopolist with incentives.

The relevant constraints of the rating agency problem can be simplified:

[21] This particular outside option may also be motivated by considering an alternative game where firms have the possibility to coordinate after the rating agency has moved in the game. If the good firm type was better off in a coordinated pooling equilibrium outcome than under the terms offered by the rating agency it would have an incentive to join a coordinated pooling equilibrium providing it with a value $V_G^{(P)}$.

[22] The equilibrium concept of subgame perfection requires that the rating agency be better off on the equilibrium path than under its best possible one period deviation followed by the worst possible subgame perfect equilibrium: collecting the fees p without incurring any cost for information acquisition. Since effort is ex post observable the punishment equilibrium generates zero profits for the rating agency.

$$
\begin{array}{llllll}
PC'_G & \omega_G & = 1 \text{ if} & p_{AAA} & \leq & b_1 \\
PC'_M & \omega_M & = 1 \text{ if} & m_2 \cdot p_{AAA} + p_{BBB} & \leq & b_2 \\
PC'_B & \omega_B & = 1 \text{ if} & m_3 \cdot p_{BBB} + p_J & \leq & b_3 \\
FC_{BBB'} & N_{BBB} & \leq R \text{ if} & p_{BBB} & \leq & b_4
\end{array} \tag{7}
$$

where b_i and m_i solely depend on ι, but not on p (see Appendix A for coefficients). Hence, conditional on ι and ω the optimal price schedule p solves a simple linear program with linear constraints. We can thus first solve for the optimum fee structure given ι, then we maximize over ι.[23]

3.3 Equilibrium

In this section, we characterize the (unique) sub-game perfect equilibrium in pure strategies. As will be shown at the end of the section, the rating agency's profit maximizing information acquisition $\bar{\iota}$ and fee schedule p will only induce the good and medium firm to ask for a rating. Thus, the rating agency chooses the four variables ι, p_{AAA}, p_{BBB} and p_J such that $\omega_G = \omega_M = 1$, $\omega_B = 0$ and $N_{BBB} \leq R$. The revenue of the rating agency in the 2-type equilibrium is given by:

$$
\begin{aligned}
\rho &= \mu_{AAA} p_{AAA} + \mu_{BBB} p_{BBB} && (8) \\
&= \pi_G NPV_G + \pi_M NPV_M - \pi_G \left(V_G^R - e\right) - \pi_M \left(V_M^R - e\right) && (9)
\end{aligned}
$$

The second representation shows that the rating agency's revenue is given by the NPV of the project net off the required participation rents for each type (relative to their initial capital e).

Lemma 1 *Constraint PC_G and FC_{BBB} bind in equilibrium:*

$$
\begin{aligned}
p_{AAA}(\iota) &= b_1 = (1-e)\frac{\bar{d} - d_{AAA}(\iota)}{1-\bar{d}} \\
p_{BBB} &= b_4 = \delta R (1 - d_M) - (1 - e) \\
\rho(\iota) &= (\pi_G + \pi_M)\, \delta \bar{N} \left(\bar{d} - \bar{d}_{GM}\right) + \iota \pi_M V_M^{(P)}
\end{aligned}
$$

where $\bar{d}_{GM} = \frac{\pi_G}{\pi_M + \pi_G} d_G + \frac{\pi_M}{\pi_M + \pi_G} d_M$

Proof See Appendix B.1. ■

Lemma 1 implies that the ex-ante participation constraint of the good types always binds, i.e. they are as well off as under their outside option: $N_{AAA} = \bar{N}$. The fee that the rating agency can charge from the AAA rated firms is increasing in its information acquisition level ι. The better the rating agency separates good firms from medium firms the lower the default probability of the AAA tranche, i.e. $d'_{AAA}(\iota) < 0$. This improves the financing terms of the good firms – which are surely rated AAA – relative to their outside option determined by the average default probability $\bar{d}$. Likewise, the face value of the BBB firms

[23] This solution approach is similar to Grossman and Hart (1983).

is set to R. Since all BBB rated firms are revealed to be of medium type, i.e. $d_{BBB} = d_M$, the optimal fee $p_{BBB} = \delta R (1 - d_M) - (1 - e)$ is independent of the information acquisition level. The just described optimal choice of fees implies that the revenue of the rating agency ρ_R is an increasing affine function in information acquisition. The intercept $(\pi_G + \pi_M)\, \delta \bar{N} \left(\bar{d} - \bar{d}_{GM}\right)$ is positive since only profitable firms select to get rated. This selection effect is stronger the greater the difference in the average default probability across all firms $\bar{d}$ relative to the average default probability among the rated group $\bar{d}_{GM}$, i.e. the higher the default probability of the bad type.

Proposition 1 *The equilibrium effort choice of the rating agency is given by:*

$$\bar{\iota} = \min\left(\frac{1}{c}\frac{\pi_M}{\pi_G + \pi_M} V_M^{(P)}, 1 - \frac{e}{V_M^{(P)}}\right)$$

Proof See Appendix B.2 ■

Corollary 2 *The profit maximizing information acquisition level $\bar{\iota}$ is:*
a) decreasing in marginal cost c
b) increasing in size of medium firms in rated pool $\frac{\pi_M}{\pi_G+\pi_M}$

Proof See Appendix 1. ■

Corollary 3 *The participation constraint of the medium firm PC_M binds if:*
1) $c \leq c^*(e) = \frac{\frac{\pi_M}{\pi_G+\pi_M}\left(V_M^{(P)}\right)^2}{V_M^{(P)} - e}$
2) $e \geq e^*(c)$

Proof See Appendix B.3. ■

The intuition for Proposition 1 and Corollaries 2 and 3 is simple. If information acquisition is sufficiently costly $c > c^*(e)$, then the rating agency does not increase the level of information acquisition on the margin because (though it would be possible without violating the medium participation constraint). In this case marginal revenue $\rho'(\iota)$ – which increases in information acquisition – is equalized to marginal cost $(\pi_G + \pi_M)\, C'(\iota)$. The level of information acquisition $\bar{\iota} = \frac{1}{c}\frac{\pi_M}{\pi_G+\pi_M} V_M^{(P)}$ is an inverse function of the slope of marginal cost c. Effort is increasing in the proportion of medium firms among the rated pool $\frac{\pi_M}{\pi_G+\pi_M}$ because higher information acquisition, i.e. better separation, is more valuable for a larger proportion of medium firms in the pool of rated firms. We believe that the set of parameters in which the cost function matters $(c > c^*(e))$ is the empirically relevant region. In the other parameter region information acquisition is bounded above by $\bar{\iota} = 1 - \frac{e}{V_M^{(P)}}$.[24]

[24] Suppose information acquisition is very cheap $(c \leq c^*(e))$, then the rating agency maximizes its profits by maximizing its revenues, i.e. forcing each firm type down to its participation constraint. A marginal increase in the level of information acquisition $\bar{\iota} = 1 - e/V_M^{(P)}$ would violate the medium firm participation constraint. Thus, on the margin the level of information acquisition is independent of cost. Put differently, if the initial equity position of the medium firm is sufficiently high ($e \geq e^*(c)$), the participation constraint PC_M must bind in equilibrium.

Lemma 2 *Bad firm types can be deterred from asking for a rating by setting $p_J = e$.*

Proof See Appendix B.4. ■

Proposition 2 *In the profit-maximizing equilibrium, only the medium and the good types decide to get rated.*

Proof See Appendix B.5. ■

Proposition 2 verifies our previous conjecture that profit maximization of the rating agency will generate an optimal fee structure such that the bad firm type finds it unprofitable to get rated. Intuitively, the one-type equilibrium is dominated because the project of the medium firm type has a sufficiently high NPV (by Assumption 1). The three-type rating equilibrium is dominated because it would feature investment in NPV negative projects on the equilibrium path (and the bad firm would only participate if they did not lose their initial equity in expectation).

Lastly, we need to verify that long-run incentive compatibility IC_R holds. In this case, truth-telling of the rating agency will automatically be optimal. The IC_R compatibility constraint ($V_R(\bar{\iota}) \geq \rho_R(\bar{\iota})$) can be rewritten as:[25]

$$IC(\iota) = \rho(\iota) - (\pi_G + \pi_M)\frac{C(\iota)}{\delta} \geq \frac{f}{\delta} \tag{10}$$

If $IC(\bar{\iota}) \geq \frac{f}{\delta}$, then $\bar{\iota}$ is incentive compatible and the equilibrium of the game. However, note that $\bar{\iota}$ does not maximize the function $IC(\iota)$, i.e. the constraint can be relaxed further.[26]

Proposition 3 ***Incentive Compatibility:***
If $\delta \geq \delta^* = \frac{f + C(\bar{\iota})(\pi_G+\pi_M)}{(\pi_G+\pi_M)\left[2C(\bar{\iota}) + \frac{d-d_{MG}}{1-d}\right]}$ the information acquisition level $\bar{\iota}$ is feasible

Proof See Appendix B.6. ■

We assume that the discount factor is sufficiently large ($\delta > \delta^*$) such that the rating agency's long-run reputation benefit outweighs the temptation to deviate in the short-run.

Proposition 4 *Truthtelling is optimal: The rating agency will provide the market with the signal it has received.*

Proof Consider a truthful equilibrium. First the rating agency has no incentive to classify firms with a AAA signal as BBB or worse (because it would reduce the fee it could extract from good firms). Secondly, it has no incentive to classify firms with a BBB signal as AAA. This would reduce the reported precision of

[25] Note that $\rho(\iota)$ depends on the assumed equilibrium play of the rating agency whereas the cost depends on the actual behavior. On the equilibrium path the distinction between assumed and actual behavior is irrelevant.

[26] This is similar to Opp (2008) and Strausz (2005).

the rating which would be anticipated by investors. However, this could be achieved at lower cost by simply reducing information acquisition. Lastly, it is inefficient to add bad firms to the investment grade pool, because this would cause NPV-negative investment in equilibrium (and reduce surplus that the rating can extract). ■

Proposition 4 also implies that side payments from firms would not increase rating agency profits in equilibrium.

3.4 Market Power

Lastly, we consider the impact of market power. Following Petersen and Rajan (1995) we account for market power of the rating agency $\lambda \in [0,1]$ (and thus the industry structure) in a reduced form way.[27] The parameter λ formally represents the fraction of surplus that the rating agency can extract from firms (relative to their outside option without a rating). We interpret λ as a tractable measure of competition without formally studying equilibria with a finite number of rating agencies.[28]

Assumption 3 $\lambda > 1 - \frac{1-d_M}{1-d_B} \frac{e}{NPV_M + e}$

Due to the empirically observed concentration of the rating agency industry we assume that market power be bounded below for the remainder of this (sub)section. When $\lambda = 1$, the analysis corresponds to the monopoly problem. For simplicity, we also assume that cost is sufficiently high $c > c^*(e)$ (see Corollary 3) such that the participation constraint of the medium firm does not even bind when $\lambda = 1$. This implies that fees are a fraction λ of the maximum fees generated by the participation and face value constraints (see equation 7):

$$p_{AAA}(\lambda, \iota) = \lambda \cdot (1-e) \frac{\bar{d} - d_{AAA}(\iota)}{1 - \bar{d}} \quad (11)$$

$$p_{BBB}(\lambda) = \lambda \cdot [\delta R (1 - d_M) - (1 - e)] \quad (12)$$

Proposition 5 *Competition reduces equilibrium information acquisition:*

$$\bar{\iota}_\lambda = \bar{\iota}_1 \lambda$$

Proof See Appendix B.7. ■

The rating agency's revenue is now a fraction λ of the revenue it would obtain as a monopolist. Given the quadratic cost function this implies that the optimal level of information acquisition $\bar{\iota}_\lambda$ is also just a fraction of the monopoly setup $\bar{\iota}$. Though this approach to model market power is relatively simple, it yields results that are consistent with previous literature on related topics. The main idea is that competition generally reduces the rents and marginal

[27] It would be interesting to study a real duopoly setup (such as in Bolton, Freixas, and Shapiro (2009)).

[28] Formally, the parameter λ can be interpreted as the probability that the rating agency can make a take-it-or-leave-it offer to a firm conditional on its acquired information.

rents that information producers can extract which lowers their incentive to acquire costly information. The intuition is therefore very much related to the classical economic result that investment in R&D is higher with patent protection guaranteeing monopoly rents.

4 Regulation

4.1 Rating Inflation

After having laid out the benchmark model in the previous section, we now turn to one of the key topics of this paper: The impact of regulation on the rating equilibrium. In the following, we consider the case in which institutional investors obtain "regulatory benefits" from holding AAA rated bonds. With the term "regulatory benefits" we refer to all channels through which the AAA label of a security can be valuable to a regulated investor independent of the information it provides about the riskiness of the security's underlying cash flows. A typical example of such regulatory benefits is that bank capital requirements mandate banks to hold 5 times as much own capital capital against BBB securities relative to AAA securities. Thus, while regulation in itself imposes cost there is a relative benefit of being rated AAA. With the introduction of the Basel II framework (2004), the capital requirements have been designed to be more sensitive to rating classes. Likewise, investment funds are often regulated to invest purely in bonds with ratings above a certain threshold. All of these regulations have in common that they are purely based on the label "AAA" rather than the underlying risk.[29] We will show that this type of regulation is the key ingredient for our main result: rating inflation through regulatory arbitrage.

In the following, we assume that the marginal investor is institutional and receives (relative) benefits b from investing in AAA rated bonds.[30] For ease of interpretation we assume that these benefits are proportional to the invested capital by investors.[31] Thus, the face value of a AAA rated bond is just a fraction $(1-b)$ of the face value of an equivalent bond with the same underlying cash flow risk, but without a AAA label.

$$N_{AAA} = \delta^{-1} \frac{(1 + p_{AAA} - e)}{1 - d_{AAA}} (1 - b) \tag{13}$$

Apart from this change, the problem of the monopolist is unaffected.[32] The revenue of the rating agency can be decomposed as follows:

$$\rho_R^{(b)} = \rho_R^{(0)} + B(\iota, b) \tag{14}$$

[29] This may be optimal if the regulator can only poorly observe risk directly.

[30] We restrict the size of regulatory benefits so that bad firms would not be able to get financing from investors even if they were rated AAA.

[31] The assumption of proportionality is irrelevant for our qualitative results.

[32] The coefficients of the fee constraints (conditional on a level of information acquisition) b_1 and m_2 have to account for the regulatory benefit (see Appendix A).

where:

$$\begin{aligned}\rho_R^{(0)} &= \pi_G NPV_G + \pi_M NPV_M - \pi_G \left(V_G^R - e\right) - \pi_M \left(V_M^R - e\right) \\ B\left(\iota, b\right) &= \frac{b}{1-b}\mu_{AAA}\left(1 - d_{AAA}\right)\delta \bar{N}\end{aligned}$$

This representation shows that the rating agency now maximizes over two sources of revenue: the traditional revenue that is derived from reducing information asymmetries $\rho_R^{(0)}$ and the additional revenue $B\left(\iota, b\right)$ which is driven by regulatory benefits. While the traditional source of revenue **increases** in the level of information acquisition $\rho_R^{(0)\prime}\left(\iota\right) > 0$ (see previous section) the regulatory component increases in the mass of AAA-rated firms μ_{AAA} and thus **decreases** in information acquisition, since $\frac{\partial B}{\partial \iota} = -\frac{b}{1-b}\left(1 - d_M\right)\pi_M < 0$. These two sources of revenue create a **conflict of interest**: The rating agency has to trade-off the benefits from providing investors with more precise information and the regulatory benefits which solely depend on the attached label AAA (less information). This counterbalancing effect of the regulatory surplus implies that information acquisition is reduced in equilibrium:

Proposition 6 *If $c > c^*\left(e\right)$ regulatory benefits b strictly decrease the level of information acquisition $\bar{\iota}$.*

$$\bar{\iota} = \min\left[\frac{1}{c}\frac{\pi_M}{\pi_G + \pi_M}\delta\left(1 - d_M\right)\left(R - \frac{\bar{N}}{1-b}\right), 1 - \frac{e}{V_M^{(P)}}\right]$$

Proof Analogous to Proof of Proposition 1 (see Appendix B.2) ■

Lower information acquisition leads to a larger pool of AAA-rated securities μ_{AAA}, a phenomenon that is commonly referred to as **rating inflation**. It should be noted, that artificial rating inflation always reduces precision (independent of the assumed signal structure).[33]

4.2 Evaluation of Policy Proposals

Constant Pricing

In this section we analyze the impact of banning rating contingent fees as envisaged by the New York State Attorney General Andrew Cuomo. We will show that this restriction on pricing can cause unintended consequences: The rating agency may now have an incentive to dilute its acquired information on the equilibrium path. This effect can occur because constrained pricing does not allow the rating agencies to extract all the surplus.[34]

[33] In our setup, rating inflation and reduced precision are completely determined by the information acquisition level ι. This link results from the the particulare signal structure and makes truthtelling incentive compatible.

[34] The main reason why the certifier in Lizzeri (1999) can extract (effectively) all surplus while charging a constant fee is because the best type has zero mass in his setup.

We assume that the rating agency can extract the largest feasible amount in case the firm cannot pay its obligations upon a negative rating. Given the common fee p the effective fees p^e are then given by:

$$\begin{aligned} p^e_{AAA} &= p \\ p^e_{BBB} &= \min(p, b_4) \\ p^e_J &= \min(p, e) \end{aligned} \tag{15}$$

Now, the rating agency maximizes over the choice of p and ι. The constraints to the maximization problem (see equation 7) can be adjusted by replacing the rating contingent fees p_r with the effective fees p^e_r. In particular, the relevant participation constraints (under truthtelling) become:

$$\begin{array}{llllll} PC'_G & \omega_G & = 1 \text{ if} & p^e_{AAA} & \leq & b_1 \\ PC'_M & \omega_M & = 1 \text{ if} & m_2 \cdot p^e_{AAA} + p^e_{BBB} & \leq & b_2 \\ PC'_B & \omega_B & = 1 \text{ if} & m_3 \cdot p^e_{BBB} + p^e_J & \leq & b_3 \\ FC_{BBB'} & N_{BBB} & \leq R \text{ if} & p^e_{BBB} & \leq & b_4 \end{array} \tag{16}$$

where the coefficients are the same as in the unconstrained problem (see Appendix A). The solution to this constrained problem cannot generate higher profits than the unconstrained problem, but may produce the same results:

Lemma 3 *If the optimal rating contingent satisfies:* $p_{AAA}(\bar{\iota}) \geq p_{BBB}(\bar{\iota})$, *the imposed constraints are irrelevant:*

$$\begin{aligned} p_{AAA}(\bar{\iota}) &= p^e_{AAA}(\bar{\iota}) \\ p_{BBB}(\bar{\iota}) &= p^e_{BBB}(\bar{\iota}) \end{aligned}$$

Proof Consider the following fee $p = p_{AAA}(\bar{\iota})$ and information acquisition level as in the rating contingent setup, i.e. $\iota = \bar{\iota}$. If $p_{AAA}(\bar{\iota}) = p \geq p_{BBB}(\bar{\iota})$ then $p^e_{BBB} = \min(p, b_4) = b_4$. But this is the optimal fee under rating contingent pricing. Therefore, it must produce the same result. Note, that the bad firms still do not have an incentive to participate as they would be worse off than under their outside option e. ■

This "irrelevance" outcome is more likely to obtain if the NPV of the medium type, the fraction of medium firms and the cost of acquiring information c become smaller.

Assumption 4 *Parameters are such that the solution to the unconstrained problem satisfies:*

$$\begin{aligned} p_{BBB}(\bar{\iota}) &> p_{AAA}(\bar{\iota}) \\ m_2 \cdot p_{AAA}(\bar{\iota}) + p_{BBB}(\bar{\iota}) &< b_2 \end{aligned}$$

Assumption 4 implies that the pricing constraint is relevant (see Lemma 3) and that the ex-ante participation constraint does not bind in the rating-contingent equilibrium. The pricing restriction implies:

$$p = p^e_{BBB} = p^e_{AAA} = b_1(\tilde{\iota}) \tag{17}$$

where $\tilde{\iota}$ is the information acquisition with constrained pricing. Assuming truthtelling the rating agency problem can now be simply written as:

$$\begin{aligned} V_R &\propto \max_{\iota} b_1(\iota) - C(\iota) \\ & \text{s.t.} \\ b_1(\iota) &= k + m\frac{1}{\pi_G + \pi_M - \iota\pi_M} \\ p &\leq \frac{b_2}{1+m_2} \end{aligned} \tag{18}$$

where: $k = (1-e)\frac{\bar{d}-d_M}{1-\bar{d}}$ and $m = (1-e)\frac{d_M-d_G}{1-\bar{d}}\pi_G$ are constants (independent of ι). The first-order conditions with respect to ι yield polynomial of degree 3 which can be solved in closed form for $\tilde{\iota}$:[35]

$$0 = \tilde{\iota}^3 - 2\tilde{\iota}^2\frac{\pi_G+\pi_M}{\pi_M} + \tilde{\iota}\left(\frac{\pi_G+\pi_M}{\pi_M}\right)^2 - \frac{m}{\pi_M c} \tag{19}$$

Proposition 7 *At the optimal level of information under truthtelling $\tilde{\iota}$ the rating agency would have an incentive to dilute its precision by adding bad firms to the pool of BBB firms.*

Proof See Appendix B.8. ■

The intuition for this result is simple: The pricing constraints imply that the rating agency cannot extract more from BBB rated firms (even though FC_{BBB} and PC_M do not bind). Since it cannot extract more revenue from the medium firms (by raising the BBB fee), the rating agency chooses the inefficient way of mixing in a fraction of bad firms to the BBB pool, i.e. increasing volume, until the face value constraint for the BBB firms binds. This reduces total surplus, but allows the rating agency to effectively extract more from medium type firms.

Thus, our model suggests that restrictions on the rating agencies' fee schedule, as considered by current policy proposals, may lead to unintended consequences: Since fees are artificially restricted, a rating agency may find it optimal to use alternative (inefficient) ways to extract the most surplus, in particular, it may choose to dilute information to increase volume (which may lead to the execution of negative NPV projects).

The Issuer Pays Model and Rating Shopping

In the media as well as academic literature rating inflation is often explained as a natural outcome of competition and the "Issuer-Pays" model. The argument that competition among rating agencies leads to ratings shopping and thus imprecision is nicely summarized by Richardson and White (2009):

[35] The closed-form expression for $\tilde{\iota}$ does not yield any interesting insights. If the rating agency charges the fee $p = b_1(\tilde{\iota})$ the participation constraint of the medium type firm does not bind.

"Most market participants now agree that the quality of the ratings of collateralized debt obligations, even ex ante, was poor. The question is why, and whether changes in regulation can forestall such behavior in future. The answer lies in the nature of the competition across the NRSROs. In theory, competition among rating agencies should be a good thing, leading to innovation and higher quality research. There is, however, a problem when this competition is put into practice. On the one hand, in the "issuer-pays" model followed by the three major players, competition can lead to inflated ratings because the company chooses who should rate them."

While we agree with the assessment that the rating quality was possibly low, the proposed mechanism is different in our paper. Leaving aside the regulatory perspective of our paper, we show that competition reduces precision of ratings because it limits the rents the rating agency can extract rather than because it gives rise to rating shopping. Our argument is consistent with a body of other earlier papers (Strausz (2005), Ramakrishnan and Thakor (1984), Diamond (1984), Petersen and Rajan (1995)) that imply that certain financial intermediation activities are natural monopolies. As long as investors are not naive and understand the nature of the game rating inflation would be fully anticipated in a rational expectations framework like ours.[36] Without regulatory use, a ratings agency can only generate revenue if it reduces information asymmetries in equilibrium. The "issuer-pays" compensation scheme is not an issue for the investor. In fact, in contrast to the investor-pays model, the issuer-pays scheme may even ensure that bad types self-select not to get rated (see Lemma 2). If the fee is paid by investors, a rating is essentially a free option to the firm and valuable self-selection could be precluded.[37] However, the issuer-pays model should be of concern to the regulator, because the regulator is an indirect stakeholder in the ratings through externalities that are not considered by the rating agency, investors or issuers.[38]

Also various empirical facts seem to contradict the shopping story for rating inflation. Firstly, the idea that smart issuers "fooled" naïve investors is not consistent with the fact a large fraction of financial institutions acted both as investors and issuers simultaneously. This fact is also highlighted by Diamond and Rajan (2009) who argue that the amount of security holdings of financial institutions cannot be explained by a mere inventory story.[39] Secondly, if rating

[36] See Bolton, Freixas, and Shapiro (2009) and Skreta and Veldkamp (2009) for models with naïve agents.

[37] This critique is distinct from the clear free-rider problem among investors that caused the major rating agencies to move away from the investor-pays model in the Seventies. A more subtle and unexplored point is that the "Investor-Pays" scheme with large investors may change outcomes because the equilibrium selection could be affected.

[38] We do not formally model externalities. The conclusion discusses extensions of the model along these lines.

[39] Wrong compensation packages combined with implicit bailout guarantees encouraged excessive risk taking on the investment side of banks. Perversely, this is what the regulator tries to avoid with capital requirements. However, as we argue regulation based on the label "AAA" leads to rating inflation and thus undermines the very goal of regulation.

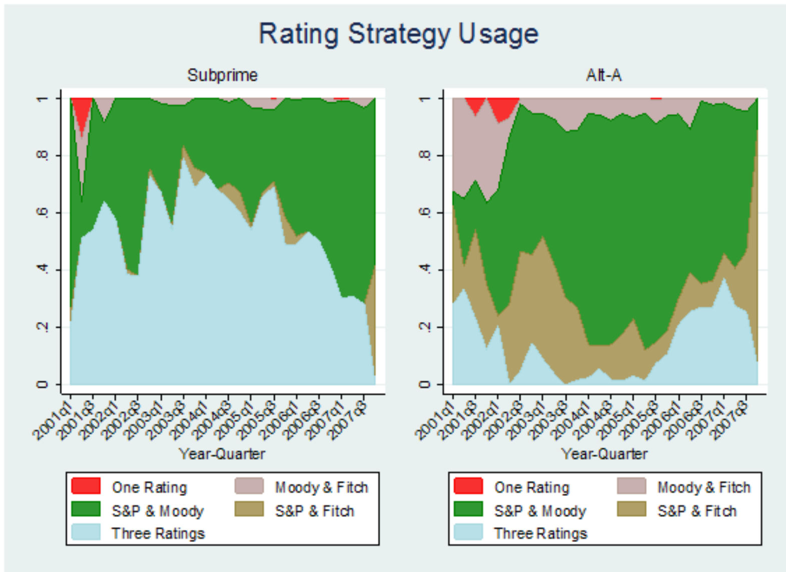


Figure 2: Rating Shopping? Figure from Ashcraft, Goldsmith-Pinkham, and Vickery (2009)

shopping was a phenomenon in equilibrium due to naïve investors one would expect that a large fraction of subprime issues would just be rated by one rating agency, i.e. the one who provides the best rating. Figure 2 (taken from Ashcraft, Goldsmith-Pinkham, and Vickery (2009)) illustrates that virtually any issue was at least rated by 2 out of the big 3 rating agencies which we view as inconsistent with the "shopping" hypothesis.[40]

Richardson and White (2009) as well as Mathis, McAndrews, and Rochet (2008) advocate a platform-pays model to avoid the perceived problems of the "issuer-pays" model and the "investor-pays" model. Instead of the issuer, a mediator (potentially an exchange or the regulator) would choose one rating agency. Though our model does not predict that "rating shopping" is a key problem this scheme could potentially solve another issue. Our model predicts that the regulatory use of ratings gives rise to less precision, i.e. rating inflation. If the platform selection process of the rating agency was not random but based on historical precision the continuation value of the rating agency would be an increasing function of today's level of information acquisition. In an optimal scheme, the positive marginal effect of precision on the continuation value should offset the partial negative effect on the regulatory surplus component (see Section 4.1). This could theoretically remove the rating bias. Practically,

[40] In fact, regulation often mandates that at least 2 ratings are obtained (which supports the main perspective of our paper).

we acknowledge that this approach requires extreme trust in the regulator / mediator. Otherwise the scope for corruption of this scheme may more than offset its positive aspects.

5 Conclusion

This paper presents a simple theoretical framework to analyze the impact of rating based regulation on rating agencies. We find that "sticky regulation" based on rating labels distorts the traditional business model of a rating agency as it implies a dual role for ratings: (a) information provision and (b) determination of regulatory cost for institutional investors. A profit maximizing rating agency responds to this type of regulation by inflating the mass of highly rated securities, which reduces the equilibrium informativeness of ratings.

Our analysis suggests two avenues for future research. First, it would be interesting to test empirically whether and how the regulatory environment is related to rating inflation. To this end, time-series changes and cross-sectional differences in regulatory frameworks of various countries could be potentially exploited. For example, our model predicts that the official recognition of a rating agency by a regulator, which implies that its ratings start to become relevant for regulatory purposes, should induce rating inflation. Another source of exploitable variation could come from cross-country differences in the implementation of Basel II requirements regarding their timing and their stringency. Our theory predicts that accredited rating agencies should respond differently to these regulatory changes than non-accredited rating agencies. Moreover, our paper suggests that rating inflation is particularly prevalent in asset classes that are primarily held by regulated institutional investors.[41]

Secondly, our paper can be interpreted as a first step towards analyzing broader issues of rating based regulation. The rationale of bank capital requirements is to prevent risk shifting by agents at systemically important institutions which face an implicit bail-out guarantee. Ratings have been chosen as risk measures by the regulator due to their historical success in evaluating risks. However, as our analysis shows, the regulatory use of ratings has negative feedback effects on the precision of ratings. This is the classical Lucas-critique. By explicitly modeling the objective function of the regulator, frictions in the banking sector, and the feedback effect on rating agency incentives extensions of our model could provide valuable insights for future policy design.

[41] For these issues, institutional investors are most likely to be marginal, so that prices should reflect regulatory benefits. By assuming a structural model of risk similar to Coval, Jurek, and Stafford (forthcoming), one could even try to impute these benefits for institutional investors.

A Notation

Symbol	**Meaning**
B	Bad type
c	Cost Parameter
$C(\iota)$	Cost function of rating agency
δ	Discount Factor
d_n	Default probability of firm type n
d_r	Default probability of rating class r
$\bar{d}$	Average default probability of all types
$\bar{d}_{GM}$	Average default probability of good and medium types
$\bar{d}_{MB}$	Average default probability of medium and bad types
G	Good type
ι	Information acquisition
e	Equity of firms
λ	Measure of market power
M	Medium type
μ_r	Mass of firms rated r
$\bar{N}$	Face value required by investor in pooling equilibrium
N_r	Face value of rating class r
NPV_n	Net present value of project for firm type n
p	Fee (Price) for rating
π_n	Population proportion of type
ρ	Revenue for rating agency
R	Payoff of firm in good state
ω_n	Participation decision of firm type n
$V_n^{(NR)}$	Value of firm type n in pooling equilibrium
$V_n^{(R)}$	Value of firm type n in (rating) equilibrium
V_R	PV of profits for rating agency

The pricing coefficients are given by:

$$
\begin{aligned}
b_1 &= (1-e)\,\tfrac{\bar{d}-d_{AAA}}{1-\bar{d}} \\
b_2 &= \tfrac{R\delta(1-d_M)-e(1-\iota)}{\iota} - (1-e)\,m_2 - 1 \\
b_3 &= m_3\left[\delta R\,(1-d_{BBB}) - 1 + e\tfrac{d_{BBB}-d_B}{1-d_B}\right] \\
b_4 &= \delta R\,(1-d_{BBB}) - (1-e) \\
m_2 &= \tfrac{1-d_{BBB}}{1-d_{AAA}}\,\tfrac{1-\iota}{\iota} \\
m_3 &= \tfrac{1-d_B}{1-d_{BBB}}\,\tfrac{1-\iota}{\iota}
\end{aligned}
$$

With regulatory benefits, two adjustments have to be made:

$$
\begin{aligned}
b_1 &= \tfrac{1-e}{1-b}\,\tfrac{b\left(1-\bar{d}\right)+\bar{d}-d_{AAA}}{1-\bar{d}} \\
m_2 &= \tfrac{1-d_{BBB}}{1-d_{AAA}}\,\tfrac{1-\iota}{\iota}\,(1-b)
\end{aligned}
$$

B Proofs

B.1 Proof of Lemma 1

The argument of the proof is as follows. First, we show that if the participation constraint of the medium firm PC_M does not bind, then the participation constraint of the good firm PC_G and the face value constraint FC_{BBB} binds.[42] Secondly, we show that a binding PC_M binding implies a binding PC_G and a binding FC_{BBB}.

Part 1) First assume, that the ex-ante participation constraint of the medium firms 2) does not bind, i.e. $V_M^{(R)} = (1-\iota) V_M^{(P)} > e$. In this case, the rating agency maximizes profits by setting the fees as high as possible. Then, the rating agency wants to set the fees as high as possible, so that PC_G and FC_{BBB} bind (see constraints in equation 7). This implies $N_{AAA} = \bar{N}_{GMB}$ and $N_{BBB} = R$. In this case, we have:

$$\begin{aligned} V_G^{(R)} &= V_G^{(P)} \\ V_M^{(R)} &= (1-\iota)\,\delta\,(1-d_M)\left[\left(R-\bar{N}\right)\right] = (1-\iota)\,V_M^{(P)} > e \qquad (20) \end{aligned}$$

Part 2) Now, assume that PC_M binds, i.e. $V_M^R = e$. First, we show that profit-maximization ensures that PC_G binds as well. From equation 8 (using $V_M^{(R)} = e$) it follows that the revenue of the rating agency can be written as:

$$\rho_R = \pi_G NPV_G + \pi_M NPV_M - \pi_G\left(V_G^{(R)} - e\right) \qquad (21)$$

Since revenue is decreasing in $V_G^{(R)}$, profit maximization implies that the rating agency wants to set the fee p_{AAA} such that the participation constraint of the good firm binds:

$$\begin{aligned} V_G^{(R)} &= V_G^{(P)} \qquad (22) \\ V_M^{(R)} &= e \qquad (23) \end{aligned}$$

Now, we show that is is optimal to set p_{BBB} such that FC_{BBB} binds. The value of the medium firm satisfies:

$$\delta\,(1-d_M)\,(1-\iota)\,(R-N_{AAA}) + \delta\,(1-d_M)\,\iota\,(R-N_{BBB}) = e \qquad (24)$$

Solving for ι and using $N_{BBB} = \frac{1-e+p_{BBB}}{\delta(1-d_M)}$ as well as the definition of $V_M^{(P)} = \delta\,(1-d_M)\left(R-\bar{N}_{GMB}\right)$ yields:

$$\iota = \frac{V_M^{(P)} - e}{\delta\,(1-d_M)\left[N_{BBB} - \bar{N}_{GMB}\right]} \qquad (25)$$

[42] Formally, a binding participation constraint means that the firm is indifferent between getting a rating and not getting a rating.

Since information acquisition is costly we want to minimize ι subject to the constraint that PC_G and PC_M bind. From equation 25 it follows that N_{BBB} (i.e. p_{BBB}) has to be set as high as possible, i.e. $N_{BBB} = R$ or equivalently $p_{BBB} = b_4$

Thus, the revenue of the rating agency is given by:

$$\begin{aligned} \rho_R(\iota) &= \mu_{AAA} b_1 + \mu_{BBB} b_4 \\ &= \frac{1-e}{1-\bar{d}} (\pi_G + \pi_M) \left[\bar{d} - \bar{d}_{GM}\right] + \iota \pi_M (1 - d_M) \delta \left(R - \bar{N}\right) \\ &= (\pi_G + \pi_M) \delta \bar{N} \left(\bar{d} - \bar{d}_{GM}\right) + \iota \pi_M V_M^{(P)} \end{aligned} \tag{26}$$

B.2 Proof of Proposition 1

According to Lemma 1, constraints PC_G and FC_{BBB} bind. Let us first assume that constraint PC_M binds. In this case the proof of Lemma 1 (last equation) implies that for $p_{BBB} = b_4$ the optimal level of information acquisition is equal to:

$$\iota = \frac{V_M^{(P)} - e}{b_4 + 1 - e - \bar{N}\delta (1 - d_M)} = 1 - \frac{e}{V_M^{(P)}} \tag{27}$$

Now assume that PC_M does not bind. The revenue of the rating agency is given by:

$$\rho(\iota) = (\pi_G + \pi_M) \delta \bar{N} \left(\bar{d} - \bar{d}_{GM}\right) + \iota \pi_M V_M^{(P)} \tag{28}$$

Revenue is an increasing affine function of ι and cost $(\pi_G + \pi_M) C(\iota)$ is an increasing quadratic function of ι. Therefore, the necessary and sufficient first order condition yields:

$$\rho'(\iota) = (\pi_G + \pi_M) C'(\iota) \tag{29}$$

Rearranging yields:

$$\iota = \frac{1}{c} \frac{\pi_M}{\pi_G + \pi_M} V_M^{(P)} \tag{30}$$

Suppose that this candidate $\iota = \frac{1}{c} \frac{\pi_M}{\pi_G + \pi_M} V_M^{(P)}$ was greater than $1 - \frac{e}{V_M^{(P)}}$, then the participation constraint of the medium firm was violated. Therefore, we can summarize:

$$\bar{\iota} = \min\left(\frac{1}{c} \frac{\pi_M}{\pi_G + \pi_M} V_M^{(P)}, 1 - \frac{e}{V_M^{(P)}}\right) \tag{31}$$

B.3 Proof of Corollary 3

Part 1). simply set $\frac{1}{c} \frac{\pi_M}{\pi_G + \pi_M} V_M^{(P)} = 1 - \frac{e}{V_M^{(P)}}$ and solve for c^*.

Part 2) Recall that: $V_M^{(P)} = (1 - d_M) \delta \left(R - \frac{1-e}{(1-\bar{d})\delta}\right) = (1 - d_M) \left(\delta R - \frac{1}{1-\bar{d}}\right) +$

$\frac{1-d_M}{1-\bar{d}} e$ which we conveniently write as: $b_V + m_V e$ where:

$$b_V = (1-d_M)\left(\delta R - \frac{1}{1-\bar{d}}\right) \quad (32)$$

$$m_V = \frac{1-d_M}{1-\bar{d}} \quad (33)$$

Moreover set $\kappa = \frac{1}{c}\frac{\pi_M}{\pi_G+\pi_M}$. Then: $\frac{1}{c}\frac{\pi_M}{\pi_G+\pi_M} V_M^{(P)} = 1 - \frac{e}{V_M^{(P)}}$ can be written as:

$$\kappa\,(b_V + m_V e) = 1 - \frac{e}{b_V + m_V e} \quad (34)$$

This yields a quadratic expression:

$$e^2 - \left[\frac{m_V - 1}{m_V^2 \kappa} - 2\frac{b_V}{m_V}\right] e - \frac{b_V}{m_V^2 \kappa} + \frac{b_V^2}{m_V^2} = 0 \quad (35)$$

Solving for e^* implies:

$$e^*_{U/L} = q \pm \sqrt{q^2 + \frac{b_V}{m_V^2}\frac{1}{\kappa}(1-\kappa b_V)} \quad (36)$$

where $q = \frac{m_V-1}{2m_V^2\kappa} - \frac{b_V}{m_V} = \frac{m_V(1-2b_V\kappa)-1}{2m_V^2\kappa}$. First, we show that the smaller root $e^*_L = q \pm \sqrt{q^2 + \frac{b_V}{m_V^2}\frac{1}{\kappa}(1-\kappa b_V)}$ is always smaller than 0. Suppose $\kappa b_V > 1$ then $q < \frac{m_V(1-2)-1}{2m_V^2\kappa} = \frac{-m_V-1}{2m_V^2\kappa} < 0$. Subtracting the positive term: $\sqrt{q^2 + \frac{b_V}{m_V^2}\frac{1}{\kappa}(1-\kappa b_V)}$ implies that $e^*_L = q - \sqrt{q^2 + \frac{b_V}{m_V^2}\frac{1}{\kappa}(1-\kappa b_V)} < 0$. Now, suppose that $\kappa b_V < 1$. Then $\frac{b_V}{m_V^2}\frac{1}{\kappa}(1-\kappa b_V) > 0$, so that $\sqrt{q^2 + \frac{b_V}{m_V^2}\frac{1}{\kappa}(1-\kappa b_V)} > |q|$ so that $e^*_L = q - \sqrt{q^2 + \frac{b_V}{m_V^2}\frac{1}{\kappa}(1-\kappa b_V)} < 0$. Thus, we only have to consider the upper root e^*_U. If $\kappa b_V < 1$ then $\sqrt{q^2 + \frac{b_V}{m_V^2}\frac{1}{\kappa}(1-\kappa b_V)} > |q|$ so that: $e^*_U = q + \sqrt{q^2 + \frac{b_V}{m_V^2}\frac{1}{\kappa}(1-\kappa b_V)} > 0$. However, if $\kappa b_V > 1$, then $q < 0$ and $\sqrt{q^2 + \frac{b_V}{m_V^2}\frac{1}{\kappa}(1-\kappa b_V)} < |q|$ so that $e^*_U < 0$. Hence, if $\kappa b_V > 1$, the participation constraint of the medium firm will always bind. If $\kappa b_V < 1$, the critical level for equity is given by: $e^* = e^*_U = q + \sqrt{q^2 + \frac{b_V}{m_V^2}\frac{1}{\kappa}(1-\kappa b_V)}$. If $e < e^*$, the participation constraint of the medium firm will not bind. If $e > e^*$, the participation constraint will bind. The expression for κb_V is:

$$\kappa b_V = \frac{1}{c}\frac{\pi_M}{\pi_G+\pi_M}(1-d_M)\left(\delta R - \frac{1}{1-\bar{d}}\right) \quad (37)$$

This term will always be greater than 1 if $c < c^*(0) = \frac{\pi_M}{\pi_G+\pi_M} V_M^{(P)}$.

B.4 Proof of Lemma 2

As Lemma 1 shows the optimal fee p_{BBB} implies that $N_{BBB} = R$. The firm value of the bad firm setting $p_J = e$ (if it chose to get rated) would be given by:

$$V_B^{(R)} = \delta\,(1-\iota)\,(1-d_B)\,(R - N_{BBB}) + \iota\,(e - p_J) = 0 \tag{38}$$

This is smaller than e. Thus, the bad firm would not find it profitable to get rated.

B.5 Proof of Proposition 2

Lemma 4 *The equilibrium analysis can be restricted to the following participation decisions:*

$$\begin{aligned} \omega_0 &= \begin{bmatrix} 0 & 0 & 0 \end{bmatrix} \\ \omega_1 &= \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \\ \omega_2 &= \begin{bmatrix} 1 & 1 & 0 \end{bmatrix} \\ \omega_3 &= \begin{bmatrix} 1 & 1 & 1 \end{bmatrix} \end{aligned}$$

Proof If good types were better off in a pooling equilibrium ($\omega_G = 0$) and thus preferred not to get rated in equilibrium, then any worse firm type must prefer to pool as well, because their financing terms are effectively subsidized by the good type. Thus, if any firm gets rated in equilibrium the good types must be among the rated firms. More generally, for any two types i and j with $d_i < d_j$ and $\omega_j = 1$ it must be true that $\omega_i = 1$. However, $\omega_i = 1$ does not necessarily imply $\omega_j = 1$. This generates the restricted set of equilibria we consider. ■

The proof proceeds as follows:

1) The $0-$type equilibrium ω_0 is dominated by a two-type rating equilibrium
2) The $1-$type equilibrium ω_1 is dominated by a two-type rating equilibrium
3) The $3-$type equilibrium ω_3 is dominated by a two-type rating equilibrium

Part 1) Suppose, no firm gets rated in equilibrium (ω_0), then profits of the rating agency would be 0. Suppose that the rating agency chooses optimum fees in the 2-firm equilibrium in the limit as effort goes to 0. Revenue is given by (see Proof of proposition 1:

$$\rho^R(\iota) = (\pi_G + \pi_M)\,\delta\bar{N}\left(\bar{d} - \bar{d}_{GM}\right) + \iota\pi_M V_M^{(P)} \tag{39}$$

Thus

$$\lim_{\iota\to 0} \rho^R(\iota) - (\pi_G + \pi_B)\,C(\iota) - f = (\pi_G + \pi_M)\,\delta\bar{N}\left(\bar{d} - \bar{d}_{GM}\right) - f > 0 \tag{40}$$

Therefore, the two player equilibrium dominates the equilibrium in which no firm gets rated

For the rest of the proof assume $f = 0$.

Part 2) In the one-firm equilibrium, it has to be ensured that the medium (and bad firm) do not find it profitable to get rated. In this case, all firms that decided to get rated are revealed to be of good type. The rating agency just has to ensure that effort is just high enough to prevent medium firms to enter.[43] If the medium firm decided to get rated its firm value would be:

$$V_M^{(R)} = (1-\iota)\, V_M^{(P)} \tag{41}$$

Thus, the minimum effort level which prevents participation of medium firms is given by:

$$\iota^* = 1 - \frac{e}{V_M^{(P)}} \tag{42}$$

Since the good firm just obtains its outside option $V_G^{(P)}$ the rating agency makes the following profit:

$$v_{R1} = \pi_G \left[NPV_G - \left(V_G^{(P)} - e \right) - C\left(\iota^*\right) \right] \tag{43}$$

In a 2-firm equilibrium with effort $\iota^* = 1 - \frac{e}{V_M^{(P)}}$ the rating agency makes the following profit:

$$v_{R2} = \pi_G NPV_G + \pi_M NPV_M - \pi_G \left(V_G^R - e \right) - \left(\pi_G + \pi_M \right) C\left(\iota^*\right) \tag{44}$$

The difference is given by:

$$v_{r_2} - v_{r1} = \pi_M \left(NPV_M - C\left(\iota^*\right) \right) > 0 \tag{45}$$

This is positive by assumption 1.

Part 3) Let us consider an equilibrium in which all three firms get rated. In this equilibrium, the ex-ante participation constraint on the bad firm PC_B must bind. Otherwise the rating agency could increase its revenue without violating any other constraint. Thus, the revenue of the rating agency is given by:

$$\rho_{R3} = \pi_G NPV_G + \pi_M NPV_M + (1-\iota_3)\pi_B NPV_B - \pi_G \left(V_G^{R3} - e \right) - \pi_M \left(V_M^{R3} - e \right) \tag{46}$$

This equilibrium is completely characterized by: N_{AAA3}, N_{BBB3}, ι_3 and p_J.[44] Now, suppose the rating agency chose the following actions in a 2 firm "Tilde" equilibrium:

$$\begin{aligned} \tilde{N}_{AAA2} &= N_{AAA3} \\ \tilde{N}_{BBB2} &= N_{BBB3} \\ \tilde{\iota}_2 &= \iota_3 \\ p_{J2} &> p_{J3} \end{aligned}$$

[43] It is assumed that the firm takes the action in the interest of the RA in case of indifference between alternatives.

[44] Note, that it is useful to directly talk about the face values N_{AAA3} and N_{BBB3} instead of the implied fees τ_{AAA3} and τ_{BBB3}.

This choice is certainly feasible (it satisfies the participation constraints of the good and medium types and prohibits participation of the bad types) and generates the following revenue:

$$\rho_{R2} = \pi_G NPV_G + \pi_M NPV_M - \pi_G \left(V_G^{R3} - e\right) - \pi_M \left(V_M^{R3} - e\right) \tag{47}$$

The difference is given:

$$\rho_{R2} - \rho_{R3} = -(1-\iota_3)\pi_B NPV_B > 0 \tag{48}$$

Thus, if the tilde deviation in the 2player equilibrium yields higher revenue (and lower cost) than the best three firm equilibrium, then the best 2 player equilibrium will do so as well. The equilibrium quantities are simply a collection of previous results.

B.6 Proof of Proposition 3

Let $\iota^{**} = \arg\max IC(\iota)$. At the maximum ι^{**} the incentive constraint $IC(\iota^{**})$ takes on the value

$$IC(\iota^{**}) = (\pi_G + \pi_M)\left(\tilde{C}(\iota^{**}) + \frac{\bar{d} - \bar{d}_{MB}}{1-\bar{d}}\right) \geq 0 \tag{49}$$

where $\tilde{C}(\iota^{**})$ is a cost function with cost parameter $\tilde{c} = \frac{c}{\delta}$. Thus, $\iota^{**} = \frac{\delta}{c}\frac{\pi_M}{\pi_G+\pi_M}\delta\left(R - \bar{N}\right)(1-d_M)$. The constraint $IC(\iota^{**}) \geq \frac{f}{\delta}$ is more likely to be satisfied if f is small and δ large. If $f = 0$, the constraint is satisfied for any δ. The optimum level $\bar{\iota}$ is sustainable as long as $IC(\bar{\iota}) \geq \frac{f}{\delta}$. Recalling the expression of $\bar{\iota} = \frac{1}{c}\frac{\pi_M}{\pi_G+\pi_M}\delta\left(R - \bar{N}\right)(1-d_M)$ implies for $IC(\bar{\iota})$

$$IC(\bar{\iota}) = \xi(\bar{\iota}) - (\pi_G + \pi_M)\frac{C(\bar{\iota})}{\delta} = (\pi_G + \pi_M)\left[\left(2 - \frac{1}{\delta}\right)C(\bar{\iota}) + \frac{\bar{d} - \bar{d}_{MG}}{1-\bar{d}}\right] \tag{50}$$

Setting this equal to $\frac{f}{\delta}$ and solving for δ yields the result.

B.7 Proof of Proposition 5

See main text for optimal choice of $\bar{\iota}$. Since BBB firms now earn rents, it has to be ensured that the bad firms still do not have an incentive to participate (see equation 7):

$$m_3 \cdot p_{BBB}(\lambda) + p_J > b_3 \tag{51}$$

Substituting the definition for b_3 and $d_{BBB} = d_M$ as well $p_J = e$ implies that information acquisition $\bar{\iota}_\lambda$ must be sufficiently large:

$$\bar{\iota}_\lambda > 1 - \frac{1}{1-\lambda}\frac{1-d_M}{1-d_B}\frac{e}{NPV_M + e} \tag{52}$$

By assumption 3 $1 - \lambda < \frac{1-d_M}{1-d_B}\frac{e}{NPV_M+e}$ so that the right hand side is less than 0 and the constraint is always satisfied.

B.8 Proof of Proposition 7

By assumption, we consider the case $p_{BBB}(\bar{\iota}) > p_{AAA}(\bar{\iota})$. This implies that the face value constraint of the BBB firm FC_{BBB} under a constant fee scheme does not bind at $\bar{\iota}$. This also implies that it does not bind at $\tilde{\iota}$. If it were to bind then the constrained maximization problem would also solve the unconstrained problem, i.e. $\tilde{\iota} = \bar{\iota}$ and hence $p_{BBB}(\bar{\iota}) \leq p_{AAA}(\bar{\iota})$, a contradiction. Moreover, by assumption 4 the participation constraint of the medium type does not bind at $\bar{\iota}$. Hence, it will not bind at the lower $\tilde{\iota}$ given that the face value constraint FV_{BBB} does not bind, either. As PC_M does not bind, the rating agency cannot extract the full surplus and as FV_{BBB} does not bind, it can add a small fraction of bad firms to the pool of BBB firms without violating any constraints. This is inefficient because bad firms have NPV negative projects.

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