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

Milton Harris † Christian C. Opp‡ Marcus M. Opp‡

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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 a better rating is valuable to a regulated investor independent of the information it provides about the riskiness of the security’s underlying cash flows. In our model a profit-maximizing rating agency can respond to these regulatory rules by adjusting its information acquisition and its disclosure policy. The model predicts that sufficiently large regulatory distortions can lead to a complete break-down of delegated information acquisition: The rating agency fully engages in rating inflation. This extreme result is more likely to happen for complex securities which are costly to evaluate. For small regulatory distortions full disclosure of information is optimal. In this case, information acquisition can decrease or increase as a response to an increase in regulatory distortions. These comparative statics depend on the distribution of risks in the cross-section. Changes in the composition of the pool towards a larger fraction of bad types decrease the incentive to acquire information. Our model captures stylized facts about the differences between corporate bond ratings and ratings on collateralized debt obligations. It also highlights the importance of cross-sectional diversification through rating multiple securities at the same time. This may explain the oligopolistic market structure of rating agencies and may make it difficult to increase competition in this sector.

JEL classification: G24, G28, G01, D82, D83.

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†University of Chicago, Booth School of Business.
‡University of Chicago, Booth School of Business. I gratefully acknowledge financial support from the German National Academic Foundation and the Best Foundation’s 2008 Arnold Zellner Doctoral Prize.
§Corresponding author: University of California, Berkeley (Haas School of Business), 545 Student Services Bldg. #1900, Berkeley, CA 94720. The author can be contacted via email at mopp@haas.berkeley.edu.
1 Introduction

"The story of the credit rating agencies is a story of colossal failure"

Henry Waxman (D-CA), chairman of the House Oversight and Government Reform Committee.

Rating agencies have been criticized by politicians, regulators and academics as one of the major catalysts of the 2008/2009 financial crisis. One of the most prominent lines of attack, as voiced by Henry Waxman, is that rating agencies "broke the bond of trust" and fooled trustful investors with inflated ratings.

However, should sophisticated financial institutions be realistically categorized as trustful and fooled investors in light of the fact that they interacted with rating agencies not only as investors but also as originators of highly rated subprime mortgage securities? Why would rational investors hold on to subprime assets given their low risk premia (see Coval, Jurek, and Stafford (2009))? Absent of behavioral reasons, there must exist additional benefit of holding these securities. We argue, that a first-order benefit to financial institutions results from the regulatory use of ratings, such as minimum bank capital requirements. Through the lense of regulation, we develop a rational-expectations model of the "rating game" in which institutional investors face regulatory constraints which are contingent on ratings. Our model predicts that rating-contingent regulation distorts the business model of rating agencies and may at least in part reconcile rating inflation in select asset classes, low risk premia and investment by rational investors.

While rating agencies themselves are not directly regulated, their ratings are widely used for regulatory purposes. Over the last 20 years bank capital requirements (Basel I guidelines (1988) and Basel II guidelines (2004)) have been become increasingly reliant on ratings as a measure of risk. For example, the risk weight of capital that banks have to hold against AAA securities is 20% vs. 100% against BBB+ securities. Moreover, the investment-grade threshold and the AAA threshold have become quasi-regulatory investment restrictions for pension and money market funds. Since these regulations are of first order relevance for institutional investors’ capital management a AAA label is economically valuable (independent of the underlyng information it provides about the risk of a security). Using the regulatory accreditation of Dominion Bond Rating Services as a natural experiment Strahan and Kisgen (2009) estimate the economic value of a one notch better rating to be 42 basis points.

Our model analyzes the feedback effect of this regulatory power on the incentives of the rating agency to a) acquire and b) disclose their information. We show that regulatory benefits for highly rated securities distort the rating agency’s incentive to acquire information. If these benefits are above a threshold, the rating agency abandons using its information acquisition technology and simply engages in rating inflation: The rating agency effectively becomes a regulatory arbitrageur rather than a provider of information. This extreme result is more likely

1 Note, that these numbers have to be multiplied by the minimum requirement for tier 1 (6%) and tier 2 capital (10%).

2 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.
to occur for complex securities that are costly to evaluate. This could explain the apparent low effort to create sophisticated models for the housing market, an area outside of the rating agency’s primary expertise. The predicted dual-standard ratings process for standard corporate bonds vs. exotic structured securities is also revealed by the high percentage (60%) of AAA rated CDOs relative to corporate bonds (1%, see Fitch (2007)). Interestingly, the effect of regulatory benefits is ambiguous below the threshold level. It is possible that the rating agency acquires more or less information in response to an increase in regulatory benefits. It may even issue fewer positive ratings in equilibrium. We show that these comparative statics depend on the distribution of types in the cross-section. If there are a large fraction of bad types and a few exceptionally good types the rating agency will acquire less information. In the opposite case, the rating agency reduces its information acquisition. A gradual shift in the distribution towards bad types, such as the inclusion of subprime mortgages, would therefore reduce information acquisition and hence would lead to a less efficient allocation of funds in the economy. Our model also reveals that 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). This may explain the oligopolistic market structure of rating agencies.

We develop these results in a simple parsimonious model by incorporating a monopolistic rating agency into a textbook private-prospects model in which firms have private information about their type. We call the issuers firms but they could be interpreted more generally as issuers of debt-like securities. The rating agency can acquire information about the issuer with a noisy signal technology that generates private signals which can be disclosed to the public (potentially with a bias). Thus, information acquisition and disclosure jointly determine the informativeness of ratings. Without regulatory benefits the rating agency’s sole economic role results from improving the efficiency of capital allocations in the economy. Through its effort it is able to affect total surplus in the economy. In this benchmark model, full disclosure is optimal: The marginal benefit of information acquisition is equalized to the marginal cost and all information is released to the public.

The introduction of regulatory benefits distorts the incentives to acquire information. Since regulatory benefits in practice only depend on the rating label (and not the underlying informativeness), there is an incentive to rate more firms favorably (volume effect). However, for small benefits full disclosure is still the optimal disclosure. As a result, the interaction of the signal structure with the cross-sectional distribution of types plays a crucial role. This interplay generates the model predictions with regards to the skewness of the cross-sectional distribution.

If the regulatory benefits are sufficiently large the rating agency would have an incentive to distort its information towards producing more highly rated securities conditional on the optimal information acquisition level under full disclosure. However, ex-post distortion of information renders ex-ante collection of information irrelevant and leads to the extreme result that the rating agency does not acquire any information and simply labels every security A. Interestingly, the rating agency would still not rate bad issuers highly if they could (perfectly

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3 For this result, it is crucial that current regulations only depend on the rating but do not distinguish between types of securities: The regulator treats AAA corporate bonds identically to a AAA senior tranches of collateralized debt obligations.

4 Our mechanism differs from these classical papers as the rating agency is not the residual claimant of the assets it rates. Hartman-Glaser, Piskorski, and Tchistyi (2009) consider the optimal mortgage securitization problem from the perspective of an issuer. Independent from our analysis, they find an "information enhancement" effect if the underwriter securitizes multiple assets at the same time.
and costlessly) identify them. This argument shows that the cost of information acquisition is an important determinant of the threshold level of regulatory benefits: Higher cost decrease the threshold level of regulatory benefits for rating inflation.

The results so far were generated in a one period setup in which the rating agency can commit to any desired level of information acquisition and any disclosure rule. We show that results can be replicated in a repeated game framework in which the rating agency cannot commit but rates multiple issuers at the same time. If issuers’ defaults are not perfectly correlated, additional information about the rating agency’s effort and disclosure rule is generated. In the extreme case with independent defaults and a continuum of firms the information acquisition level becomes public information. Deviations from equilibrium play would be punished by investors through the loss of future business. Market discipline of this sort will not matter if regulatory benefits are sufficiently high: in this case, there is no commitment problem on the side of the rating agency: Everybody anticipates that the rating agency does not acquire information and market discipline cannot induce delegated information acquisition. In contrast, a regulator could provide incentives for information acquisition using the threat of revoking regulatory accreditation.

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. 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)). 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. 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. Thus, the sharp criticism of the issuer-pays model by regulators – such as SEC chairman Mary Schapiro – on the basis of "inherent conflicts of interest" is not valid in a world with rational investors. Ironically, our model reveals that it is the regulatory use of ratings that creates conflicts of interest, albeit of a different kind.

The joint analysis of continuous information acquisition and the optimum disclosure rule extends classical papers on information asymmetries in asset markets such as or in which (some) agents are either endowed with private information (see Admati and Pfleiderer (1986)) or are

5 We define market 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")

6 The regulatory use of ratings has to be distinguished from the regulation of rating agencies which is the focus of Stolper (2009). Our paper 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. 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.
not able to vary the precision of their signals such as in Grossman and Stiglitz (1980) or Hellwig (1980). We believe that the joint analysis of these questions is important: Intuitively, if information is dilated ex post given information, effort to collect information ex ante is distorted. The monopolistic seller of information in the seminal paper by Admati and Pfeiderer can also be interpreted as a rating agency using an investor-pays business model. It is important to notice that investors in a competitive financial market do not care about the precision of information per se, they are only interested in superior information relative to other (non-informed) investors. Thus, investors’ willingness to pay for information that is released to the general public is equal to 0. It is apparently not a coincidence that the investor-pays model was abandoned in favor of the issuer-pays model in the 1970’s following the widespread availability of photocopiers (see White (2007) and Sangiorgi, Sokobin, and Spatt (2009)). Moreover, the use of ratings for regulatory purposes which started in the late Seventies effectively prohibits the exclusivity of rating information and therefore renders the investor-pays model not viable.

Inderst and Ottaviani (2009) study the role of general advisors who can acquire and disclose customer-specific information a in a rational-expectations setting: For example, doctors can recommend appropriate treatments to their patients but may be influenced by kickbacks that they receive from pharmaceutical companies. Our setup differs because rating agencies do not provide customer-matched information. More importantly, the advice (the rating) is used by a contractually unrelated third party (the government) in a payoff-relevant way. This makes advice valuable independent of the information it provides and creates distortions. To our knowledge, this feature is largely unstudied in the existing literature even though it applies to many regulatory or quasi-regulatory settings such as auditing. Thus, while our model uses the concrete institutional focus on rating agencies the results should apply more broadly to environments where messages exchanged between two parties are mechanically used by a third party.

Lizzeri (1999) considers the optimum disclosure policy of a general information certifier which can perfectly observe the type of the seller at zero cost (i.e. in our case the issuer). He shows that if the lowest types create positive value to the buyer (i.e. in our case investor) the information certifier will not disclose any information. Intuitively, the information provider does not affect total surplus in this scenario (different than in our setup), so that any provided information would just have redistributive effects. This extreme result does not hold if the certifier can charge different fees from each type, types have different outside options, or some types create negative value. In addition, we consider the ex-ante incentive of the certifier to acquire information (i.e. not just the disclosure policy) which becomes particularly relevant when we study the distortions created by rating-contingent regulation.

The market structure for certification providers has been analyzed by various papers. While Strausz (2005), Ramakrishnan and Thakor (1984) and Diamond (1984) predict that certification

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8 This is because prices are set such that investors break-even.
9 There are also important differences to auditors: 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)).
10 Note, that the seller in his setup sells 100% of the assets. Thus, his setup corresponds better to an entrepreneur who sells off the entire equity of a firm rather than an entrepreneur who issues debt and remains the residual cash flow claimant.
providers are essentially natural monopolists, Lizzeri (1999) finds the opposite effect. Fundamentally, these opposite predictions result from the fact that market power in the first three papers tends to reduce commitment problems which Lizzeri abstracts from. Recent empirical evidence by Becker and Milbourn (2008) indicates that competition decreases ratings precision. However, 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.

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 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.

The benchmark model is outlined in Section 2. The feedback effect of current regulations is presented in Section 3. Section 1 considers a repeated game setup which illustrates the importance of rating multiple securities. Section 5 concludes.

2  Benchmark Model

2.1  Setup

The baseline model features an asymmetric information environment in which firms have superior information about the quality of their projects relative to investors, a.k.a. a standard privately-known prospects textbook model (see Chapter 6.2 of Tirole (2005)). Our contribution is to incorporate a monopolistic rating agency into this setup. The regulatory use of ratings will be introduced in the subsequent section. All players (firms, investors and a rating agency) are assumed to be risk-neutral.

There are a continuum of firms of measure 1. Each firm is owned by a risk-neutral entrepreneur who has no cash. The entrepreneur has access to a risky project that requires an initial investment of 1 and may either succeed or fail. If the project succeeds, the firm’s net cash flow at the end of the period is \( R > 1 \). In case of failure, the cash flow is 0. Firms differ solely with regards to their probability of success. In particular, there are two firm types \( n \in \{g, b\} \) with respective default probabilities \( d_n \). where \( g \) represents "good" and \( b \) stands for "bad".\footnote{An earlier version of this paper contained three firm types. For ease of exposition, we now focus on a 2-player setup. The results are qualitatively identical.}
The fraction of good types in the population \( \pi_g \) is common knowledge. The NPV of a type \( n \) project is given by:

\[
V_n = R (1 - d_n) - 1
\]  

(1)

The good type has positive NPV projects \((V_g > 0)\), whereas the bad type has negative NPV projects \((V_b > 0)\). The average project with default probability \( d = \pi_g d_g + \pi_b d_b \) is assumed to be of negative NPV.\(^{12}\)

Firms seek financing from competitive investors via the public debt market.\(^{13}\) Since investors require to break even on each investment given available public information, the average project could not be financed. Firms have access to an alternative costly financing channel which can be interpreted as a reduced form way of accounting for the possibility of relationship lending (through banks) or other ways of costly information revelation. This channel gives rise to an outside option for good types \( U_g \) and represents the intuitive notion that good types have access to "bypass" technologies that would allow them to bypass the public debt market. The effective cost of these technologies is \( V_g - U_g \) is wasteful from a social planner’s perspective.\(^{14}\) In the following, we treat \( U_g \) as an exogenous parameter and analyze how it affects the optimizing behavior of rating agencies.

Firms can approach rating agencies which have access to an information production technology which generates private signals \( s \in \{A, B\} \) of quality \( \iota \in (0, 1] \). We consider the following signal structure (see Figure 1). Good firm types receive the good signal \( A \) with probability \( 1 - \alpha (\iota) \) and obtain a bad signal with probability \( \alpha (\iota) \). Bad types obtain the low signal with probability \( 1 - \beta (\iota) \) and the signal \( A \) with probability \( \beta (\iota) \). Thus, \( \alpha (\iota) \) and \( \beta (\iota) \) can be interpreted as the respective errors that the rating agency’s information technology generates. Note, that these "honest" errors are different from the noise that the rating agency can create by strategically misreporting the obtained signal (which we will discuss below). The errors are a decreasing function of information acquisition and the marginal benefit of an additional unit of information is declining.\(^{15}\)

\[
\alpha' (\iota) < 0, \beta' (\iota) < 0
\]

(2)

\[
\alpha'' (\iota) \geq 0, \beta'' (\iota) \geq 0
\]

(3)

By definition of a good signal, the good type obtains the good signal more frequently than the bad type for any positive level of information acquisition.\(^{16}\)

\[
1 - \alpha (\iota) \geq \beta (\iota)
\]

(4)

Without loss of generality, information acquisition is normalized between 0 and 1 so that:

\[
1 - \alpha (0) = \beta (0)
\]

(5)

\[
\alpha (1) = \beta (1) = 0
\]

(6)

\(^{12}\) This assumption simplifies the exposition of the paper, particularly the proof of Proposition 1.\(^{12}\)

\(^{13}\) The standard debt contract is optimal contract in this environment (see Tirole (2005)).\(^{13}\)

\(^{14}\) If \( U_G = 0 \) these bypass technologies are prohibitively costly.\(^{14}\)

\(^{15}\) Information acquisition reduces the error, so that a decreasing marginal benefit implies a positive second-order derivative.\(^{15}\)

\(^{16}\) This restriction also implies that the bad type obtains the bad signal more frequently than the good type \((1 - \beta (\iota) \geq \alpha (\iota))\).
For the intuition of most results, it is sufficient to consider the following example:

\[ \alpha (\iota) = \beta (\iota) = \frac{1 - \iota}{2} \tag{7} \]

Without information acquisition both types get the signal \( A \) (or \( B \)) with 50% probability. At the maximum information acquisition level \( \iota = 1 \) the firm type can be perfectly determined.

The cost function for information acquisition \( C ' (\iota) \) is increasing and convex satisfying:

\[ C ' (0) = 0 \]
\[ \lim_{\iota \to 1} C ' (\iota) = \infty \tag{8} \]
\[ \lim_{\iota \to 1} C ' (\iota) = \infty \tag{9} \]

Since signals \( s \) are not publicly observable, the rating agency can potentially assign ratings \( r \neq s \). Consistent with practice, the message space is restricted to a letter rating. Thus, a disclosure rule is completely characterized by the probabilities of misreporting \( \varepsilon = (\varepsilon_{AB}, \varepsilon_{BA}) \) conditional on the privately observed signal \( s \in \{A, B\} \). The term \( \varepsilon_{AB} \) refers to the probability that an issuer with signal \( A \) is rated \( B \) (see Figure 1, \( \varepsilon_{BA} \) is defined analogously). Formally equivalent, the rating agency could also report the implied posterior type attributes, i.e. it could issue a report that specifies the probability that a specific firm is of type \( \tilde{n} \). Full disclosure implies \( \varepsilon = (0, 0) \). Without loss of generality, we restrict ourselves to disclosure rules which ensure that the \( A \) category represents the superior rating class.

In the following analysis, we assume that the value of future business is high enough (reputation) that the rating agency can effectively commit to any desired level of information acquisition \( \iota \geq 0 \) and any disclosure rule \( \varepsilon \geq 0 \). This assumption can be formally justified within a repeated game setup outlined in section 4. We want to stress that this assumption – while potentially controversial for other questions – works against the main result of the paper.

For its rating services the rating agency charges a fee \( f \) that has to be paid upon a successful capital market issue. This captures the standard business practice of the rating agency. Also, consistent with reality the rating agency cannot take any equity stakes in the firms.

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Footnotes:

17 For example, the rule "always misreport" \( \varepsilon = (1, 1) \) is informationally equivalent to \( \varepsilon = (0, 0) \). In such a case, we could simply relabel the categories and our analysis goes through.

18 It would be trivial to generate distortions of information acquisition in a setup in which the rating agency does not care about reputational capital.
The logical sequence of events in the game played by the participants is:

1. Rating agency sets fee \( f \), announces the quality of the rating \( \iota \) and the disclosure rule \( \varepsilon \)
2. Firms decide whether to get a rating or not
3. Rating agency receives noisy signal \( s \)
4. Rating agency reports rating \( r \)
5. Investors decide whether to provide funding to firms
6. Firms pay the fee \( f \) and invest funds
7. Cash flows are realized at the end of the period and debt is repaid

2.2 Analysis

The symmetric Perfect Bayesian Equilibrium (in which all firms of the same type play the same strategy) can be characterized as follows:

**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 \( p \), the information acquisition level \( \iota \), the disclosure rule \( \varepsilon \) and the fee \( f \).
2) Each firm makes a participation decision to maximize present value of its cash flows given the fee structure \( f \), the rating quality \( \iota \), the disclosure rule \( \varepsilon \) and the financing terms for each rating class \( N_r \).
3) The rating agency sets a fee \( f \), information acquisition \( \iota \) and a disclosure rule \( \varepsilon \) that maximizes its profits given the firm’s participation decision and financing terms required by investors.

For ease of exposition, the profit maximization problem of the rating agency is solved in three steps. We first solve for the investor problem (1) and the firm problem (2) to simplify the rating agency decision problem (3). This solution approach is similar to Grossman and Hart (1983).

2.2.1 Investor Problem

First consider investors’ strategies taking firms’ and the rating agency’s strategy as given. Let \( p_n \) be an indicator function for firms of type \( n \) obtaining a rating, i.e. \( p_n = 1 \) if type \( n \) firms obtain ratings and \( p_n = 0 \) if they don’t, and let \( p = (p_g, p_b) \). Moreover, let \( \mu_s \) denote the mass of firms for which the rating agency obtains the signal \( s \):

\[
\mu_A(p, \iota) = p_g \pi_g (1 - \alpha(\iota)) + p_b \pi_b \beta(\iota) \\
\mu_B(p, \iota) = p_g \pi_g \alpha(\iota) + p_b \pi_b (1 - \beta(\iota))
\]
Given a disclosure rule $\varepsilon$ the mass of firms with a reported rating of $r \in \{A, B\}$, denoted as $\mu_r$, satisfies:

$$
\mu_A (p, \iota, \varepsilon) = \mu_A (1 - \varepsilon_{AB}) + \mu_B \varepsilon_{BA} \quad (12)
$$

$$
\mu_B (p, \iota, \varepsilon) = \mu_B (1 - \varepsilon_{BA}) + \mu_A \varepsilon_{AB} \quad (13)
$$

Moreover, let $d_r (p, \iota, \varepsilon)$ represent the posterior default probability of a firm in rating class $r$.

$$
d_A (p, \iota, \varepsilon) = \pi g \mu_A \frac{(1 - \alpha (\iota)) (1 - \varepsilon_{AB}) + \alpha (\iota) \varepsilon_{BA}}{\mu_A} d_g + \pi b \mu_B \frac{(1 - \beta (\iota)) \varepsilon_{BA} + \beta (\iota) (1 - \varepsilon_{AB})}{\mu_B} d_b
$$

$$
d_B (p, \iota, \varepsilon) = \pi g \mu_B \frac{(1 - \alpha (\iota)) \varepsilon_{AB} + \alpha (\iota) (1 - \varepsilon_{BA})}{\mu_B} d_g + \pi b \mu_B \frac{(1 - \beta (\iota)) (1 - \varepsilon_{BA}) + \beta (\iota) \varepsilon_{AB}}{\mu_B} d_b
$$

Competition among investors ensures that the required face value of bonds with rating $r$ is given by:

$$
N_r (p, \iota, \varepsilon, f) = \frac{1 + f}{1 - d_r} \quad (14)
$$

Investors provide financing as long as $N_r \leq R$.

**Lemma 1** If both firm types get rated, at most one rating class (called $A$) may obtain financing irrespective of the level of information acquisition $\iota$ and the disclosure rule $\varepsilon$. Financing requires participation of good types.

**Proof:** Suppose both rating classes get financed, then the population of firms would get financed as $p = (1, 1)$. However, the average project is of negative NPV. Hence, the break-even constraint of investors would be violated. ■

The off-equilibrium path beliefs of investors are specified as follows: If $p = (0, 0)$ investors assign failure probability $d_g$ to any rated firm, regardless of the rating. Also assume that if $p = (1, 1)$, investors assign a default probability of $d_b$ to any unrated firm.

### 2.2.2 Firm Problem

Now consider the decision of a firm of type $n$ to approach the rating agency for a rating, taking the strategies of all investors, the rating agency and all other firms as given.

**Lemma 2** Bad types have a strict incentive to get rated if $N_A < R$.

The intuition for this lemma is straightforward. Due to limited liability, approaching the rating agency is a free option for the bad type firm: If it is lucky to obtain an A-rating (either due to an honest mistake or misreporting on the side of the rating agency) it will obtain an expected positive payoff. Otherwise it’s payoff is simply zero. Lemma[1] and[2] together imply that bad types always mimic the good type. If both types remain unrated financing through the public debt market is impossible because the average project is of negative NPV. Each firm would simply get their outside option $U_n$.

By Lemma[1] rational investors only fund $A$ rated securities with terms $N_A < R$ if good types choose to participate. This crucial participation decision will enter as a (binding) constraint in
the rating agency problem which is studied in the subsequent section. To keep the analysis as simple as possible, we assume that firms have access to their outside option regardless of their rating. Since fees are only paid upon a successful capital market issue – which is precluded by a $B$-rating – good firms will only approach the rating agency if the expected payoff conditional on an $A$-rating is greater than their outside option $\bar{U}_g$:

$$(1 - d_g) (R - NA) \geq \bar{U}_g$$

Defining $N_U < R$ as the (threshold) face value of debt satisfying $(1 - d_g) (R - N_U) = \bar{U}_g$ we obtain a simple participation strategy of the good type:

$$p^*_g = \begin{cases} 
1 & \text{if } NA \leq N_U \\
0 & \text{if } NA > N_U 
\end{cases}$$

Intuitively, good types only participate if the face value of public debt is sufficiently low.

### 2.2.3 Rating Agency Problem

Since the rating agency can only collect fees if they enable firms to obtain funds from capital markets the previous two subproblems imply that the rating agency needs to set fees $f$, the information acquisition level $\epsilon$ and the disclosure rule $\bar{\epsilon}$ which induce the good type to get rated $(NA (\iota, \varepsilon, f) \leq N_U)$. By Lemma 2 this also induces the bad type to get rated. Fees $f$ may only be collected from all firms that are labelled as $A$ (see Lemma 1). Thus, the equilibrium represents the solution to the following profit maximization problem of the rating agency:

$$\max_{\iota, f, \bar{\epsilon}} \Pi (\iota, f, \bar{\epsilon}) = \bar{\mu}_A (\iota, \varepsilon) f - C (\iota) \text{ s.t.}$$

$$NA (f, \iota, \varepsilon) \leq N_U$$

The solution of the problem is split into three steps. First, we solve for the optimal fee $f$ as a function of information acquisition $\iota$ and the disclosure rule $\bar{\epsilon}$. Secondly, we prove that given the optimal fee the optimum disclosure rule is full disclosure $\bar{\epsilon} = (0, 0)$. Third, we solve for the optimum level of information acquisition.

The participation constraint $NA \leq N_U$ can be rewritten as a constraint on the fee using equation 14:

$$f \leq f^* (\iota, \varepsilon) = N_U (1 - d_A (\iota, \varepsilon)) - 1$$

Profit maximization of the rating agency implies that this constraint always binds: For a given level of informativeness implied by $(\iota, \varepsilon)$ and cost $C (\iota)$, the rating agency wants to charge the maximum possible fee $f^*$. It is useful to define an auxiliary variable $x_n$ that measures the revenue contribution a firm of type $n$ creates:

$$x_n \equiv (1 - d_n) N_U - 1$$

As the outside option of the good type converges to 0, i.e. $N_U$ approaches $R$, the revenue contribution approaches the $NPV$ of the firm’s project. Since the outside option of good types is (by assumption) between 0 and the $NPV$ of the project, $x_n$ must be strictly smaller than the associated $NPV$.

$$xb < NPV_b < 0 < x_g < NPV_g$$

---

19 As $B$-rated firms do not generate revenue the rating agency does not even need to publish bad ratings.

20 Formally, the relation $0 < \bar{U}_g < NPV_g$ implies that: $(1 - d_g) N_U > 1$ and $N_U < R$. 

11
**Proposition 1**  Full Disclosure is optimal for all (relevant) levels of information acquisition:  
\( \epsilon = 0 \)

**Proof:** Given the optimum fee level \( f^* (\iota, \epsilon) \), revenue \( S (\iota, \epsilon) \) is just a function of information acquisition and the disclosure rule \( \epsilon \). Full-disclosure revenue can be written as:

\[
S (\iota, 0) = (1 - \alpha (\iota)) \pi_g x_g + \beta (\iota) \pi_b x_b
\]

For an arbitrary disclosure rule revenue can be decomposed into the full-disclosure revenue and the deviation from full disclosure:

\[
S (\iota, \epsilon) = S (\iota, 0) + [\pi_g x_g \alpha (\iota) + \pi_b x_b (1 - \beta (\iota))] \epsilon_{BA} - S (\iota, 0) \epsilon_{AB}
\]

Thus, for a fixed \( \iota \), the revenue (and thus profits) of the rating agency is linear in \( \epsilon_{AB} \) and \( \epsilon_{BA} \). The coefficient on \( \epsilon_{BA} \) is given by:

\[
\frac{dS}{d\epsilon_{BA}} = \pi_g x_g \alpha (\iota) + \pi_b x_b (1 - \beta (\iota)) < (1 - \beta (\iota)) (\pi_g x_g + \pi_b x_b) < (1 - \beta (\iota)) (\pi_g NPV_g + \pi_b NPV_b) < 0
\]

The first relation follows because \( \alpha (\iota) < 1 - \beta (\iota) \) and \( x_g > 0 > x_b \). The second one follows from \( x_n < NPV_n \). The third one follows from the assumption that the average project is not worthwhile financing. Thus, for any \( \iota \), revenue is decreasing in \( \epsilon_{BA} \). Hence, it must be optimal to choose \( \epsilon_{BA} = 0 \).

Now, consider \( \epsilon_{AB} > 0 \). The coefficient on \( \epsilon_{AB} \) is given by:

\[
\frac{d\Pi}{d\epsilon_{AB}} = -S (\iota, 0) < 0
\]

The revenue under full disclosure \( S (\iota, 0) \) must be greater than 0 in equilibrium. If the rating agency made negative revenue (which can happen because we did not explicitly consider a non-negativity restriction on fees), the rating agency would simply not operate.  

The intuition for this proof is simple. Labeling B firms as A (\( \epsilon_{BA} > 0 \)) reduces profits through 2 channels. First, it reduces total surplus in the economy because a higher fraction of \( NPV \) negative projects are financed. Secondly, it increases rents that accrue to bad firms (which are more likely to get rated A) while rents to good firms are unchanged. Therefore, the share of the pie accruing to the rating agency must decrease. Thus, the volume effect (more firms are rated A) is outweighed by the reduced fee that the rating agency can charge for its service. Labeling A firms as B (\( \epsilon_{AB} > 0 \)) reduces profits simply because A-rated firms have on average \( NPV \) positive projects and some of them would no longer be financed in equilibrium. This leads to a decline in ratings volume while fees cannot be raised.

Using the optimality of full disclosure we can now characterize the equilibrium of the benchmark model (assuming that an equilibrium with positive profits of the rating agency exists):
Proposition 2  In equilibrium
a) Both firm types decide to get a rating
b) The optimal level of information acquisition satisfies: 
\[ C'(x^*) = -\alpha'(x^*) \pi_g x_g + \beta'(x^*) \pi_b x_b \]
c) The fee satisfies: 
\[ f'(x^*) = N_C (1 - \delta_A(x^*)) - 1 \]
d) The fraction of financed firms satisfies:
\[ \mu_A(x^*) \]
e) Rating agency profits are given by:
\[ (1 - \alpha(x^*)) \pi_g x_g + \beta(x^*) \pi_b x_b - C(x^*) \]

Proof: Part a) and c) and d) follow from the discussion in the main text. Using full disclosure the profit of the rating agency conditional on any level of information acquisition satisfies:
\[ \Pi = \mu_A(x) f(x) - C(x) \]
\[ = (1 - \alpha(x)) \pi_g x_g + \beta(x) \pi_b x_b - C(x) \]

The optimal level of information acquisition must solve the first-order condition:
\[ -\alpha'(x^*) \pi_g x_g + \beta'(x^*) \pi_b x_b - C'(x^*) = 0 \]

The second order condition is satisfied since \( \alpha''(x), \beta''(x) \) and \( C''(x) \) are positive and \( x_b < 0 < x_g \)
\[ -\alpha''(x^*) \pi_g x_g + \beta''(x^*) \pi_b x_b - C''(x^*) < 0 \]

The restrictions on the cost function and the errors ensure that there exists a unique interior level of information acquisition \( 0 < x^* < 1 \). This proofs part b). Part e) follows directly. \( \blacksquare \)

The optimum level of information trades off the marginal cost of information acquisition \( C'(x^*) \) with the marginal private benefit of information acquisition which results from increasing the proportion of good projects by \(-\alpha'(x^*) \pi_g > 0\) and decreasing the proportion of bad projects \( \beta'(x^*) \pi_b < 0\). Each additional good project undertaken generates a revenue contribution of \( x_g \) to the rating agency while each bad project avoided generates a value of \( |x_b| \). Since \( x_n < NPV_n \) the choice of information acquisition does not equalize marginal cost to the marginal social benefit \((-\alpha'(x^*) \pi_g NPV_n + \beta'(x^*) \pi_b NPV_b)\)\(^21\)

3  Rating-Contingent Regulation

This central section of the paper extends the previous section by incorporating the effects of regulatory use of ratings into our existing framework (see examples in Introduction). The existing regulations or quasi-regulations imply that investors receive a regulatory benefit from "higher" rated securities independent of the underlying risk of the securities. Empirically, the AAA threshold and the investment grade threshold are of highest relevance to investors. Though our model only features two rating classes, our results can be extended to multiple rating classes. We assume that a regulator is committed to its policy\(^22\)

Assumption 1  The marginal investor is regulated and receives an equivalent monetary benefit of \( y < |x_b| \) per unit of invested capital in an A-rated security.

\(^{21}\) Theoretically, the marginal social benefit should also account for (positive or negative) project externalities which we do not explicitly consider.

\(^{22}\) Within the repeated game section, we briefly discuss the implications of allowing for endogenous changes in government regulation.
This assumption is important for the remainder of the analysis. It can be motivated on theoretical and empirical grounds. In the framework of intermediary asset pricing by He and Krishnamurthy (2008) intermediaries – i.e. regulated entities – are marginal in setting asset prices. Thus, prices of two equivalent bonds with different ratings should command different prices if regulatory constraints bind. This logic is analogous to the collateral channel in Garleanu and Pedersen (2009) which may lead to deviations from the law of one price. Empirically, our assumption is consistent with the study of Strahan and Kisgen (2009) who find that higher rated bonds require significantly lower yields even after controlling for the risk of the underlying issue.

The parameter \( y \) can be interpreted as the percentage yield reduction that investors are willing to accept solely for the \( A \) label. It captures the comparative statics relative to a regulated economy without preferential treatment for \( A \)-rated securities. The restriction on the size of the regulatory benefit \( y < |x_b| \) ensures that the revenue contribution per unit of financed bad project is still negative. Thus, if information acquisition was costless the rating agency would still not have an incentive to label bad types as \( A \). The effective regulatory subsidy implies that the face value for \( A \)-rated securities now satisfies:

\[
N_A (t, \varepsilon, f) (1 - d_A) = (1 + f) (1 - y)
\]

This de-facto regulatory power of rating agency increases the maximum fee that the rating agency is able to charge for any given level of information acquisition:

\[
\hat{f}^* (t, y) = N_{\hat{U}} \frac{1 - d_A(t, \varepsilon)}{1 - y} - 1 \tag{25}
\]

By defining the adjusted threshold face value parameter \( \hat{N}_{\hat{U}} (y) = \frac{N_{\hat{U}}}{1 - y} \) and \( \hat{x}_n = (1 - d_n) \hat{N}_{\hat{U}} - 1 \) the mathematical problem of the rating agency is essentially unchanged.

**Proposition 3** Full Disclosure is optimal if \( y \leq \bar{y} < |x_b| \) where \( \bar{y} \) satisfies: \( C (t^* (\bar{y})) = |\alpha (t^* (\bar{y})) \pi_g \hat{x}_g (\bar{y}) + (1 - \beta (t^* (\bar{y}))) \pi_b \hat{x}_b (\bar{y})| \). Otherwise, all firms are rated \( A \) (\( \varepsilon_{AB} = 0, \varepsilon_{BA} = 1 \)) and no information (\( t = 0 \)) is acquired.

**Proof:** The structure of the proof is similar to the proof of Proposition I. The Full-Disclosure revenue is given by: \( (1 - \alpha (t)) \pi_g \hat{x}_g + \beta (t) \pi_b \hat{x}_b \). Total revenue can be written as:

\[
S (t, \varepsilon) = S (t, 0) + [\pi_g \hat{x}_g \alpha (t) + \pi_b \hat{x}_b (1 - \beta (t))] \varepsilon_{BA} - S (t, 0) \varepsilon_{AB} \tag{26}
\]

Since \( \varepsilon_{AB} = 0 \) was the optimal policy without regulatory benefits for rating class \( A \), it must also be true that is suboptimal to label firms with a \( A \)-signal as \( B \) in the presence of regulatory benefits for rating class \( A \). This logic does not necessarily apply for the distortion towards rating class \( A \). We formally consider the problem of maximizing profits \( \Pi (t, \varepsilon_{BA}) \) subject to the constraint that \( 0 \leq \varepsilon_{BA} \leq 1 \):

\[
\max_{\varepsilon_{BA}, t} \Pi (t, \varepsilon_{BA}) = S (t, \varepsilon_{BA}) - C (t) \quad \text{s.t.:} \quad 0 \leq \varepsilon_{BA} \leq 1 \tag{27}
\]

The comparison refers to an economy in which investors are regulated and the \( A \) label does not result in relaxations of capital constraints.
We apply the Kuhn-Tucker method:

\[ L = \Pi (\iota, \varepsilon_{BA}) - \kappa_0 \varepsilon_{BA} + \kappa_1 \varepsilon_{BA} \]  

(28)

The first order conditions with respect to \( \varepsilon_{BA} \) and \( \iota \) imply:

\[
\frac{\partial L}{\partial \varepsilon_{BA}} = \frac{\partial S}{\partial \varepsilon_{BA}} = \pi_g \bar{x}_g \alpha (\iota) + \pi_b \bar{x}_b (1 - \beta (\iota)) - \kappa_0 + \kappa_1 = 0
\]  

(29)

\[
\frac{\partial L}{\partial \iota} = \frac{\partial \Pi}{\partial \iota} = [-\alpha' (\iota) \pi_g \bar{x}_g + \beta' (\iota) \pi_b \bar{x}_b] (1 - \varepsilon_{BA}) - C' (\iota) = 0
\]  

(30)

First, we prove by contradiction that the maximization problem of the rating agency always yields a corner solution for \( \varepsilon_{AB} \), i.e. either \( \varepsilon_{BA} = 0 \) or \( \varepsilon_{BA} = 1 \). Suppose \( \kappa_0 = \kappa_1 = 0 \), so that an interior solution for \( \varepsilon_{BA} \) obtains. Since the derivative with respect to \( \varepsilon_{BA} \) (equation 29) is not a function of \( \varepsilon_{BA} \), the first-order condition can only be satisfied if \( \iota \) satisfies \( \pi_g \bar{x}_g \alpha (\iota) + \pi_b \bar{x}_b (1 - \beta (\iota)) = 0 \). Note, that \( \pi_g \bar{x}_g \alpha (\iota) + \pi_b \bar{x}_b (1 - \beta (\iota)) \) is a decreasing function of \( \iota \). Assume that \( \pi_g \bar{x}_g \alpha (0) + \pi_b \bar{x}_b (1 - \beta (0)) > 0 \) so that a unique level of information acquisition \( \iota^* \) solves the equation 29. Given \( \iota^* \) the level of \( \varepsilon_{BA} \) has to be chosen such that the first order condition for \( \iota \) (equation 30) is satisfied. Denote the solution as \( \varepsilon_{BA}^{**} \). Profits of the rating agency are then given by:

\[
\Pi (\iota^*, \varepsilon_{BA}^{**}) = S (\iota^*, 0) + [\pi_g \bar{x}_g \alpha (\iota^*) + \pi_b \bar{x}_b (1 - \beta (\iota^*))] \varepsilon_{BA}^{**} - C (\iota^*)
\]  

(31)

\[
\Pi (\iota^*, \varepsilon_{BA}^{**}) = S (\iota^*, 0) - C (\iota^*)
\]  

(32)

\[
< \max \ S (\iota, 0) - C (\iota) = S (\iota^*, 0) - C (\iota^*)
\]  

(33)

where \( \iota^* \) refers to the optimum level of information acquisition using full disclosure. Thus, the solution \( \varepsilon_{BA}^{**}, \varepsilon_{BA}^{**} \) is strictly dominated by full disclosure. Thus, either the solution is represented by full disclosure \( (\iota^*, 0) \) as discussed in the previous section or \( \varepsilon_{BA} = 1 \). If \( \varepsilon_{BA} = 1 \) and all firms are rated \( A \), the first-order condition on information acquisition implies:

\[
C' (\iota) = 0
\]  

(34)

which is solved by \( \iota = 0 \). Since \( C (0) = 0 \) profits of the rating agency are:

\[
\Pi (\iota = 0, \varepsilon_{BA} = 1) = \pi_g \bar{x}_g + \pi_b \bar{x}_b
\]  

(35)

Full disclosure is the solution as long as \( \Delta \Pi (y) = \Pi (\iota^*, 0) - \Pi (0, 0, 1) \geq 0 \). Note that \( \Delta \Pi (0) > 0 \) (see previous section without regulatory benefits) and \( \Delta \Pi (1) < 0 \) (in this extreme case investors are fully subsidized by the government). In order to prove existence of a unique \( \bar{y} \) that satisfies \( \Delta \Pi (\bar{y}) = 0 \) it remains to be shown that \( \Delta \Pi' (y) < 0 \forall y \in (0, 1) \)

\[
\Delta \Pi (y) = -\alpha (\iota^*) \pi_g \bar{x}_g (1 - \beta (\iota^*)) \pi_b \bar{x}_b - C (\iota^*)
\]  

(36)

The derivative is:

\[
\Delta \Pi' (y) = \left[ -\alpha' (\iota^*) \pi_g \bar{x}_g + \beta' (\iota^*) \pi_b \bar{x}_b - C' (\iota^*) \right] \frac{d\iota^*}{dy}
\]  

(37)

\[
- [\alpha (\iota^*) \pi_g (1 - d_g) + (1 - \beta (\iota^*)) \pi_b (1 - d_b)] \frac{dN_{UB}}{dy}
\]  

(38)

\[
= - [\alpha (\iota^*) \pi_g (1 - d_g) + (1 - \beta (\iota^*)) \pi_b (1 - d_b)] \frac{dN_{UB}}{dy} < 0
\]  

(39)

\[ \text{The complementary slackness conditions are omitted.} \]

\[ \text{Since } \alpha (0) = 1 - \beta (0) \text{ this simply requires that the cum-benefit average NPV (from an investor perspective) } \pi_g \bar{x}_g + \pi_b \bar{x}_b \text{ is positive.} \]
Proof: Let us define the function \( C'(\tau^*) = -\alpha'(\tau^*) \pi_g \bar{x}_g + \beta'(\tau^*) \pi_b \bar{x}_b \). Since \( \tilde{N}_{U} = \frac{N_0}{y} \) it is obvious that \( \frac{d\tilde{N}_{U}}{dy} > 0 \). ■

This proposition reveals that regulatory benefits can have extreme consequences: Once regulatory benefits are sufficiently high \( y > \bar{y} \), the rating agency stops acquiring any information \( \tau = 0 \) and labels all firms as \( A \), in particular firms with a bad signal \( (\varepsilon_{BA} = 1) \). Interestingly, at the threshold level \( \bar{y} \) the level of information acquisition drops discontinuously to zero (see Figure ). This is true despite the fact that a financed unit of bad types still contributes negative revenue \( y < |x_b| \): the cost of identifying these bad project exceeds the benefit of avoiding them. The discontinuity in information acquisition can be mathematically explained as follows: Once it is profitable to choose \( \varepsilon_{BA} > 0 \), it turns out to be optimal to set \( \varepsilon_{BA} = 1 \) because the marginal benefit of this distortion is constant (independent of \( \varepsilon_{BA} \)) while the direct cost of choosing \( \varepsilon_{BA} > 0 \) is zero. Given that the rating agency reports an \( A \) rating for \( B \) rated firms in any case, it would be wasteful to first acquire a lot of costly information to separate good types from bad types and then bunching them together ex post. Therefore, the rating agency chooses not to acquire information in the first place and sets \( \tau = 0 \).

This argument reveals that the threshold level \( \bar{y} \) is a decreasing function of the cost of information acquisition. Formally, we can state this as follows

**Proposition 4** For the class of cost functions \( C_{\tau,k} (\tau) = \tau C (\tau) + k \) where \( \tau, k \in \mathbb{R}^+ \) the threshold level of regulatory benefits \( \bar{y} \) is decreasing in the cost parameters \( \tau \) and \( k \).

**Proof:** Let us define the function \( g (\tau^*, \bar{y}, \tau) = -\alpha (\tau^*) \pi_g \bar{x}_g - (1 - \beta (\tau^*)) \pi_b \bar{x}_b (\bar{y}) - \tau C (\tau^*) - k \). The threshold level satisfies:
\[
g (\tau^*, \bar{y}, \tau) = 0
\]
Optimal information acquisition implies that \( \frac{\partial g}{\partial \tau^*} = 0 \). Thus:
\[
\frac{d\tilde{N}_{U}}{d\tau} = -\frac{\partial g}{\partial \tau^*} = -\alpha (\tau^*) \pi_g (1 - d_g) + (1 - \beta (\tau^*)) \pi_b < 0
\]
\[
\frac{d\tilde{N}_{U}}{dk} = -\frac{\partial g}{\partial k} = -[\alpha (\tau^*) \pi_g (1 - d_g) + (1 - \beta (\tau^*)) \pi_b] < 0
\]
Since \( \tilde{N}_{U} \) is an increasing function of \( y \) the proof is completed. ■

Thus, if the cost of information acquisition becomes higher (higher \( \tau \) and \( k \)) the extreme result \( \tau^* = 0 \) and \( \varepsilon_B = 1 \) becomes more likely. More complex securities – which are presumably more costly to evaluate – are hence more likely to fall into this region.

While large regulatory benefits \( y > \bar{y} \) cause the rating agency to effectively abandon its information production technology and leads to excessive financing of negative NPV projects, small benefits \( (y \leq \bar{y}) \) generate non-trivial comparative statics: Since full disclosure is optimal (see Proposition 3) information acquisition (and thus investment efficiency) may increase, decrease

26 If there was an upper bound for the degree of distortion (less than \( \varepsilon_{BA} < 1 \) the constraint would bind at this level \( \varepsilon_{BA} \). This exogenous constraint could represent limits on the amount of rating inflation the regulator tolerates.

27 The fixed (set-up) cost is only incurred if the information acquisition level is positive.
or remain constant as a response to increases in regulatory benefits. Intuitively, the regulatory benefit of rated securities $y$ simply reduces the outside option of good types (increases $N_{U}$). Thus, we solely have to analyze the comparative statics of the equilibrium quantities (as outlined in Proposition 2) with respect to $N_{U}$ under the full disclosure regime. Of special interest are 1) the effect of regulatory benefits on the level of information acquisition and 2) the mass of $A$-rated firms.

**Proposition 5** In the full-disclosure region ($y \leq \bar{y}$) the comparative statics associated with increase in regulatory benefits $y$ are:

\[
\begin{array}{ccc}
\tau_{g} < \bar{\tau} & \frac{d\pi^{*}}{dy} & \frac{d\mu_{A}}{dy} \\
\bar{\tau} < \tau_{g} < \bar{\bar{\tau}} & (+) & (-) \\
\tau_{g} > \bar{\bar{\tau}} & (-) & (+)
\end{array}
\]

where: $\bar{\tau} = \frac{1}{1 + \alpha'(\pi^{*}) \frac{1 - d_{g}}{1 - d_{b}}}$ and $\bar{\bar{\tau}} = \frac{1}{1 + \alpha'(\pi^{*})}$

**Proof:** Since full disclosure is optimal in this region, the first-order-optimality condition for information acquisition (see Proposition 2), denoted as $h\left(\pi^{*}, N_{U}\right)$, is satisfied:

\[
h\left(\pi^{*}, N_{U}\right) = -\alpha'\left(\pi^{*}\right) \pi_{g} x_{g}\left(N_{U}\right) + \beta'\left(\pi^{*}\right) \pi_{b} x_{b}\left(N_{U}\right) - C'\left(\pi^{*}\right) = 0
\]  

(43)

where $x_{n}\left(N_{U}\right) = (1 - d_{n}) N_{U} - 1$. Since $N_{U}$ is an increasing function of $y$, the sign of $\frac{d\pi^{*}}{dy}$ is identical to $\frac{d\pi_{g}}{d\pi^{*}}$. We are interested in the effect on $\pi$:

\[
\frac{d\pi^{*}}{dN_{U}} = -\frac{\partial h}{\partial N_{U}} = -\alpha'\left(\pi^{*}\right) \pi_{g} (1 - d_{g}) + \beta'\left(\pi^{*}\right) \pi_{b} (1 - d_{b})
\]

(44)

Since $\frac{\partial h}{\partial \pi^{*}}$ refers to the second-order condition (negative). We obtain:

\[
\text{sign} \left(\frac{d\pi^{*}}{dy}\right) = \text{sign} \left(-\alpha'\left(\pi^{*}\right) \pi_{g} (1 - d_{g}) + \beta'\left(\pi^{*}\right) \pi_{b} (1 - d_{b})\right)
\]

(45)

Using $\pi_{b} = 1 - \pi_{g}$ yields conditions for a reduction in information acquisition:

\[
\pi_{g} < \bar{\bar{\tau}} = \frac{1}{1 + \alpha'(\pi^{*}) \frac{1 - d_{g}}{1 - d_{b}}}
\]

(46)

Otherwise information acquisition will be increased.

Now, consider the mass of rated firms $\mu_{A}$:

\[
\mu_{A} = \pi_{g} (1 - \alpha (\pi)) + \pi_{b} \beta (\pi)
\]

(47)

\[
\text{sign} \left(\frac{d\mu_{A}}{dy}\right) = \text{sign} \left(\frac{\partial \mu_{A}}{\partial \pi} \frac{d\pi^{*}}{dy}\right)
\]

(48)
Analogously to above, the sign is determined by:

\[
\text{sign} \left( -\pi_g \alpha'(\iota^*) + \pi_b \beta'(\iota^*) \right) \left[ -\pi_g \alpha'(\iota^*) \left( \frac{1-d_g}{1-d_b} \right) + \pi_b \beta'(\iota^*) \right] \]

(49)

Since \(-\pi_g \alpha'(\iota^*) \left( \frac{1-d_g}{1-d_b} \right) + \pi_b \beta'(\iota^*) > -\pi_g \alpha'(\iota^*) + \pi_b \beta'(\iota^*)\) it must be true that if the first term is positive, the second term is positive as well. Likewise if the second term is negative, the first one is negative as well. Thus, we obtain sufficient conditions for an increase in the mass of \(A\)-rated securities \(\frac{d\mu_A}{d\pi} > 0\)

\[
-\pi_g \alpha'(\iota^*) + \pi_b \beta'(\iota^*) > 0 \\
-\pi_g \alpha'(\iota^*) \left( \frac{1-d_g}{1-d_b} \right) + \pi_b \beta'(\iota^*) < 0 \tag{50} \tag{51}
\]

In contrast, a decrease in the mass of \(A\)-rated securities occurs if and only if both of these conditions are violated: Using \(\pi_b = 1 - \pi_g\) yields the region in which \(\frac{d\mu_A}{d\pi} < 0\) holds:

\[
\frac{1}{1 + \frac{\alpha'(\iota^*)}{\beta'(\iota^*)} \left( \frac{1-d_g}{1-d_b} \right)} = \pi < \pi_g < \bar{\pi} = \frac{1}{1 + \frac{\alpha'(\iota^*)}{\beta'(\iota^*)}} \tag{52}
\]

Several observations in order. The sign of the comparative statics is **independent** of the payoff in the good state \(R\), the level of the outside option \(N_U\), and the cost function for information acquisition \(C'(\iota)\). It solely depends on the distribution of the underlying risks (the default probabilities \(d_n\) and relative proportion of types \(\pi_n\)) as well as the ratio of the change in the \(\alpha\) error relative to the \(\beta\) error. Using the natural starting point \(\alpha(\iota) = \beta(\iota)\), the threshold parameters for the proportion of good types simplify to \(\bar{\pi} = \frac{1}{1 + \frac{d_g}{1-d_g}}\) and \(\bar{\pi} = \frac{1}{2}\). Such a situation is illustrated in Figure[2]. If the percentage of good projects in the economy is smaller than \(\bar{\pi}\) an increase in regulatory benefits will result in less information acquisition and a larger number of \(A\) rated firms. In the intermediate range between \(\bar{\pi}\) and \(\bar{\pi}\) information acquisition is increased, but fewer firms are rated \(A\). For \(\pi_g > \bar{\pi}\) more firms will be rated \(A\) and information acquisition increases. Thus, a reduction in information acquisition (\(\pi < \bar{\pi}\)) is always associated with an increase in the number of \(A\)-rated firms.

The threshold values are determined by the interplay of two effects. Recall that revenue \(S = \mu_A(\iota) \cdot f(\iota, N_U)\) consists of two components: volume \(\mu_A(\iota)\) and price \(f^*(\iota, N_U)\). Revenue can be increased through the volume and / or the price channel. Higher regulatory benefits of ratings increase the price \(f\) holding information acquisition fixed \(\frac{\partial f}{\partial N_U} > 0\). Higher information acquisition, i.e. quality, increases the price \(\frac{\partial f}{\partial \pi} > 0\) and this effect is even more pronounced if regulatory benefits are high \(\frac{\partial^2 f}{\partial \pi \partial N_U} = -d_A'(\iota) > 0\). However, higher information acquisition has an ambiguous effect on volume depending on the level of \(\pi_g\). For \(\pi_g > \bar{\pi}\) an increase in information acquisition generates an increase in volume \(\mu_A'(\iota) > 0\). Since the volume effect \(\mu_A'(\iota) > 0\) and the price effect \(\frac{\partial^2 f}{\partial \pi \partial N_U} > 0\) go in the same direction, the marginal benefit of information acquisition is increased. The rating agency increases both its volume and precision at the same time. For \(\pi_g < \bar{\pi}\) the price effect and the volume effect go in different directions. For \(\bar{\pi} < \pi_g < \bar{\pi}\) the price effect dominates: Information acquisition is increased although it leads to a decrease in volume. If \(\pi_g < \bar{\pi}\) the volume effect dominates: Information acquisition is reduced and thus volume is increased.
Since our signal structure is kept very general, it is useful to analyze our results in the full disclosure region with respect to the signal structure. It is useful to study two extreme examples which both predict an increase in the mass of A rated firms, but generate different implications for the level of information acquisition:

1. No alpha error $\alpha(i) = 0\forall i \geq 0$: i.e. good types always get the high signal. This signal structure can be interpreted as an exam that is too easy (US driver license). All good types get it right, but also a sizeable fraction of bad students. In this case, $\pi = \bar{\pi} = 1$. Information acquisition is always reduced if regulatory benefits increase.

2. No beta error $\beta(i) = 0\forall i \geq 0$: i.e. bad types always get the low signal. This signal structure refers to an exam that is too hard. Bad types always fail and good types sometimes fail. In this case $\pi = \bar{\pi} = 0$. Information acquisition is always increased if regulatory benefits increase.
4 Repeated Game Analysis

So far, we assumed that the rating agency can commit to any desired disclosure rule and level of information despite the fact that information acquisition is not observable. This is particularly relevant for the case $y \leq y$ in which full disclosure is optimal under commitment. In this section, we show that this assumption can be endogenized within a repeated game in which the previous setup corresponds to the stage game $\Gamma$. Let $\delta$ represent the one period discount factor and assume for simplicity that all relevant actions occur at the beginning of the period. Let $t$ index time and $h^{t-1}$ represent the entire history of realized defaults in rating class $A$ as well as the announced ex-ante probability of default of the rating agency. Note, that the announced ex-ante probability of default is fully determined by the disclosure rule $\varepsilon$ and information acquisition $i$.

In the previous section with a committed rating agency, it was irrelevant whether each period one firm is drawn from the pool of firms or the entire cross-section of firms is rated. For the repeated game section, it turns out to be important to observe the entire cross-section of firms to enhance information about the rating agency’s effort. With independence of realized defaults and signals across firms, the cross-section of firms perfectly reveals the effort choice of the rating agency ex post to the public, i.e. the announced default probability of $d_A (i)$ must coincide with the realized default probability $\tilde{d}_A$ (assuming the rating agency does not deviate). While the independence assumption is clearly extreme, it captures an important element that holds more generally for arbitrary correlation structures: Cross-sectional diversification increases the precision of the signal about the effort of the rating agency and thus strengthens the reputation mechanism. In addition, independence has the convenient feature that it allows us to use the machinery of games with perfect public information. Formally, we aim to support the best possible subgame perfect equilibrium from the perspective of the rating agency (as described in the previous section) with the worst possible subgame perfect equilibrium:

**Lemma 3** The worst possible subgame perfect equilibrium features zero information acquisition $i = 0$ and no capital provision by investors.

It is clearly optimal that the rating agency does not acquire any information given that investors will not fund rating class $A$. Likewise, given that the rating agency does not exert effort, it is optimal not to fund any rated firm. Therefore, this equilibrium features zero profits for the rating agency. We believe that the loss of future business is the only realistic punishment of rating agencies as the "Freedom-of-Speech-Act" exempts opinion providers from legal sanctions. The loss of future business can be also be interpreted as a form of "market discipline".

Due to the equilibrium concept of subgame perfection it is sufficient to check sustainability by considering the best possible one period deviation. The best possible one period deviation involves choosing $i = 0$ and $\varepsilon$ such that the mass of rated firms is consistent with the announced level of information acquisition, i.e.:

$$\tilde{\mu}_A (\varepsilon) = \mu_A (0) (1 - \varepsilon_{AB}) + \mu_B (0) \varepsilon_{BA} = \mu_A (\varepsilon^*)$$

This implies that the realized cash flow from a project does not have to be discounted. This assumption is not crucial, but simplifies the comparison to the previous sections.

Also note that the term "announcement" does not reflect any special role of the announcement itself. It solely serves to coordinate on an equilibrium.
This deviation allows the rating agency to collect revenue once from A-rated firms without incurring the cost of information acquisition. The equilibrium considered in the previous section is sustainable if and only if the continuation value from future business outweighs the short-run temptation not to not acquire information:

\[
\frac{S(t^*) - C(t^*)}{1 - \delta} > S(t^*)
\]

This results in the following Folk Theorem:

**Proposition 6** Folk Theorem: If the discount factor \( \delta \) is greater than \( \tilde{\delta} = \frac{C(t^*)}{S(t^*)} \), the equilibrium of the repeated game \( \Gamma^\infty \) replicates the equilibrium of the stage game \( \Gamma \) with commitment on the side of the rating agency characterized in Proposition 2.

Note, that if \( y > \tilde{y} \), the incentive problem of the rating agency is non-existent. Investors observe that all firms (mass 1) are rated A so that the disclosure rule and implied level of information acquisition \( (t_{\text{min}}) \) is revealed through the report alone. In this case, the discount factor is irrelevant and the repeated game setup superfluous. For high regulatory benefits reputation enforced through "market discipline" would not incentivize the rating agency to produce informative ratings. Everybody in the economy (save for the regulator) knows that the rating agency has moved the business of regulatory arbitrage rather than providing information. In this case, disciplinary action by the regulator using the threat of removing regulatory accreditation could incentivize the rating agency to provide informative ratings.

### 5 Conclusion

This paper has analyzed the business model of a profit-maximizing rating agency when ratings are used for regulatory purposes. In such an environment, ratings do no just convey information about the riskiness of the underlying security, but are also driven by regulatory considerations. Our model predicts that sufficiently large regulatory benefits of highly rated securities can destroy the rating agency's traditional role of delegated information acquisition: The rating agency will just engage in rating inflation. This phenomenon occurs more likely with complex securities which are costly to evaluate and leads to a severe misallocation of funds in the economy. Interestingly, if regulatory benefits are below a certain threshold full disclosure of information is optimal: Regulatory benefits may then even increase the rating agency's incentive to acquire information translating into higher investment efficiency in the economy. The comparative statics in the full-disclosure region depend on the cross-sectional distribution of risks in the economy.

We believe that these results suggest further empirical and theoretical extensions of our paper. First and foremost, our analysis is relevant for the planned regulatory overhaul of the financial sector. It would be interesting to incorporate an active regulator into our model that trades off the distortions in the informativeness of ratings with the potential direct benefits of regulation in dampening excessive risk-taking of financial institutions. Due to human capital constraints, it may be sensible to reduce the regulator's information set relative to the investors leading to more robust regulation. Such an analysis would be especially interesting in the context of aggregate shocks that give rise to time varying default risks which make it more difficult...
to disentangle bad luck from low effort. This extension would potentially result in interesting implications on the dynamics of rating agency distortions in the context of government regulation.

Moreover, it seems worthwhile to analyze the effect of incorporating a second rating agency into the model to better understand the effect of competition. If competition is modeled simply in a reduced form way by limiting the rents that accrue to the rating agency (see Petersen and Rajan (1995)) our model suggests that the comparative statics with respect to an increase in regulatory benefits can also be interpreted as the comparative statics of an increase in market power. However, this reduced form modeling approach does not consider the non-trivial implications of imperfectly correlated signals across rating agencies and regulation that is contingent on two positive ratings (which is common practice).

On the empirical side, it would be interesting to test the feedback effect of regulation on the behavior of rating agencies using official accreditation of rating agencies as a natural experiment. While the study of Strahan and Kisgen (2009) mainly confirms the priced impact of ratings (a necessary condition for our analysis) testing the feedback effect on the rating agency’s precision of ratings is left for future research. Our model would also predict that recently accredited rating agencies start exploiting their regulatory power by extending their service to new security classes in which they possess relatively little expertise.

References


