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Rating agencies in the face of regulation[☆]

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Abstract

This paper develops a theoretical framework to shed light on variation in credit rating standards over time and across asset classes. Ratings issued by credit rating agencies serve a dual role: they provide information to investors and are used to regulate institutional investors. We show that introducing rating-contingent regulation that favors highly rated securities may increase or decrease rating informativeness, but unambiguously increases the volume of highly rated securities. If the regulatory advantage of highly rated securities is sufficiently large, delegated information acquisition is unsustainable, since the rating agency prefers to facilitate regulatory arbitrage by inflating ratings. Our model relates rating informativeness to the quality distribution of issuers, the complexity of assets, and issuers' outside options. We reconcile our results with the existing empirical literature and highlight new, testable implications, such as repercussions of the Dodd-Frank Act.

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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 between 2007 and 2009.

Massive downgrading and defaults during the 2008/2009 financial crisis have led politicians, regulators, and the popular press to conclude that the rating agencies' business-model is fundamentally flawed. Since the issuer pays the rating agency to provide a rating, so the popular argument goes, rating agencies can capture some or all of the benefit of providing high ratings, implying "huge conflicts of interest" (Krugman, 2010) between rating agencies and the investors.

Recent academic studies provide a more nuanced perspective. For example, Stanton and Wallace (2010) provide evidence that incentives for rating inflation were particularly strong in the commercial mortgage-backed securities (MBS) market because of regulatory changes that reduced risk-based capital weights for *Aaa*-rated commercial MBSs compared with lower rated whole loans in the years leading up to the 2008/2009 crisis. This suggests that the increase in the regulatory advantage of the *Aaa* rating for these securities played an important role in the massive rating downgrades and high default rates observed during and following the crisis. For another example, although rating standards in the residential MBS market declined in the years leading up to the 2008/2009 crisis (Ashcraft, Goldsmith-Pinkham, and Vickery, 2010), they stayed conservative for corporate bonds.[1] These facts are difficult to explain based purely on conflicts of interest inherent in the issuer-pays model. We argue that theories of rating standards should not merely explain rating agencies' performance or failure in one specific episode but rather shed light on economic conditions that lead to better or worse outcomes when information acquisition is delegated to rating agencies.

To this end, this paper develops a theory that addresses determinants of cross-sectional and time-series variation in rating standards within a rational-expectations framework. Our analysis focuses on the interaction between the existing issuer-pays model of major rating agencies, and the regulatory use of ratings, such as the use of credit ratings to determine bank capital requirements. Rational expectations of investors imply that investors are not fooled in equilibrium by "obvious" conflicts of interest inherent in the business model of rating agencies.[2] Incorporating the regulatory use of ratings into the analysis is appealing because there is extensive empirical evidence that regulatory implications of ratings are a first-order concern for marginal investors; that is, ratings affect market prices through the channel of regulation, independent of the information they provide about the riskiness of securities (Kisgen and Strahan, 2010;

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[1]The sample of Ashcraft, Goldsmith-Pinkham, and Vickery (2010) covers the period between 2001 and 2007. Griffin and Tang (2012) report a sudden increase in rating standards as of mid-2007.

[2]In line with our rational expectations hypothesis, He, Qian, and Strahan (2012) and Kronlund (2011) provide evidence that investors required larger yields for bond issues that were subject to a greater risk of rating inflation.

Ashcraft, Goldsmith-Pinkham, Hull, and Vickery, 2011).[3] Our contribution is to incorporate the rating agency's ability to sell favorable regulatory treatment explicitly in a theoretical framework and to analyze its feedback effect on rating standards. Our results contrast with the popular notion that *catering* (to issuers) hurts investors, since they take ratings at face value and do not anticipate rating agencies' strategic incentives.[4] In our framework, the rating agency effectively caters to institutional investors' demands for regulatory relief, and investors are not fooled by inflated ratings.

Our analysis is positive in the sense that we take existing regulatory rules that favor highly rated securities as given, and analyze their impact on rating standards across asset classes with differential characteristics and over time. Although we do not attempt to answer a broader question of optimal regulation design in this paper, our model contributes toward a better understanding of the subtle effects rating-contingent regulation can have on rating standards.[5] Moreover, since regulation is an observable economic variable, our theory produces testable implications. In particular, it allows us to analyze the repercussions on credit rating standards implied by the Dodd-Frank Act, which mandates the elimination of rating-contingent regulation.

Our model reveals how the mere existence of a regulatory advantage for highly rated securities implies that small changes in characteristics such as the quality distribution of issuers, the complexity of securities, and issuers' outside options may induce large shifts in rating standards. This vulnerability is generated by an endogenous threshold level of the regulatory advantage beyond which the rating agency finds it profitable to stop acquiring any information and merely facilitates regulatory arbitrage through rating inflation. Below this threshold level, the rating agency acquires costly, private information and reveals this information truthfully to the public. In this case, an increase in the regulatory advantage of highly rated securities may actually increase rating informativeness. Since different asset classes will have different threshold levels for rating inflation, the effect

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[3]In the United States, the Securities and Exchange Commission (SEC) recognizes ten rating agencies, the so-called nationally recognized statistical rating organizations (NRSROs). White (2010) provides an excellent summary of the regulatory use of ratings. Kisgen and Strahan (2010) use the regulatory accreditation of Dominion Bond Rating Services as a natural experiment to identify the impact of regulation. Bongaerts, Cremers, and Goetzmann (2012) also document the first-order importance of rating-contingent regulation by exploiting the regulatory treatment of securities rated by multiple rating agencies.

[4]Kraft (2011) analyzes whether rating agencies cater to borrowers with rating-based loan coupon rates. She finds mixed evidence for this notion of catering.

[5]Given that regulation is the culprit, one might ask why the regulation is structured the way it is. An explanation that follows from our model is that the existing regulation worked pretty well for many years and failed only when new, highly complex classes of securities, whose information costs were much larger than those of the corporate bonds that had been the rating agencies' steady diet, were introduced. Another possible reason for using the current regulatory framework is lack of a good alternative. For example, using market prices, such as credit default swaps (CDS) on bank debt, instead of ratings is problematic as market prices used for regulation will, as Bond, Goldstein, and Prescott (2010) point out, reflect the regulation itself. We study normative issues of ratings-based banking regulation in a companion paper (see Harris, Opp, and Opp, 2012).

of regulatory changes may be heterogeneous across asset classes.[6] In the cross-section, this may help explain why rating practices for some classes of securities are conservative whereas ratings for other classes of securities are inflated.[7] In particular, more complex, harder-to-rate securities (such as CDOs) may have inflated ratings, whereas more traditional securities (such as corporate bonds), for which rating agencies have considerable experience and hence a lower cost of information production, are accurately rated.

Our model features a monopolistic rating agency within a private-prospects setup in which issuers/firms have private information about their type. There is a continuum of firms with two types of projects: positive net present value (NPV) projects and negative NPV projects. The rating agency has access to an information acquisition technology that generates private, noisy, binary signals about the type of projects. The precision of the signal is a continuous choice variable for the rating agency and determines the incurred information acquisition cost. The rating agency may truthfully disclose its private signals to the public, disclose biased ratings, or disclose no rating since the existence of the signal cannot be verified, as in Sangiorgi and Spatt (2012). Information acquisition and disclosure thus jointly determine the informativeness of ratings. We assume in the main exposition that the rating agency can commit to an announced level of information production and disclosure strategy. We show in Appendix A, however, that effective commitment can be incentive compatible for the rating agency in a repeated-game version of the model through rating multiple, not perfectly correlated, securities.

Absent regulation, the rating agency acquires costly information and publishes informative ratings. Truthful disclosure is optimal as it maximizes the rents the rating agency can extract for any given amount of private information it has. Although disclosing more favorable ratings relative to received signals increases the volume of highly rated securities, the resulting dilution of the information contained in ratings lowers the fee the rating agency can charge. This trade-off favors truthful disclosure. Thus, without rating-based regulation, the issuer-pays arrangement is not subject to rating inflation, that is, deliberate upward bias in reported ratings. With respect to the level of information produced, given truthful disclosure, the trade-off is between the marginal cost of more information production (which may vary across assets) and the increase in surplus the rating agency can extract from firms by providing better information to investors.

Introducing rating-contingent regulation that favors highly rated securities may increase or decrease the rating agency's information production, depending on the distribution of firm types. Yet, relative to the equilibrium without regulation, the rating agency has an incentive to rate more firms highly. If the distribution of firm types is skewed toward good types, an increase in the preferential regulatory treatment of highly rated securities leads the rating agency to produce more information, since increased preci-

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[6]Our model does not suggest that rating standards should be homogeneous across rating classes. However, the regulator should be aware of these heterogeneous practices as shown in the empirical study of Cornaggia, Cornaggia, and Hund (2012).

[7]For example, exotic, structured securities receive a much higher percentage of *Aaa* ratings (e.g., 60% for collateralized debt obligations (CDOs) than do corporate bonds (1%). See Fitch (2007).

sion results in more highly rated securities. The opposite is true when more bad types are present. Further, when the marginal investor's economic benefit from the preferential regulatory treatment of highly rated securities exceeds an endogenously determined threshold, regulation induces a complete breakdown of delegated information acquisition that is characterized by regulatory arbitrage and rating inflation. We show that this endogenous threshold is the level of the regulatory advantage at which pure regulatory arbitrage delivers the rating agency the same profits as optimal costly information acquisition and truthful disclosure of signals. The threshold thus depends crucially on evaluation costs, making complex securities such as structured products natural candidates for regulation-induced rating inflation. Moreover, our results predict that rating inflation is more likely to occur in boom times, when a higher fraction of good firms exists or the value of projects is higher, and in situations in which competitive forces that determine the good issuers' outside options are weak.[8] The fact that information is being chosen endogenously in our setup is crucial for rating inflation of this kind. If information acquisition were costless, the rating agency would always acquire and publish a perfect signal and rating inflation would not occur.

We structure the remainder of the paper as follows. We discuss the related literature in the next section. Section 3 presents the model. Its empirical implications and evidence are presented in Section 4. Section 5 concludes. Most formal proofs can be found in the Appendix whereas additional robustness checks are relegated to the Online Appendix.

2. Related literature

Our paper provides a rational explanation of rating inflation driven by rating-contingent regulation and an analysis of the effect such regulation has on the behavior of rating agencies. In contrast, the models of Bolton, Freixas, and Shapiro (2012) and Skreta and Veldkamp (2009) rely on behavioral biases of investors. In Bolton, Freixas, and Shapiro (2012), rating inflation emerges from a sufficiently high fraction of naïve investors, who take ratings at face value.[9] In Skreta and Veldkamp (2009), investors do not rationally account for an upward bias in reported ratings that is due to the fact that issuers can "shop for ratings"; i.e., they may approach several rating agencies and only disclose more favorable ratings.[10] The less correlated rating agencies' signals, the more scope there is

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[8]This result might explain the abrupt change in rating standards found by Griffin and Tang (2012) in mid-2007 when the economic crisis was looming.

[9]Such a mechanism cannot explain, as we do, the striking cross-sectional differences in rating patterns between conservatively rated plain vanilla corporate bonds and structured securities.

[10]Sangiorgi and Spatt (2012) study an environment in which ratings shopping of issuers is rationally accounted for by investors. Consistent with rational investor behavior, Kronlund (2011) finds that "investors appear to account for the expected bias in ratings when pricing yields. Specifically, if an agency rated an issuer's bonds one notch higher on average than the other agencies last year, a new bond with a rating from this agency will be associated with approximately 12 basis points higher yield, controlling for the bond's rating."

for rating shopping.[11] In contrast, our paper highlights the conflict of interest arising from rating agencies' ability to undermine the regulatory system, a channel which neither requires rating shopping nor investor irrationality.

The models of Bolton, Freixas, and Shapiro (2012) and Skreta and Veldkamp (2009) have the property that buyers are fooled by issuers in equilibrium. However, given the scale of the 2008/2009 crisis and the involvement of very sophisticated institutions (see White, 2010; Diamond and Rajan, 2009), an explanation that relies purely on behavioral distortions might be too simplistic. Indeed, Stanton and Wallace (2010) conclude that the sophistication of commercial MBS investors makes investor naïveté a less tenable explanation for the emergence of rating inflation in these years.[12]

Other models of rating agencies center around the idea that the interaction between a rating agency and borrowing firms can feature multiple equilibria. In Manso (2011), multiple equilibria with accurate ratings can arise if debt contracts specify higher coupon payments for lower credit ratings, implying a feedback effect of ratings on default risk. Boot, Milbourn, and Schmeits (2006) consider a model in which credit ratings can serve as a coordinating mechanism among market participants that helps implement equilibria without moral hazard on the side of the firm.

Whereas the focus of our paper is the issuer-pays model and its interaction with rating-contingent regulation, one can interpret the monopolistic seller of information in the classical models by Admati and Pfleiderer (1986, 1988) as a rating agency using the investor-pays model. Among other things, our model deviates from their setup in that the information provider can endogenously acquire information, but is not allowed to trade on its own account.

Our theory is also related to the economics of broader information certifiers and intermediaries. Lizzeri (1999) considers the optimal disclosure policy of a committed information certifier who can perfectly observe the type of the seller at zero cost. Our main departure from this seminal paper is that we consider not only the disclosure policy of a certifier, but also study the ex ante incentive of the certifier to acquire costly information.[13] Second, we introduce rating-contingent regulation that affects buyers', that is, investors', valuations in order to study the feedback effect on information acquisition. It is helpful to reconcile our prediction of full disclosure conditional on (endogenous) information acquisition with Lizzeri's result that the certifier discloses no information. Lizzeri's extreme result crucially relies on the assumption that the information intermediary is restricted to charge a uniform fee from all sellers regardless of their type, and, more importantly, information does not matter from a social perspective. In our setting, some

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[11]While Skreta and Veldkamp (2009) refer to low signal correlations across rating agencies as complexity, we model complexity as the rating agency's cost of determining the quality of an asset.

[12]Further empirical evidence on rating agencies' practices, in particular rating inflation, in the structured finance market can be found in Benmelech and Dlugosz (2009) and Coval, Jurek, and Stafford (2009).

[13]Endogenous information acquisition can also be found in the setting of Inderst and Ottaviani (2012), who study the quality of customer-specific advice by an intermediary.

projects have negative NPV, so information does matter from a social perspective.[14]

Various papers have analyzed the market structure for certification providers. Whereas Strausz (2005), Ramakrishnan and Thakor (1984), and Diamond (1984) predict that certification providers are essentially natural monopolists, Lizzeri (1999) finds the opposite effect. These opposite predictions result from the fact that market power in the first three papers tends to reduce commitment problems from which Lizzeri (1999) abstracts.

3. The model

3.1. Economic environment

3.1.1. Agents, technology, and information

Our model features an asymmetric information environment in which firms have better information than investors about the quality of their projects. Relative to a standard private-prospects setup, we add a monopolistic rating agency that has access to a proprietary information production technology.[15] All players (firms, investors, and one rating agency) are risk-neutral. There is a continuum of firms of measure 1. Each firm is owned by an 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 zero. Firms differ solely with regard to their probability of default.[16] In particular, there are two firm types $n \in \{g, b\}$ with respective default probabilities d_n, where g and b stand for "good" and "bad," respectively.[17] Although only entrepreneurs observe their projects' types, the fraction of good types in the population, π_g, is common knowledge. The NPV of a type-n project is given by

$$V_n = R\left(1 - d_n\right) - 1. \tag{1}$$

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 $\bar{d} = \pi_g d_g + \pi_b d_b$ is assumed to have negative NPV.[18] The parameters of the model, such as the default probabilities or the distribution of types, should be interpreted as asset-class specific.

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[14]Similar to Rock (1986), Kartasheva and Yilmaz (2012) introduce differentially informed investors into the setup of Lizzeri (1999). As a result, informative ratings can alleviate a lemons problem even if all projects have positive NPV.

[15]Note that the oligopolistic market structure of rating agencies is much better approximated by a monopoly than perfect competition. We account for some elements of competition by providing good firms with an outside option.

[16]We assume firms default on their contracts with investors if and only if their projects fail. Consequently, we refer to the probability of failure as the *default* probability.

[17]An earlier version of this paper contained three firm types. For ease of exposition, we now focus on a two-type setup. Most of our results are robust to the inclusion of multiple types (see Online Appendix).

[18]This assumption simplifies some of the proofs, because one never needs to worry about the case in which all firms get funded. This assumption does not affect our qualitative predictions.

Firms seek financing from competitive investors via the public debt market.[19] Investors require a non-negative NPV on each investment. Since the average project yields a negative NPV, adverse selection prevents financing of projects via the public debt market unless information asymmetry can be resolved to a sufficient degree. Firms can approach a rating agency that has access to an information production technology that generates noisy, private signals $s \in \{A, B\}$ of firm type, where A (B) refers to the good (bad) signal. We consider the following signal structure (see the left panel of Fig. 1):

$$\Pr\left(s = A \mid n = g\right) = \Pr\left(s = B \mid n = b\right) = 1 - \alpha\left(\iota\right), \tag{2}$$

where $\iota \in [0, \frac{1}{2}]$ denotes the rating agency's choice of information production. Importantly, the quality of the rating agency's signal, $1 - \alpha\left(\iota\right)$, is endogenous. Signals are informative if the error probability $\alpha\left(\iota\right)$ is smaller than 50%.[20] It is convenient and without loss of generality to assume α is affine; that is,

$$\alpha\left(\iota\right) = \frac{1}{2} - \iota.^{21} \tag{3}$$

Since signal quality is strictly increasing in the level of information production, ι, we will sometimes refer to ι itself as signal quality. The cost function for information acquisition $C\left(\iota\right)$ is increasing and convex,[22]

$$C'\left(0\right) = 0, \text{ and} \tag{4}$$

$$\lim_{\iota \to \frac{1}{2}} C'\left(\iota\right) = \infty. \tag{5}$$

Consistent with practice, the publication of a rating involves two steps (see Fig. 1). First, firms are provided with a free *indicative* rating $\tilde{r}$ by the rating agency (see also Fulghieri, Strobl, and Xia, 2011). Second, the indicative rating becomes the public rating, $r = \tilde{r}$, if the issuer decides to purchase the rating, denoted as $p_n\left(\tilde{r}\right) = 1$, for a fee $f > 0$. Otherwise, the issuer remains unrated (U) (see the right panel of Fig. 1).[23] Since signals s are not publicly observable, the rating agency can potentially offer indicative ratings,

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[19]The exact nature of the security issued is not important for our purposes. Given our simple, two-outcome projects with verifiable outcomes and zero payoff in the "failure" state, all securities are equivalent. We refer to the security issued as debt in keeping with the fact that in reality, only debt-like securities are rated.

[20]All results would go through if the error probabilities were different for different firm types. We consider the effect of different error probabilities and more general signal structures in the Online Appendix.

[21]The affine functional form for α is not without loss of generality if the error probabilities are different for different type firms, but our results require only that the error probabilities are decreasing in information acquisition and weakly convex. In the Online Appendix, we discuss further generalizations of the signal structure.

[22]We assume the costs of information acquisition are sufficiently low that operating a rating agency is profitable (see Online Appendix for a discussion of the parameter requirements).

[23]The equilibrium implications would be identical if the rating agency charged rating-contingent fees.
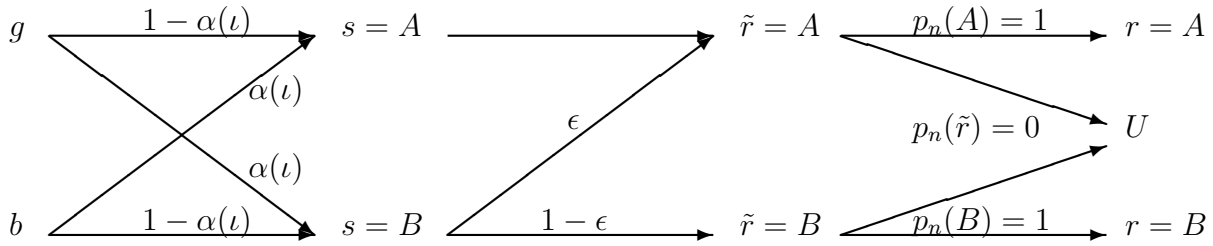
Fig. 1. Conditional on each type $n \in \{g, b\}$, the credit rating agency observes a quality signal $s \in \{A, B\}$. In case of a B-signal, the rating agency offers an indicative A-rating with probability ε. If a rating is purchased by the issuer, $p_n(\tilde{r}) = 1$, the rating $\tilde{r}$ becomes the public rating r. Otherwise, i.e., $p_n(\tilde{r}) = 0$, the firm remains unrated (U).

$\tilde{r} \neq s$. We model this formally as the probability ε that the rating agency offers an indicative rating of A to a firm with a B-signal. Thus, we consider only the economically relevant case of an upward bias in the offered rating relative to the signal.[24] As a result, firms with an indicative A-rating are of above-average quality. Full disclosure ($\varepsilon = 0$) maximizes the informativeness of ratings for any given level of information acquisition.

In the following analysis, we assume the value of future business is high enough that the rating agency can effectively commit to any desired level of information acquisition $\iota \geq 0$ and any disclosure rule $\varepsilon \geq 0$. We provide a formal justification for this assumption within a repeated-game setup in Appendix A. The formal argument resorts to variants of the Folk-Theorem as discussed by Fudenberg and Maskin (1986) and Fudenberg, Levine, and Maskin (1994).

We summarize the sequence of events in the game as follows:

1. The rating agency sets a fee f, information acquisition ι, and the disclosure rule ε.
2. Firms solicit a rating.[25]
3. The rating agency incurs information-acquisition cost $C(\iota)$ and receives a private, noisy signal s.
4. The rating agency reports an indicative rating $\tilde{r}$ to firms.
5. Firms decide whether to agree to pay the fee f to publish their ratings, and ratings of firms who do are published.
6. Investors decide whether to provide funding to firms.
7. Firms that agreed to pay the fee f do so, and invest the remainder of the funds raised.
8. Cash flows are realized at the end of the period, and debt is repaid if possible.

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[24]The Online Appendix proves that this is without loss of generality.

[25]It is possible to introduce an additional stage in which firms are allowed to send private messages about their type to the rating agency, and the rating agency can offer a menu of contracts. Since the equilibrium implications of this extension can be mapped into our current setting by (proportionally) adjusting the cost function, all qualitative implications of our setup are unaffected. This extension is laid out in the Online Appendix.

To capture the notion that firms with good projects have access to alternative costly ways of signaling their type, we introduce type-dependent outside options (see Laffont and Tirole, 1990), $\bar{U}_n$, satisfying $\bar{U}_b = 0 < \bar{U}_g < V_g$. Instead of purchasing a rating from the rating agency that we model, good types could choose to have their type verified by another rating agency or some other financial institution with access to an information production technology (e.g., a bank.). To keep the analysis simple, we assume firms have access to their outside option regardless of the rating published by the rating agency. The effective cost of these alternative technologies $(V_n - \bar{U}_n)$ is assumed to represent a loss in total surplus. Economically, the outside option captures in reduced form an important element of competition and prevents the monopolistic rating agency from extracting the entire surplus from the projects that are financed.[26]

3.1.2. Rating-contingent regulation

Regulatory and quasi-regulatory rules contingent on ratings can be found in bank capital requirements, suitability requirements (investment class restrictions), or collateral requirements. Although the underlying purpose of these regulations depends on the specific context, they all share the feature that better-rated securities imply lower regulatory compliance costs. For the purpose of studying feedback on the rating agency's decision, it only matters whether these regulatory advantages have pricing implications. The empirical analysis of Kisgen and Strahan (2010) reveals that investors require a regulatory yield spread of 39 basis points (bps) for a one-notch rating change, holding risk constant.[27] We take this empirical result as given and incorporate the effect of rating-contingent regulation in the following tractable way.

Assumption 1. *The marginal investor assigns a shadow value of $y < |V_b|$ dollars to the differential regulatory implications of holding an A-rated bond instead of a B-rated bond.*

Investors will purchase r-rated bonds with face value N_r if the value of expected repayments and regulatory advantages (if any) weakly exceeds the funds provided to the firm. Formally, the investors' participation constraint for an r-rated bond is given by

$$N_r\left(1 - d_r\right) + y \cdot 1_{r=A} \geq 1 + f, \tag{6}$$

where $1_{r=A}$ represents the indicator function for rating class A. The restriction on the size of $y < |V_b|$ is meant to exclude empirically less relevant cases and greatly simplifies

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[26]With oligopolistic credit rating agencies, the value of the outside option is itself endogenous, i.e., from the viewpoint of each rating agency, the value of an issuer's outside option would depend on the strategy of the other rating agencies. Such an analysis is interesting in its own right, separate from our focus on regulation, but would come at a great loss of tractability. Literally, our current model only captures an exogenous, non-strategic component of competition. For example, a regulatory change such as the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994 exogenously increased the competition from banks (see Ahmed, 2011).

[27]For this spread to be an equilibrium phenomenon, regulated investors must be marginal and regulatory constraints must bind (see He and Krishnamurthy, 2012).

the exposition of the paper. In the Online Appendix, we demonstrate the robustness of our results to relaxing this assumption.

Throughout the paper, we will consider y as an exogenous variable and will for simplicity refer to it as the "regulatory advantage" of A-rated bonds. Since our analysis focuses on the positive implications of existing regulatory rules, we make no attempt to rationalize rating-contingent regulation within our model as an optimal regulatory design.

3.2. Analysis

In the following, we analyze a symmetric Perfect Bayesian Equilibrium of the game described in Section 3.1 (in which all firms of the same type play the same strategy).

Definition 1. *Equilibrium:*
1) Each firm makes a rating purchase decision, $p_n(\tilde{r}) \in \{0, 1\}$, where $p = 1$ indicates the firm purchases its rating, to maximize the net present value of its net cash flows (after repayment of debt), given its indicative rating $\tilde{r}$, type n, the fee f, the signal precision ι, the disclosure rule ε, and the financing terms for each rating class, N_A and N_B.
2) Investors set face values N_r to break-even for each rating class r, given the firms' rating purchase decisions p, the regulatory advantage y, the information acquisition level ι, the disclosure rule ε, and the fee f.
3) The rating agency sets a fee f, information acquisition ι, and a disclosure rule ε, that maximizes its profits given the firms' rating purchase decisions and the financing terms required by investors.

For ease of exposition, we analyze the optimal strategies in three steps. First, we solve the firm's problem; second, we solve the investors' problem; and finally, we use the results from the first two steps to simplify and solve the rating agency's problem. This solution approach is similar to the approach used in Grossman and Hart (1983).

3.2.1. Firm problem

First, consider the decision of a firm of type n to purchase an indicative rating $\tilde{r}$, taking the strategies of all investors, the rating agency, and all other firms as given. Let N_r denote the minimum face value investors are willing to accept to purchase a bond with (public) rating r. A bad type purchases a rating $\tilde{r}$ ($p_b^*(\tilde{r}) = 1$) as long as $N_r < R$, which yields a positive expected payoff. In contrast, a good type only purchases a rating $\tilde{r}$ if the expected payoff of approaching the capital market using this rating is greater than its outside option $\bar{U}_g$. Thus, for a good type to purchase a rating, the face value of public debt must be sufficiently low, that is, $N_r \leq \bar{N} < R$, where $\bar{N}$ ensures that a good firm is just indifferent between purchasing a rating and using the outside option. In other words, $\bar{N}$ satisfies

$$(1 - d_g)(R - \bar{N}) = \bar{U}_g. \tag{7}$$

11

Since, whenever a good type purchases a rating $\tilde{r}$, $N_r \leq \bar{N} < R$, the bad type will also purchase that rating. This result is stated formally in the following lemma.

Lemma 1. $p_g(\tilde{r}) = 1$ *implies* $p_b(\tilde{r}) = 1$.

3.2.2. Investor problem

Now consider investors' strategies, taking firms' and the rating agency's strategies as given. Given Lemma 1 and the investors' break-even constraint, we obtain

Lemma 2. *B-rated and unrated firms cannot obtain public financing. A-rated firms may obtain public financing if $p_g(A) = 1$.*

Proof. See Appendix B. ∎

While the proof of this lemma needs to address all possible combinations of purchase decisions of both types conditional on the indicative rating, the main idea behind the proof is simple. First, since the *average* project in the economy cannot obtain public financing, a security class $r \in \{A, B, U\}$, where U stands for "unrated," must feature a disproportionately high fraction of good types to attract financing. Second, since firms with an indicative A-rating are on average better firms, only this class may obtain financing provided that good types actually purchase the A-rating.

As a result of Lemma 2, the rating agency can only collect fees f and make positive profits if it induces the good type to purchase the A-rating. By Lemma 1, this implies that bad types purchase the A-rating as well, i.e., $p_b(A) = 1$. Going forward, we will analyze only the case in which $p_n(A) = 1$ and $p_n(B) = 0$ for all types n.

The masses of firms for which the rating agency obtains the signals $s = A$ and $s = B$, denoted as μ_A and μ_B, respectively, satisfy

$$\mu_A(\iota) = \pi_g(1 - \alpha(\iota)) + \pi_b\alpha(\iota), \tag{8}$$
$$\mu_B(\iota) = \pi_g\alpha(\iota) + \pi_b(1 - \alpha(\iota)). \tag{9}$$

Given a disclosure rule ε, the mass of firms with an *indicative* rating of $\tilde{r} = A$, denoted by $\tilde{\mu}_A$, satisfies

$$\tilde{\mu}_A(\iota, \varepsilon) = \mu_A + \mu_B\varepsilon. \tag{10}$$

Since both types purchase the A-rating, the mass of firms with a public A-rating is also given by $\tilde{\mu}_A$. The posterior default probability of a security with a *public A*-rating, $d_A(\iota, \varepsilon)$, follows directly from Bayes' Law, i.e.,

$$d_A(\iota, \varepsilon) = \frac{\pi_g[1 - \alpha(\iota)(1 - \varepsilon)]}{\tilde{\mu}_A}d_g + \frac{\pi_b[\alpha(\iota) + (1 - \alpha(\iota))\varepsilon]}{\tilde{\mu}_A}d_b. \tag{11}$$

Competition among investors implies that the participation constraint (see Eq. (6))

binds, i.e., the face value N_A satisfies

$$N_A(\iota, \varepsilon, f, y) = \frac{1 + f - y}{1 - d_A(\iota, \varepsilon)}. \tag{12}$$

Investors provide financing as long as $N_A \leq R$, the maximum firms can pledge to deliver in the good state of the world.

3.2.3. Rating agency problem

The previous two subproblems imply the rating agency must set the fee f, information acquisition ι, and disclosure rule ε such that it induces good types to purchase an A-rating $(N_A(\iota, \varepsilon, f, y) \leq \bar{N})$. In equilibrium, fees f are collected from all firms that are offered an indicative rating of A, with mass $\tilde{\mu}_A(\iota, \varepsilon)$ (by Lemmas 1 and 2). Thus, the solution to the following profit maximization problem determines the rating agency's equilibrium behavior:

$$\max_{\iota, \varepsilon, f} \Pi(\iota, \varepsilon, f, y) = \tilde{\mu}_A(\iota, \varepsilon) f - C(\iota), \text{ s.t.} \tag{13}$$
$$N_A(\iota, \varepsilon, f, y) \leq \bar{N}.$$

First, we solve for the optimal fee f as a function of information acquisition ι, the disclosure rule ε, and the regulatory advantage y before studying the central question in this paper on how information acquisition and disclosure rules are set. The investors' participation constraint $N_A \leq \bar{N}$ can be rewritten as a constraint on the fee using Eq. (12):

$$f \leq f^*(\iota, \varepsilon, y) = (1 - d_A(\iota, \varepsilon)) \bar{N} + y - 1. \tag{14}$$

Profit maximization of the rating agency implies this constraint always binds: for a given level of y and rating quality implied by (ι, ε), the rating agency wants to charge the maximum possible fee f^*. It is useful to define an auxiliary variable $x_n(y)$ that measures the revenue contribution a firm of type n creates if it obtains an A-rating:

$$x_n(y) \equiv (1 - d_n) \bar{N} + y - 1. \tag{15}$$

This revenue contribution is increasing in the preferential regulatory treatment of A-rated securities y, and decreasing in the outside option of good types $\bar{U}_g$. If $y = \bar{U}_g = 0$, the revenue contribution of a type-n project is just equal to its NPV, i.e., $x_n = V_n$, since in this case, $\bar{N} = R$. Also, by Assumption 1, the revenue contribution of a bad firm with an A-rating is negative for any possible y, i.e., $x_b(y) < 0$.

3.2.4. Equilibrium

Benchmark $(y = 0)$. To understand clearly the mechanics of our results, it is useful first to study the optimal choice of information production ι^* and disclosure ε^* in an economy without rating-contingent regulation, $y = 0$, before tackling the case of $y > 0$.

Proposition 1. *The benchmark equilibrium is characterized by*
a) full disclosure ($\varepsilon^* = 0$),
b) the level of information acquisition satisfies $C'(\iota^*) = \pi_g x_g(0) - \pi_b x_b(0)$,
c) the fee satisfies $f^*(\iota^*, 0, 0) = \bar{N}(1 - d_A(\iota^*, 0)) - 1$,
d) the fraction of firms financed through the bond market is $\mu_A(\iota^*)$, and
e) rating agency profits are given by $(1 - \alpha(\iota^*))\pi_g x_g(0) + \alpha(\iota^*)\pi_b x_b(0) - C(\iota^*)$.

Proof. See Appendix B and Online Appendix. ∎

The rating agency fully discloses acquired information. Labeling firms with a B-signal as A ($\varepsilon > 0$) reduces profits through two channels. First, it reduces total surplus in the economy because a higher fraction of negative NPV projects is financed (recall $V_b(0) < 0$). Second, 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 decreases. Thus, the reduced fee that the rating agency can charge for its service outweighs the volume effect (more firms are rated A).

The optimal level of information production for the rating agency trades off the marginal cost, $C'(\iota^*)$, with the marginal private benefit of information acquisition that results from increasing the proportion of good projects rated A by π_g and decreasing the proportion of bad projects rated A by π_b. Each additional good project undertaken generates a revenue contribution of $x_g(0)$ to the rating agency whereas each bad project not financed avoids a loss of $|x_b(0)|$.[28]

Rating-contingent regulation ($y > 0$). Now suppose the regulatory advantage of an A-rating is positive. First, note that the rating agency would still prefer not to assign bad firms an A-rating if these could be *costlessly* identified, because their revenue contribution $x_b(y)$ is still negative, since $y < |V_b| < |x_b(0)|$.

We now present the main result of this subsection and one of the main results of the paper.

Proposition 2. *There exists a unique threshold level of the regulatory advantage, $\bar{y} \in (0, |x_b(0)|)$, such that full disclosure of information $\iota^*(y)$ is optimal if $y \leq \bar{y}$. Otherwise, all firms are rated A ($\varepsilon = 1$) and no information ($\iota = 0$) is produced. The threshold level of the regulatory advantage is defined implicitly by the equation*

$$(1 - \alpha(\iota^*(\bar{y})))\pi_g x_g(\bar{y}) + \alpha(\iota^*(\bar{y}))\pi_b x_b(\bar{y}) - C(\iota^*(\bar{y})) = \pi_g x_g(\bar{y}) + \pi_b x_b(\bar{y}), \quad (16)$$

where $\iota^*(y)$ is the optimal level of information acquisition for $y \leq \bar{y}$ defined by $C'(\iota^*) = \pi_g x_g(y) - \pi_b x_b(y)$.

Proof. See Appendix B. ∎

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[28]We show in the Online Appendix that the choice of signal quality does not equalize marginal cost with marginal social benefit.
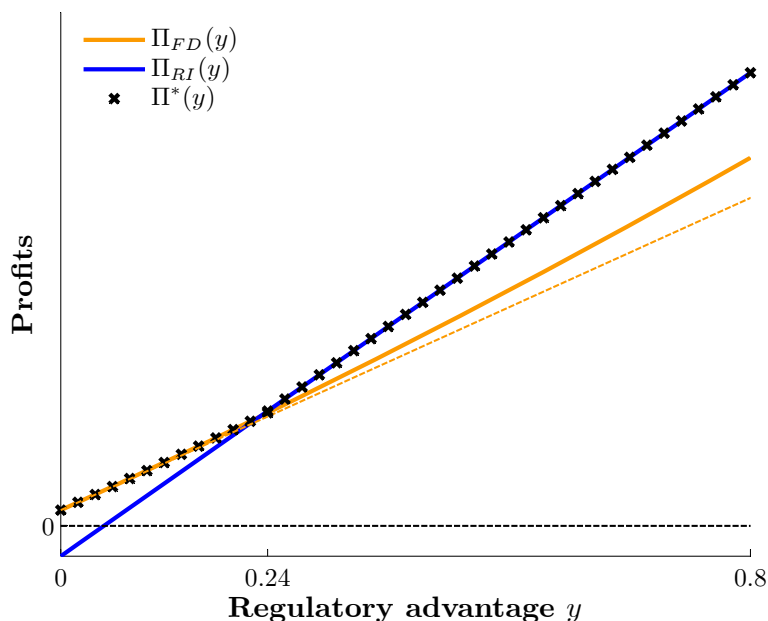
Fig. 2. The graph plots profits under full disclosure $\Pi_{FD}(y)$ and rating inflation $\Pi_{RI}(y)$ as a function of the regulatory advantage y. Equilibrium profits $\Pi^*(y)$ for $y < 0.24$ are given by full disclosure. At the rating inflation threshold $\bar{y} = 0.24$, profits from full disclosure and rating inflation are equalized. Rating inflation obtains for $y > 0.24$. The dotted line plots full disclosure profits assuming that information acquisition is fixed at $\iota^*(0)$. The cost function satisfies $C(\iota) = \frac{3}{5}\iota^2$. The remaining parameters are $R = 2$, $d_g = 0.4$, $d_b = 0.9$, $\bar{U}_g = 0$, and $\pi_g = 0.75$.

Proposition 2 shows that, although full disclosure will still be optimal if the regulatory advantage is not too large, for sufficiently large advantages $(y > \bar{y})$, the rating agency stops acquiring any information $(\iota = 0)$ and rates all firms as A, including firms with a bad signal $(\varepsilon = 1)$. At the threshold level $\bar{y}$, the level of information acquisition drops discontinuously to zero. The existence of some threshold level follows intuitively from the fact that higher regulatory advantages provide increased incentives to rate more securities highly. The surprising feature, however, is that, at the threshold level $\bar{y}$, the rating agency still loses money on every bad type that is rated A, since $x_b(\bar{y}) < 0$. The key ingredient for this feature is costly information acquisition.

The main ideas of the proof can be understood as follows. First, due to linearity of the profit function in ε, an interior solution for the disclosure rule $(0 < \varepsilon < 1)$ is strictly dominated by either full disclosure $(\varepsilon = 0)$ or complete rating inflation $(\varepsilon = 1)$. Thus, the rating agency's optimal joint choice of information acquisition and disclosure simplifies to the comparison of profits under two scenarios (as plotted in Fig. 2): optimal information acquisition $\iota^*(y)$ subject to full disclosure yielding profits of $\Pi_{FD}(y)$, or optimal rating inflation $(\varepsilon = 1)$ with no information acquisition yielding profits of $\Pi_{RI}(y) = \pi_g x_g(0) +$

15

$\pi_b x_b (0) + y.$[29] For low y, the strategy of rating inflation is unprofitable, i.e., $\Pi_{RI} (y) < 0 < \Pi_{FD} (y)$, so that full disclosure is optimal. At the threshold level $\bar{y}$, full disclosure profits $\Pi_{FD} (y)$ (left-hand side of Eq. (16)) are equal to rating inflation profits (right-hand side of Eq. (16)). The existence of a unique threshold level follows simply from the fact that profits under rating inflation are more sensitive to y than under full disclosure, formally, $\Pi'_{RI} (y) = 1 > \Pi'_{FD} (y)$ (see slopes in Fig. 2). The strict inequality follows from the fact that more (all) firms capture the regulatory advantage under rating inflation.

Finally, the threshold level is such that the rating agency still loses money on each financed bad type. This is optimal because full disclosure profits (see left-hand side of Eq. (16)) require costly information acquisition, whereas rating inflation avoids this cost altogether (see right-hand side of Eq. (16)). If information acquisition were costless, the optimal threshold would be simply $\bar{y} = |x_b (0)|$, i.e., the level at which the revenue contribution of bad types becomes non-negative.

Note that the rating inflation threshold, which satisfies $\bar{y} < |x_b (0)| = |V_b| + \frac{1-d_b}{1-d_g} \bar{U}_g$, may be so large that it is outside of the assumed parameter region, i.e., $\bar{y} > |V_b|$.[30] In this case, full disclosure will obtain for all $y < |V_b|$. We delegate the detailed equilibrium analysis for the case $y > |V_b|$ to the Online Appendix. Such extreme regulatory advantages, that is, $y > |V_b|$, can give rise to another kind of rating inflation in which all firms that obtain funding through the public market are bad firms and all good firms use their outside option.

3.3. Comparative statics

A key objective of our model is to explain which economic forces determine potential *differences* in the level of $\bar{y}$ across asset classes, and how regulation affects rating standards when the regulatory advantage of highly rated securities is below the threshold $\bar{y}$. In addition to the effect of y, we consider comparative statics with respect to

1. the parameters c and k for the class of cost functions $C_{c,k} (\iota) = cC (\iota) + k$, where $c, k \in \mathbb{R}^+$,[31]
2. the outside option of good issuers $\bar{U}_g$,
3. the payoff for success R, and
4. the fraction of good types π_g.

We present some intuition for our results following the formal statements and discuss their empirical implications in Section 4.

Determinants of the rating inflation threshold $\bar{y}$.

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[29]If the rating agency chooses $\varepsilon = 1$, any resources spent on information acquisition would be wasted.
[30]This can never happen if $\bar{U}_g = 0$.
[31]The fixed (set-up) cost, k, is only incurred if the information-acquisition level is positive.

16

Corollary 1. *The threshold level $\bar{y}$ is*
1) decreasing in the cost parameters c and k,
2) increasing in the outside option, $\bar{U}_g$,
3) decreasing in the payoff for success, R,
4) decreasing in the fraction of good types, π_g .

Proof. The comparative statics follow directly from the definition of the threshold (see Proposition 2) and the implicit function theorem. ∎

1) If the cost of information acquisition is higher (higher c or k), the rating inflation regime becomes relatively more attractive. Fig. 3 illustrates this relationship by plotting the equilibrium level of information acquisition $\iota^*(y)$ as a function of the regulatory advantage of A-rated securities y for low and high information acquisition costs ($c = 0.4$ and $c = 0.6$).[32] The left (right) panel plots the comparative statics for the case in which the population proportion of good types is greater (smaller) than 0.5. In both panels, the rating inflation threshold is lower (0.11 vs. 0.2 and 0.07 vs. 0.1) when the information acquisition cost is higher.

2) Although a better outside option for good types, $\bar{U}_g$, reduces the rating agency's profits in both regimes (under rating inflation and in case of information production), it reduces profits from rating inflation more, because in the rating-inflation regime, the rating agency provides all firms with the rents associated with the outside option $\bar{U}_g$ (all firms are rated A and obtain funding with face value $\bar{N}$), whereas the agency provides only a fraction of firms (those with high signals) with those rents when firms are rated truthfully. An increase in issuers' outside options therefore makes full disclosure *relatively* more attractive, implying the inflation threshold $\bar{y}$ is higher.

3) An increase in the payoff for success, R, has just the opposite effect on the inflation threshold as does the good firms' outside option, $\bar{U}_g$. In particular, an increase in R increases rating agency profits in both regimes, but it increases profits from rating inflation more for the same reason that an increase in $\bar{U}_g$ reduces them more. That is, the increase in R increases the amount the rating agency can extract from A-rated firms, and there are more of these when all firms are rated A. An increase in the payoff for success therefore makes full disclosure *relatively* less attractive, implying the inflation threshold $\bar{y}$ is lower.

4) An increase in the population proportion of good types π_g increases the rating agency's profits in both regimes, but it increases profits from rating inflation more. In the case of rating inflation, all bad projects are rated A and contribute negatively toward the rating agency's profits. In contrast, only a fraction of bad projects is financed if the rating agency provides informative ratings. A replacement of bad projects by good projects (as induced by an increase in π_g) therefore increases profits in the rating-inflation regime more.

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[32]In Fig. 3, $C'(\iota) = c\iota$, where c is either 0.4 or 0.6.

Determinants of information provision in the full-disclosure region. In the following, we analyze the determinants of information provision ι in the full-disclosure region $(y \leq \bar{y})$. First, consider the effect of the regulatory advantage y on the amount of information acquisition ι^* and the mass of A-rated firms μ_A.[33]

Proposition 3. *In the full-disclosure region $(y \leq \bar{y})$, an increase in y increases information acquisition if and only if $\pi_g > \frac{1}{2}$. Otherwise, information acquisition decreases. The mass of A-rated firms strictly increases with increases in y for $\pi_g \neq \frac{1}{2}$.*
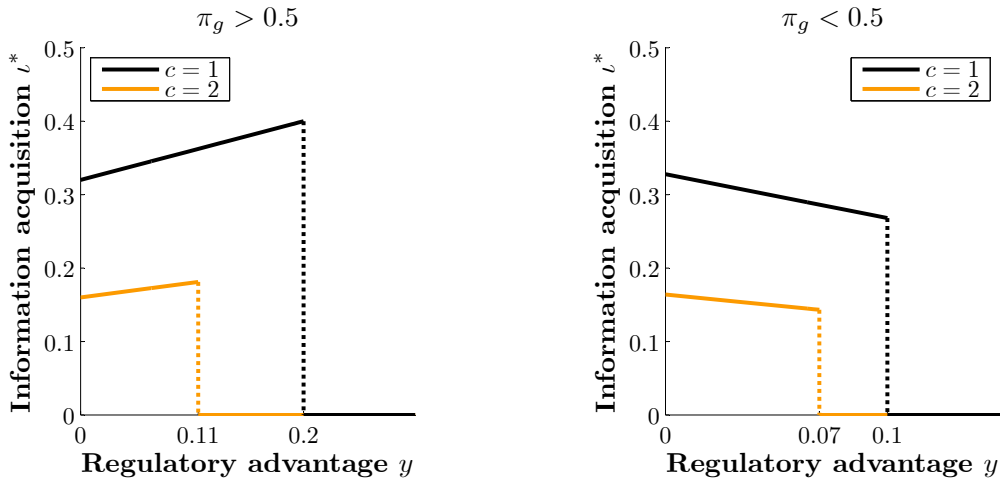
Proof. See Appendix B. ∎

Fig. 3. The graph plots equilibrium information acquisition ι^* as a function of the regulatory advantage y. The left (right) panel plots the comparative statics if the population proportion of good types is greater (smaller) than $\frac{1}{2}$ for low and high marginal costs c, respectively, where $C'(\iota) = c\iota$. In the left panel, the inflation threshold $\bar{y}$ falls from 0.2 to 0.11 when c increases from 1 to 2. Similarly, in the right panel, $\bar{y}$ falls from 0.1 to 0.07 when c increases from 1 to 2. The parameters for the left panel are $R = 2$, $d_g = 0.4$, $d_b = 0.8$, $\bar{U}_g = 0$, and $\pi_g = 0.7$. The parameters for the right panel are $R = 2$, $d_g = 0.1$, $d_b = 0.6$, $\bar{U}_g = 0.05$, and $\pi_g = 0.2$.

Proposition 3 shows that the level of information acquisition may increase or decrease in response to changes in the regulatory treatment of A-rated securities, depending on the distribution of risks in the cross-section.

In the left panel of Fig. 3, information acquisition increases as a function of y, since the fraction of good types satisfies $\pi_g = 0.7 > \frac{1}{2}$. In contrast, the right panel plots a case in which $\pi_g = 0.2 < \frac{1}{2}$ so that information acquisition decreases. The "volume channel" of regulation, the incentive to label more firms as A in response to a preferential regulatory treatment of A-rated securities, drives these comparative statics of informativeness. Since in the full-disclosure region, the fraction of A-rated firms is increasing in ι if and only if

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[33]Note that full-disclosure profits $\Pi_{FD}(y)$ is a convex function of y. Convexity results from the endogenous adjustment of information acquisition. If information acquisition were fixed at $\iota^*(0)$, the graph would be linear with slope $(1 - \alpha(\iota^*(0)))\pi_g + \alpha(\iota^*(0))\pi_b$ as shown by the dotted line in Fig. 2.

$\pi_g > \frac{1}{2}$, the sign of the "volume effect" on equilibrium information acquisition depends solely on the proportions of the two types π_n.

Corollary 2. *In the full-disclosure region $(y < \bar{y})$, information acquisition is*
1) decreasing in the cost parameter c and independent of k,
2) increasing in $\bar{U}_g$ for $\pi_g < \frac{\kappa}{1+\kappa}$ and decreasing otherwise, where $\kappa \equiv \frac{1-d_b}{1-d_g} < 1$ represents the ratio of success probabilities for the two firm types,
3) decreasing in R for $\pi_g < \frac{\kappa}{1+\kappa}$ and increasing otherwise,
4) increasing in π_g for $x_g(y) + x_b(y) > 0$ and decreasing otherwise.

Proof. See Appendix B. ∎

1) The comparative statics with respect to the cost parameters are directly intuitive. Higher marginal costs decrease the level of information. This is illustrated in both panels of Fig. 3 upon comparing low ($c = 1$) and high marginal costs ($c = 2$). Fixed costs only affect the threshold level for rating inflation. Hence, conditional on full disclosure, fixed costs do not affect the level of information acquisition.

2) An increase in the good types' outside option may increase or decrease information acquisition. On the one hand, an improvement in good types' outside option increases the rating agency's incentive to identify bad issuers since doing so allows the rating agency to avoid granting bad issuers rents they obtain by pooling with good issuers (these rents are directly related to the outside option $\bar{U}_g$). On the other hand, the rating agency has lower incentives to identify good issuers since it can extract lower rents from good types when their outside option is better. The latter effect dominates if the fraction of good types in the pool is large.

3) The comparative statics with respect to the payoff for success, R, are just the opposite of the comparative statics with respect to $\bar{U}_g$. Intuitively, it is irrelevant to the rating agency whether its rents are increased through higher R or a lower outside option $\bar{U}_g$.

4) An increase in the fraction of good types increases information acquisition if the gain per identified good type, $x_g(y)$, outweighs the loss of enabling financing for a bad type, $x_b(y)$. Thus, it depends on whether the incentives for information acquisition are primarily derived from sorting out bad types or enabling financing for good types.

4. Empirical implications

In this section, we discuss how our theoretical analysis may explain or predict the observed behavior of rating standards. Hence, we focus our discussion on predictions that can be most easily taken to the data, i.e., the unambiguous comparative statics for rating inflation (see Proposition 2 and Corollary 1) and the mass of highly rated securities (see Proposition 3). We begin by relating the model parameters to their empirical counterparts, with an emphasis on sources of variation for the regulatory advantage, y,

and the parameters affecting the threshold level $\bar{y}$.[34] This is followed by a discussion of how this variation affects ratings. Finally, we offer predictions about how planned future changes in regulation, such as the Dodd-Frank Act, will affect ratings going forward. Thus, these changes should provide a laboratory for testing our theoretical analysis.

An initial challenge for mapping our model to the data is the assumption that all issuers are observationally equivalent and only consist of one project. First, we should note that the "project" should be interpreted as the marginal funded project, and not the set of all projects undertaken by the firm.[35] Secondly, we should interpret our signals A vs. B relative to publicly available information, e.g., conditional on the size/leverage of the firm and the security class. This is consistent with the behavior of actual rating agencies which have generally provided relative assessments within particular categories, rather than across categories. Thus, for example, for some firms, the distinction between A and B refers to the difference between investment-grade and junk status, while, for others, it represents the difference between Aa and A (Moody's scale).[36]

This "conditional" interpretation also yields a first source of exogenous variation in y, our most important parameter. Following the results by Kisgen and Strahan (2010) and Ellul, Jotikasthira, and Lundblad (2011), the regulatory advantage is especially important around the investment-grade / junk threshold and at the Aaa vs. Aa threshold.[37] Thus, even within a security class and within the same time period, the regulatory advantage of the higher rating, y, should be greater at these benchmark thresholds. By Propositions 2 and 3, this creates greater incentives to inflate around these thresholds, i.e., a systematic tilt of the rating distribution toward the higher rating. In fact, this might explain why Griffin and Tang (2012) find that the rating agency in their analysis made positive rating adjustments to their internal model output at the Aaa threshold, i.e., a deliberate upward bias in ratings.[38] Our theoretical framework would also suggest that such positive adjustments should be significantly less frequent around less prominent rating thresholds, e.g., the Aa to A threshold.

Secondly, while the source of variation in y discussed in the previous paragraph results from differential regulatory importance across rating grades, differential importance of regulation to the marginal investor across security classes provides cross-sectional variation in y (controlling for the rating grade). To the extent that the marginal investor's regulatory constraint binds in one security class, but does not bind in another security class, say because the marginal investor in the latter class is a retail investor, one would

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[34]This discussion has significantly benefited from numerous insightful suggestions of Chester Spatt.

[35]Thus, it is possible that even a highly rated firm funds (on the margin) negative NPV projects.

[36]It is important to note, however, that the actual ratings-based regulatory treatment of securities is not conditional on such public information, i.e., regulation is just based on rating labels.

[37]Kisgen and Strahan (2010) estimate that the reduction in the debt cost of capital is 54 bps around the investment-grade cutoff vs. an average reduction of 39 bps. Likewise, Chen, Lookman, Schürhoff, and Seppi (2012) find evidence that the priced impact of ratings is disproportionately large in BB+ bonds just below the investment-grade boundary.

[38]Note that the usually unobserved internal model output of the rating agency could be interpreted as the true signal s in our paper.

expect cross-sectional differences in the incentives to inflate. The competing behavioral explanation for rating inflation of Bolton, Freixas, and Shapiro (2012) counterfactually predicts the opposite result for rating inflation, i.e., particularly strong incentives to inflate in asset classes with predominantly naïve retail investors. Along similar lines, one could exploit cross-sectional variation in the "tightness" of regulatory constraints across countries. To our knowledge, neither of these avenues has been explored. We also want to note that our model's predictions with regard to rating inflation do not apply to the class of sovereign debt, since country ratings are generally free of charge. Hence, the rating agency does not internalize the regulatory advantage of high ratings through fees, which shuts off the mechanism at the heart of our paper.

Third, time-series changes in regulation provide quasi-natural experiments. Here, one can distinguish between changes in regulation of the institutional investor, as exploited in the commercial MBS sample of Stanton and Wallace (2010), or changes in the regulatory status of a rating agency, such as in Kisgen and Strahan (2010). In the former case, our analysis predicts the rating inflation in the commercial MBS market documented in Stanton and Wallace (2010). In the latter case, Kisgen and Strahan (2010) investigate empirically the results of the SEC's accreditation of Dominion Bond Rating Services as an NRSRO. This accreditation allowed Dominion's ratings to be used for regulatory purposes, implying that, after accreditation, a high rating by Dominion offered a regulatory advantage, i.e., $y > 0$. Before they were designated an NRSRO, high Dominion ratings carried no such advantage, i.e., $y = 0$. Consequently, our model predicts a shift in the distribution of Dominion's assigned ratings towards better ratings, especially around the relevant cutoffs, after SEC accreditation. Kisgen and Strahan (2010), however, do not find empirical evidence of this behavior for Dominion Bond Rating Services. It would be interesting to examine the behavior of other recently accredited rating agencies before and after regulatory approval.

After highlighting exogenous variation of regulatory advantage y (across the rating spectrum, across security classes, and in the time-series), we now interpret variation of other model parameters that affect the threshold level for rating inflation $\bar{y}$ (as in Corollary 1). For example, if we interpret differences in information cost functions as reflecting differences in the complexity or difficulty of assessing the risks of the securities in question, we obtain the implication that more complex security classes should be more susceptible to rating inflation. It seems plausible that the century-long experience of rating agencies in rating standard corporate bonds makes these assets easier to evaluate than structured securities like CDOs, which require fundamentally different evaluation skills.[39] Viewed through the lens of our model, it is not surprising that CDOs were subject to rating inflation, while corporate bonds were not.

As another example, suppose that the good issuers' outside option, $\bar{U}_g$, reflects (in reduced form) the extent to which there is competition from, say, banks or other rating

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[39]Thus, although structured securities may not be inherently more complex than corporate bonds, the existing human capital of rating agencies makes rating corporate bonds cheaper as most of the costs are already sunk.

agencies for facilitating the issuance of securities. Result (2) in Corollary 1 then implies that, all else equal, increased competition for issuers can help prevent the occurrence of rating inflation, but its predictions on rating informativeness in the full-disclosure region depend on the fraction of good firms in the population, π_g (see Corollary 2). The empirical study of Becker and Milbourn (2011) finds strong support for less informative ratings of Standard and Poor's (S&P) and Moody's as a response to competition from Fitch. This result is consistent with our model if the fraction of good firms is not too large for a sufficient fraction of the securities in the sample.

If we view variations in the payoff to success, R, or fraction of good projects, π_g, as reflecting primarily business-cycle fluctuations, then results (3) and (4) in Corollary 1 predict more inflation in booms, e.g., as in the period leading up to the recent crisis. Consistent with this prediction, Griffin and Tang (2012) find a discontinuous increase in rating standards in April 2007, when the recession was imminent. Moreover, to the extent that the fraction of good types is smaller for new industries, result (4) may also be interpreted as predicting greater rating inflation in new industries.

Our model also has implications for the planned overhaul of financial regulation. In contrast to the supranational Basel III guidelines, the recently proposed Dodd-Frank Act aims to eliminate all regulation based on ratings in the US. Since other countries have not yet come forward with similar proposals to eliminate rating-contingent regulation, an isolated move of the US could provide another interesting source of exogenous cross-country variation. If this fundamental regulatory change is implemented, we would expect a reduction of the regulatory advantage of higher ratings. As a result, our model would predict a systematic downward shift in the distribution of ratings of the current NRSROs, especially around the two identified thresholds. Ratings for security classes that are subject to rating inflation, should become more conservative and exhibit large increases in informativeness.[40] For other security classes, the implied increase in conservative ratings should be less pronounced and informativeness of ratings may actually decrease depending on the underlying conditional distribution of risks (see Proposition 3). For example, if one is willing to attribute the historically lower default probabilities of municipal bonds relative to corporate bonds (conditional on a rating) to a significantly higher fraction of good types among municipal bonds, then our model would predict an increase in the precision of corporate bond ratings (where $\pi_g < \frac{1}{2}$) relative to municipal bond ratings (where $\pi_g > \frac{1}{2}$) around the relevant cutoffs after implementation of Dodd-Frank (see comparative statics of Proposition 3 with a decrease in y).[41] To make relevant net welfare comparisons, however, it is necessary to know how the alternative to rating-contingent regulation following Dodd-Frank's mandate to use "all publicly

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[40]This statement assumes that the decrease in y is sufficiently large to revert back to the full-disclosure region.

[41]For S&P, the historical cumulative default probabilities for non-investment grade municipal bonds is 7.37% vs. 42.35% for corporate bonds. This significant differential is persistent across all rating grades and is larger for lower ratings (similarly for Moody's). These calculations have been compiled as part of the Municipal Bond Fairness Act put forward by Frank (2008).

available information" is implemented.[42]

Finally, we want to highlight that the robustness of the model to various types of regulation implies that our model will not help us differentiate the effects of different regulatory channels, say, suitability regulation for investment funds vs. bank capital regulation. In terms of our model, we require only that regulation matters, i.e., ratings themselves are priced in addition to the information they contain, to feed back into the rating agency's incentives to acquire and disclose information.

While different kinds of regulation may have different ramifications for other economic outcomes, their impact on the informativeness of ratings, our focus, is effectively the same. Similarly, governance rules imposed by private parties in the investment industry have become quasi-regulations with importance similar to official rules set by the regulator. To the extent that Dodd-Frank does not affect this quasi-regulation, some effective regulatory power of rating agencies might persist even if official regulation removes references to ratings.

5. Conclusion

This paper develops a theoretical framework to explain variation in credit-rating standards over time and across asset classes. Our model focuses on the interaction between the issuer-pays model and the regulatory use of ratings, such as the use of credit ratings to determine bank capital requirements. The analysis reveals how variables such as the quality distribution of issuers, the complexity of assets, and issuers' outside options affect rating standards. Further, we show that the mere existence of a preferential regulatory treatment of highly rated securities implies that small changes in those variables may induce large shifts in rating standards. The effects of such changes may be heterogeneous across asset classes and help explain empirically documented cross-sectional differences in rating standards.

Although our implications are consistent with findings of the recent empirical literature (Stanton and Wallace, 2010; Ashcraft, Goldsmith-Pinkham, and Vickery, 2010), a host of empirical designs remain that could be employed to test the empirical predictions of our model (see Section 4). In particular, quasi-natural experiments that exploit variation in regulation across jurisdictions or time are promising candidates given our theory's tight link to regulation. In addition, testing the feedback effect of regulation on the behavior of rating agencies using official accreditations of rating agencies by regulators, as considered by Kisgen and Strahan (2010), would be interesting. Whereas Kisgen and Strahan (2010) mainly confirm the priced impact of ratings, future studies could test the direct feedback effect of regulatory accreditation on rating standards.

Our current model captures competition in a reduced-form way through the outside

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[42]The normative analysis of rating-contingent regulation of banks and its alternatives is the focus of Harris, Opp, and Opp (2012). It should be noted that public ratings are by definition part of "all publicly available information."

option of borrowers. It would certainly be interesting to develop a richer framework that not only allows for competition from other rating agencies, but also from imperfect substitutes such as banks or private equity funds which provide informed direct lending to the borrower. To appropriately model the oligopolistic rating agency industry, it seems reasonable to develop a dynamic collusion setup rather than applying an inherently static view such as Bertrand competition. If rating agencies were colluding perfectly, the oligopolistic equilibrium outcome would be identical to the monopolistic outcome studied in this paper; an extreme, but not completely unrealistic case. Other interesting aspects are whether and how rating agencies try to differentiate themselves in terms of price or ratings quality.

Finally, from a theoretical perspective, it is interesting to address the normative side of rating-contingent regulation, that is, to consider an optimal regulation design problem in the presence of capital market frictions that motivate the regulator's need for measures of creditworthiness such as in the case of a moral hazard problem among banks. See Harris, Opp, and Opp (2012). In this context, an analysis of the relative merits of using credit ratings rather than alternative market-based measures of creditworthiness as a basis for regulation would be a valuable contribution toward the financial reform debate. We leave these important questions for future research.

Appendix A. Repeated-game analysis

Commitment plays an important role in our analysis. In a one-period setting without commitment (and one rated firm), the rating agency always has an incentive to claim it has received an A-signal; that is, the optimal ex post disclosure rule is given by $\varepsilon = 1$. Rationally anticipating this behavior, investors would ignore any ratings for the purpose of evaluating the risk of a security. By backward induction, any finite repetition of the stage game will feature this uninformative equilibrium at each point in time. To obtain informative ratings as an equilibrium outcome, one can either resort to introducing incomplete information about the rating agency's type (honest vs. opportunistic) in the spirit of Kreps, Milgrom, Roberts, and Wilson (1982) or choose an infinite horizon setup. Whereas Fulghieri, Strobl, and Xia (2011) and Mathis, McAndrews, and Rochet (2009) choose the former approach, we will use the latter.

Let the previous setup correspond to the stage game Γ of an infinitely repeated game Γ^∞. Moreover, let δ represent the one-period discount factor for the rating agency and assume for simplicity that all relevant actions occur at the beginning of the period.[43] We assume rating agencies announce not only the rating of securities but also the ex ante probabilities of default associated with a given rating (as is their current practice). Let t index time and h^{t-1} represent the entire history of both realized defaults in rating class A and ex ante probabilities of default of A-rated firms. Note, that the announced ex

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[43]This implies 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. See also Opp (2012) for a similar modeling assumption.

ante probability of default is fully determined by the disclosure rule ε and information acquisition ι.

First, we consider the special case that defaults and signals are independent across firms. With a continuum of firms, this implies the realized default rate of a cross-section of firms perfectly reveals to investors ex post whether the rating agency deviated from its announced information production and disclosure strategy. That is, the announced default probability of $d_A(\iota)$ must coincide with the realized average default rate $\bar{d}_A$ if the rating agency does not deviate. Formally, independence has the convenient feature of allowing us to use the machinery of games with perfect public information. We aim to support the best possible subgame perfect equilibrium from the perspective of the rating agency using the worst possible equilibrium as the punishment for deviations from equilibrium play.

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

It is clearly optimal for the rating agency not to 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 for investors not to fund any rated firm. This is the worst possible subgame perfect equilibrium for the rating agency.

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 $\iota = 0$ and randomly assigning $\mu_A(\iota^*)$ firms with an A-rating, where $\mu_A(\iota^*)$ refers to the mass of A-rated securities under the recommended level of information acquisition with full disclosure. As a result, investors cannot already back out a deviation from the supply of ratings alone. 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 acquire information, that is, if and only if

$$\frac{S(\iota^*) - C(\iota^*)}{1 - \delta} > S(\iota^*), \tag{A.1}$$

where: $S(\iota^*) = (1 - \alpha(\iota^*))\pi_g x_g(y) + \alpha(\iota^*)\pi_b x_b(y)$.

This results in the following:

Proposition 4. *Folk Theorem: If the discount factor δ is greater than $\underline{\delta} = \frac{C(\iota^*)}{S(\iota^*)}$, the equilibrium of the repeated game Γ^∞ replicates the equilibrium of the stage game Γ with commitment on the part of the rating agency characterized in Proposition 1.*

Intuitively, higher costs increase the temptation to cheat and as such increase the discount factor threshold, whereas higher revenue reduces the threshold. Since the regulatory advantage of A-rated securities positively affects revenue, it makes informative ratings viable for a wider range of discount factors.

Note, that if $y > \bar{y}$, the incentive problem of the rating agency vanishes. Investors observe that all firms (mass 1) are rated A so that the disclosure rule and implied level of information acquisition ($\iota = 0$) is revealed through the report alone. In this case, the discount factor is irrelevant and the repeated-game setup is superfluous.

Finally, consider the case in which investors can detect deviation from the equilibrium strategy only stochastically, either because there are only a finite number of firms or because of correlation in defaults, even conditional on observable factors. In this case, we can make use of the well-known Folk Theorem with *imperfect public information* (see Fudenberg, Levine, and Maskin, 1994). Roughly speaking, if deviations from the rating agency's announced strategy can be identified with sufficient accuracy from public information, then a discount factor $\underline{\delta} < 1$ exists such that for all $\delta > \underline{\delta}$, the profit-maximizing equilibrium with commitment described in Proposition 1 represents an equilibrium in the infinitely repeated game without commitment.[44] In this case, rating multiple firms at the same time helps the statistical identification of cheating through cross-sectional diversification and increases the range of discount factors for which commitment is feasible.

Appendix B. Proofs

Proof of Lemma 2. Investors can potentially fund three types of securities: A-rated bonds, B-rated bonds, and unrated bonds. Funding is possible if there exists a face value $N_r \leq R$ such that

$$N_r (1 - d_r) + y \cdot 1_{r=A} \geq 1 + f. \tag{B.1}$$

Let $p(r) = (p_g(r), p_b(r))$. Since $p_g(r) = 1$ implies $p_b(r) = 1$ by Lemma 1 and $p(r) = (0,0)$ implies that rating class r is irrelevant, we have to consider only two relevant subcases for each purchase decision. Consider first the decision to purchase a B-rating.

1. $p(B) = (1,1)$: Recall that the set of firms with an indicative rating of B are by definition worse than the average firm. Since, in this case, both type firms are assumed to purchase a B-rating, $d_B(\iota, \varepsilon) = \tilde{d}_B(\iota, \varepsilon) \geq \bar{d}$. As the rating agency's fee is positive ($f > 0$), B-rated firms cannot obtain public financing in this case.

2. $p(B) = (0,1)$: In this case, investors infer that B-rated firms are bad, i.e., $d_B = d_b$, and hence, B-rated firms cannot obtain financing.

Consider now the decision to buy an A-rating.

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[44]Since Fudenberg, Levine, and Maskin (1994) only prove the result for a finite action set, a direct application of their theorem (without modification) requires the actions of the rating agency to be discretized. The model of Mathis, McAndrews, and Rochet (2009) features incomplete information and an infinite horizon. In their setup, the opportunistic rating agency also always reports truthfully if it is sufficiently patient.

1. $p(A) = (1,1)$: Again, since, in this case, both type firms are assumed to purchase an A-rating, $d_A(\iota, \varepsilon) = \tilde{d}_A(\iota, \varepsilon) \leq \bar{d}$, i.e., A-rated firms are better than the average firm. Since they also capture the regulatory advantage y, A-rated firms may obtain financing provided that the level of information acquisition is sufficiently high, i.e., $d_A(\iota, \varepsilon)$ is sufficiently low.

2. $p(A) = (0,1)$: In this case, investors infer that A-rated firms are bad. Since $y < |V_b|$ by assumption and $f \geq 0$, financing for A-rated bad firms is prohibited. We will consider the possibility of this case in the Online Appendix when we analyze the parameter region $y > |V_b|$.

Since $p(B) = (0,0)$, unrated firms are either of average risk if $p(A) = (0,0)$ or worse than average risk if $p(A) = (1,1)$. As a result, they cannot obtain financing.

Proof of Proposition 2. Profits of the rating agency are given by

$$\Pi(\iota, \varepsilon) = S(\iota, 0, y) + [\pi_g x_g(y) \alpha(\iota) + \pi_b x_b(y)(1 - \alpha(\iota))]\varepsilon - C(\iota), \qquad (\text{B.2})$$

where $S(\iota, 0, y) = (1 - \alpha(\iota))\pi_g x_g(y) + \alpha(\iota)\pi_b x_b(y)$.

As the objective function is linear in ε, we need to consider only three cases:

Case 1. Full Disclosure: $\varepsilon = 0$. The choice of information acquisition $\iota^*(y)$ maximizes $S(\iota, 0, y) - C(\iota)$.

Case 2. Rating Inflation: $\varepsilon = 1$. In this case, no information ($\iota = 0$) is acquired because there is no point in investing in information if it will not be used.

Case 3. Partial Rating Inflation: $0 < \varepsilon < 1$. In this case, the coefficient on ε in the objective function must be zero.

We will first show that Case 3 cannot occur in equilibrium because it yields lower profits than full-disclosure profits (Case 1). Since partial inflation requires the coefficient on ε to be zero, the associated information acquisition level ι^{**} must satisfy $\pi_g x_g \alpha(\iota^{**}) + \pi_b x_b(1 - \alpha(\iota^{**})) = 0$.[45] This would imply that profits are given by

$$\Pi(\iota^{**}, \varepsilon) = S(\iota^{**}, 0, y) + [\pi_g x_g \alpha(\iota^{**}) + \pi_b x_b(1 - \alpha(\iota^{**}))]\varepsilon - C(\iota^{**}), \qquad (\text{B.3})$$

$$= S(\iota^{**}, 0, y) - C(\iota^{**}) < \max_\iota S(\iota, 0, y) - C(\iota). \qquad (\text{B.4})$$

Thus, it is only necessary to compare the profits under full disclosure and rating inflation. Under full disclosure, the optimal level of information acquisition $\iota^*(y)$ must satisfy the first-order condition, $C'(\iota^*(y)) = \pi_g x_g(y) - \pi_b x_b(y)$. The rating agency's expected profits for Cases 1 and 2 are

$$\Pi(\iota^*(y), 0) = [1 - \alpha(\iota^*(y))]\pi_g x_g(y) + \alpha(\iota^*(y))\pi_b x_b(y) - C(\iota^*(y)), \text{ and} \qquad (\text{B.5})$$

$$\Pi(0, 1) = \pi_g x_g(y) + \pi_b x_b(y). \qquad (\text{B.6})$$

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[45]If no ι satisfies this condition, Case 3 is not possible.

The difference in profits, $\Delta\Pi(y) = \Pi(\iota^*(y), 0) - \Pi(0, 1)$, is a function of y, satisfying $\Delta\Pi(0) > 0$ (since full-disclosure profits are positive and the average NPV is negative) and $\Delta\Pi(|x_b(0)|) < 0$.[46] Thus, the existence of a unique threshold level $\bar{y} \in (0, |x_b(0)|)$ can be proved by establishing that $\Delta\Pi'(y) < 0 \forall y \in (0, |x_b(0)|)$. Using the envelope theorem, the derivative is given by

$$\Delta\Pi'(y) = -\pi_g \alpha(\iota^*(y)) - [1 - \alpha(\iota^*(y))]\pi_b < 0. \tag{B.7}$$

The threshold level $\bar{y}$ can be obtained by setting $\Delta\Pi(\bar{y}) = 0$.

Proof of Proposition 3. The first-order-optimality condition for information acquisition (see Proposition 1) can be written as

$$\pi_g x_g - \pi_b x_b + (\pi_g - \pi_b) y = C'(\iota^*). \tag{B.8}$$

By the implicit function theorem, we obtain

$$\frac{d\iota^*}{dy} = \frac{\pi_g - \pi_b}{C''(\iota^*)}. \tag{B.9}$$

This expression is positive if and only if $\pi_g > \frac{1}{2}$, negative if $\pi_g < \frac{1}{2}$, and zero if $\pi_g = \frac{1}{2}$. The mass of highly rated firms is given by $\mu_A = \pi_g(1 - \alpha(\iota)) + \pi_b\alpha(\iota)$. The comparative statics satisfy

$$\frac{d\mu_A}{dy} = \frac{\partial\mu_A}{\partial\iota}\frac{d\iota^*}{dy} = (\pi_g - \pi_b)\frac{\pi_g - \pi_b}{C''(\iota^*)} = \frac{(\pi_g - \pi_b)^2}{C''(\iota^*)} \geq 0. \tag{B.10}$$

This expression is strictly positive for $\pi_g \neq \frac{1}{2}$.

Proof of Corollary 2. By Proposition 2, the level of information acquisition satisfies for any $y < \bar{y}$:
$$C'(\iota^*(y)) = \pi_g x_g(y) - \pi_b x_b(y). \tag{B.11}$$

1) Obvious.
2) To obtain the comparative statics with respect to $\bar{U}_g$, note that $\frac{dx_n}{dU_g} = -\frac{1-d_n}{1-d_g}$. Thus, by the implicit function theorem, we obtain

$$\frac{d\iota^*}{d\bar{U}_g} = \frac{\pi_b\kappa - \pi_g}{C''(\iota^*)}, \tag{B.12}$$

where $\kappa \equiv \frac{1-d_b}{1-d_g} < 1$. Thus, for $\frac{d\iota^*}{d\bar{U}_g} > 0$, it is required that $\pi_g \leq \frac{\kappa}{1+\kappa}$ (as $C'' > 0$).

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[46]Recall that we constrain the subsidy y to be less than the negative contribution of the bad types to the agency's revenue, so that even with the subsidy, bad types' contribution to revenue is negative. If $y = |x_b(0)|$, bad types contribute zero revenue in both the full-revelation case and the rating-inflation case. In the full-revelation case, only good-type firms with good signals contribute $x_g(0) + y$ to revenue, whereas in the rating-inflation case, all good-type firms contribute this amount. Thus, when $y = |x_b(0)|$, rating inflation is better for the rating agency; that is, $\Delta\Pi(|x_b|) < 0$.

3) Applying the implicit function theorem yields

$$\frac{d\iota^*}{d\pi_g} = \frac{x_g\left(y\right) + x_b\left(y\right)}{C''\left(\iota^*\right)}. \tag{B.13}$$

Since $C'' > 0$, $\text{sign}\left(\frac{\partial \iota^*}{\partial \pi_g}\right) = \text{sign}\left(x_g\left(y\right) + x_b\left(y\right)\right)$.

References

Admati, A.R., Pfleiderer, P., 1986. A monopolistic market for information. Journal of Economic Theory 39, 400–438.

Admati, A.R., Pfleiderer, P., 1988. Selling and trading on information in financial markets. American Economic Review 78, 96–103.

Ahmed, J., 2011. Competition in lending and credit ratings. Unpublished working paper. University of California, Berkeley.

Ashcraft, A., Goldsmith-Pinkham, P., Hull, P., Vickery, J., 2011. Credit ratings and security prices in the subprime MBS market. American Economic Review 101, 115–119.

Ashcraft, A.B., Goldsmith-Pinkham, P., Vickery, J.I., 2010. MBS ratings and the mortgage credit boom. Unpublished working paper. Federal Reserve Bank of New York Staff Report No. 449.

Becker, B., Milbourn, T., 2011. How did increased competition affect credit ratings? Journal of Financial Economics 101, 493–514.

Benmelech, E., Dlugosz, J., 2009. The alchemy of CDO credit ratings. Journal of Monetary Economics 56, 617–634.

Bolton, P., Freixas, X., Shapiro, J., 2012. The credit ratings game. Journal of Finance 67, 85–112.

Bond, P., Goldstein, I., Prescott, E.S., 2010. Market-based corrective actions. Review of Financial Studies 23, 781–820.

Bongaerts, D., Cremers, K.M., Goetzmann, W.N., 2012. Tiebreaker: Certification and multiple credit ratings. Journal of Finance 67, 113–152.

Boot, A.W.A., Milbourn, T.T., Schmeits, A., 2006. Credit ratings as coordination mechanisms. Review of Financial Studies 19, 81–118.

Chen, Z., Lookman, A.A., Schürhoff, N., Seppi, D.J., 2012. Bond ratings matter: Evidence from the Lehman Brothers Index rating redefinition. Unpublished working paper. Shanghai University of Finance and Economics, Chartis Lausanne, University of Lausanne, and Carnegie Mellon.

Cornaggia, J., Cornaggia, K., Hund, J., 2012. Credit ratings across asset classes: $A \equiv A$? Unpublished working paper. Indiana University Bloomington and Rice University.

Coval, J.D., Jurek, J.W., Stafford, E., 2009. The economics of structured finance. Journal of Economic Perspectives 23, 3–25.

Diamond, D.W., 1984. Financial intermediation and delegated monitoring. Review of Economic Studies 51, 393–414.

Diamond, D.W., Rajan, R.G., 2009. The credit crisis: Conjectures about causes and remedies. American Economic Review 99, 606–610.

Ellul, A., Jotikasthira, C., Lundblad, C.T., 2011. Regulatory pressure and fire sales in the corporate bond market. Journal of Financial Economics 101, 596–620.

Fitch, 2007. Inside the ratings. Information Brochure. Fitch.

Frank, B., 2008. H.R. 6308: Municipal Bond Fairness Act. Act. U.S. House of Representatives, Washington, DC.

Fudenberg, D., Levine, D., Maskin, E., 1994. The folk theorem with imperfect public information. Econometrica 62, 997–1039.

Fudenberg, D., Maskin, E., 1986. The folk theorem in repeated games with discounting or with incomplete information. Econometrica 54, 533–554.

Fulghieri, P., Strobl, G., Xia, H., 2011. The economics of unsolicited credit ratings. Unpublished working paper. University of North Carolina at Chapel Hill.

Griffin, J.M., Tang, D.Y., 2012. Did subjectivity play a role in CDO credit ratings? Journal of Finance 67, 1293–1328.

Grossman, S.J., Hart, O.D., 1983. An analysis of the principal-agent problem. Econometrica 51, 7–45.

Harris, M., Opp, C., Opp, M.M., 2012. Optimum rating-contingent regulation. Unpublished working paper. University of Chicago, University of Pennsylvania, and University of California, Berkeley.

He, J., Qian, J., Strahan, P., 2012. Are ratings all created equal? The impact of issuer size on the pricing of mortgage-backed securities. Journal of Finance, forthcoming.

He, Z., Krishnamurthy, A., 2012. Intermediary asset pricing. American Economic Review, forthcoming.

Inderst, R., Ottaviani, M., 2012. Competition through commissions and kickbacks. American Economic Review 102, 780–809.

Kartasheva, A., Yilmaz, B., 2012. Precision of ratings. Unpublished working paper. University of Pennsylvania.

Kisgen, D.J., Strahan, P.E., 2010. Do regulations based on credit ratings affect a firm's cost of capital? Review of Financial Studies 23, 4324–4347.

Kraft, P., 2011. Do rating agencies cater? Evidence from rating-based contracts. Unpublished working paper. New York University.

Kreps, D.M., Milgrom, P., Roberts, J., Wilson, R., 1982. Rational cooperation in the finitely repeated prisoners' dilemma. Journal of Economic Theory 27, 245–252.

Kronlund, M., 2011. Best face forward: Does rating shopping distort observed bond ratings? Unpublished working paper. University of Illinois, Urbana-Champaign.

Krugman, P., 2010. Berating the raters. New York Times, New York edition, April 26.

Laffont, J.J., Tirole, J., 1990. Optimal bypass and cream skimming. American Economic Review 80, 1042–1061.

Lizzeri, A., 1999. Information revelation and certification intermediaries. RAND Journal of Economics 30, 214–231.

Manso, G., 2011. Feedback effects of credit ratings. Unpublished working paper. University of California, Berkeley.

Mathis, J., McAndrews, J., Rochet, J.C., 2009. Rating the raters: Are reputation concerns powerful enough to discipline rating agencies? Journal of Monetary Economics 56, 657–674.

Opp, M.M., 2012. Expropriation risk and technology. Journal of Financial Economics 103, 113–129.

Ramakrishnan, R.T.S., Thakor, A.V., 1984. Information reliability and a theory of financial intermediation. Review of Economic Studies 51, 415–432.

Rock, K., 1986. Why new issues are underpriced. Journal of Financial Economics 15, 187–212.

Sangiorgi, F., Spatt, C., 2012. Opacity, credit rating shopping and bias. Unpublished working paper. Stockholm School of Economics and Carnegie Mellon.

Skreta, V., Veldkamp, L., 2009. Ratings shopping and asset complexity: A theory of ratings inflation. Journal of Monetary Economics 56, 678–695.

Stanton, R., Wallace, N., 2010. CMBS subordination, ratings inflation, and the crisis of 2007–2009. Unpublished working paper. University of California, Berkeley.

Strausz, R., 2005. Honest certification and the threat of capture. International Journal of Industrial Organization 23, 45–62.

White, L.J., 2010. Markets: The credit rating agencies. Journal of Economic Perspectives 24, 211–226.