The Economics of Solicited and Unsolicited Credit Ratings

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Abstract

This paper develops a dynamic rational expectations model of the credit rating process, incorporating three critical elements of this industry: (i) the rating agencies' ability to misreport the issuer's credit quality, (ii) their ability to issue unsolicited ratings, and (iii) their reputational concerns. We analyze the incentives of credit rating agencies to issue unsolicited credit ratings and the effects of this practice on the agencies' rating strategies. We find that the issuance of unfavorable unsolicited credit ratings enables rating agencies to extract higher fees from issuers by credibly threatening to punish those that refuse to solicit a rating. Also, issuing unfavorable unsolicited ratings increases the rating agencies' reputation by demonstrating to investors that they resist the temptation to issue inflated ratings. In equilibrium, unsolicited credit ratings are lower than solicited ratings, because all favorable ratings are solicited; however, they do not have a downward bias. We show that, under certain conditions, a credit rating system that incorporates unsolicited ratings leads to more stringent rating standards. Finally, we argue that credit rating standards vary over the business cycle in a countercyclical fashion where economic "booms" are associated with lower standards and are followed by an increase in default rates of highly rated securities.

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1 Introduction

The role of credit rating agencies as information producers has attracted considerable attention during the financial crisis of 2007-2009. Their failure to predict the risk of many structured financial products and the subsequent massive downgrades—and defaults—have put the transparency and integrity of the credit rating process in question. Of particular concern to both investors and regulators is the incentive of credit rating agencies to inflate their ratings to please fee-paying issuers, questioning the effectiveness of reputation as a disciplining device.

Among the most controversial aspects of the credit rating industry is the issuance of unsolicited ratings. Unsolicited ratings are published by credit rating agencies *"without the request of the issuer or its agent"* (Standard & Poor's, 2007). In contrast to solicited ratings, which are requested and paid for by issuers, the issuance of unsolicited ratings does not involve the payment of a rating fee. Unsolicited credit ratings have been widely used since the 1990s and account for a sizeable portion of the total number of credit ratings.[1]

Despite the prevalence of unsolicited credit ratings, the agencies' incentives to issue them are not well understood. In a speech given in 2005, then-Chief Economist of the U.S. Securities and Exchange Commission Chester Spatt argued that *"from an incentive compatibility perspective, this [practice] would appear to weaken the incentive constraint that encourages a firm to pay for being rated; this suggests that it is puzzling that the rating services evaluate companies that do not pay for ratings"* (Spatt, 2005).[2] Credit rating agencies argue that unsolicited ratings should be seen as a service to *"meet the needs of the market for broader*

[1] Focusing on international issuers that received a credit rating by Standard and Poor's Ratings Services during the period from 1998 to 2000, Poon (2003) reports that unsolicited ratings have been assigned to 323 out of 595 issuers (53%). For the U.S. market, Gan (2004) estimates that unsolicited ratings account for 22% of all new issue ratings between 1994 and 1998. This estimate is based on rating fees paid by the issuers; the exact number is not known, since prior to 2004 rating agencies did typically not disclose whether a credit rating has been solicited by the issuer or not.

[2] In addition, Chester Spatt suggested that *"the most natural way to resolve the puzzle [...] would be if the unsolicited ratings were not as favorable to the rated company as the paid or solicited ratings"* so that *"the systematic downward bias in unsolicited ratings [is a way to] 'punish' firms that would otherwise not purchase ratings."* In Section 4, we will show that this is indeed the case in our model economy.

ratings coverage" (Standard & Poor's, 2007). Issuers, on the other hand, have expressed concern that these ratings—which they sometimes refer to as "hostile ratings"—are used to punish firms that would otherwise not purchase ratings coverage. For example, Herbert Haas, a former chief financial officer of the German insurance company Hannover Re, recalls a conversation with a Moody's official in 1998 who told him that if Hannover paid for a rating, it *"could have a positive impact"* on the grade.[3] This practice seems to be consistent with the empirical evidence showing that unsolicited ratings are, on average, lower than solicited ratings.[4]

In this paper, we develop a dynamic rational expectations model to address the question of why rating agencies issue unsolicited credit ratings and why these ratings are, on average, lower than solicited ratings. We analyze the implications of this practice for credit rating standards, rating fees, and social welfare. Our model incorporates three critical elements of the credit rating industry: (i) the rating agencies' ability to misreport the issuer's credit quality, (ii) their ability to issue unsolicited ratings, and (iii) their reputational concerns.

We focus on a monopolistic rating agency that interacts with a series of potential issuers that approach the credit market to finance their investment projects.[5] Markets are characterized by asymmetric information in that the firms' true credit worthiness is private information to the issuers. The credit rating agency evaluates the issuers' credit quality, i.e., their ability to repay investors. It makes these evaluations public by assigning credit ratings

[3]See *The Washington Post* from November 24, 2004. The article reports that within weeks after Hannover refused to pay for Moody's services, Moody's issued an unsolicited rating for Hannover, giving it a financial strength rating of "Aa2," one notch below that given by S&P. Over the course of the following two years, Moody's lowered Hannover's debt rating first to "Aa3" and then to "A2." Meanwhile, Moody's kept trying to sell Hannover its rating services. In March 2003, after Hannover continued to refuse to pay for Moody's services, Moody's downgraded Hannover's debt by another three notches to junk status, sparking a 10% drop in the insurer's stock price. The scale of this downgrade came as a surprise to industry analysts, especially since the two rating agencies Hannover paid for their services, S&P and A.M. Best, continued to give Hannover high ratings. For a more detailed account of this incident, see Klein (2004); additional anecdotal evidence of this practice can be found in Monroe (1987) and Schultz (1993).

[4]See, e.g., Gan (2004), Poon and Firth (2005), Van Roy (2006), and Bannier, Behr, and Güttler (2010).

[5]While we deliberately ignore the effect of competition and the related issue of "ratings shopping" in our analysis, it is important to note that the credit rating industry is a very concentrated and partially segmented market where three providers (Standard and Poor's, Moody's, and Fitch) have a market share of over 90%.

to issuers in return for a fee. Issuers agree to pay for these rating services only if they believe that their assigned rating substantially improves the terms at which they can raise capital. This creates an incentive for the rating agency to strategically issue inflated ratings in order to motivate issuers to pay for them. At the same time, investors cannot directly observe the agency's rating policy. Rather, they use the agency's past performance, as measured by the debt-repaying records of previously rated issuers, to assess the credibility of its ratings. The agency's credibility in the eyes of investors is summarized by its "reputation."

The credit rating agency faces a dynamic trade-off between selling inflated ratings to boost its short-term profit and truthfully revealing the firms' prospects to improve its long-term reputation.[6] Issuing inflated ratings is costly to the rating agency in the long run, since it increases the likelihood that a highly rated issuer will not be able to repay its debt, thereby damaging the rating agency's reputation. This, in turn, lowers the credibility of the rating agency's reports, making them less valuable to issuers and thus reducing the fee that the rating agency can charge for them in the future. The rating agency's optimal strategy balances higher short-term fees from issuing more favorable reports against higher long-term fees from an improved reputation for high-quality reports. Thus, in our model reputational concerns act as a disciplining device by curbing the agency's incentive to inflate its ratings. This disciplining effect is, however, limited by the fact that, after a default, investors are not able to perfectly distinguish cases of "bad luck" from cases of "bad ratings" (that is, inflated ratings).

Our analysis shows that the adoption of unsolicited credit ratings increases the rating agency's short-term profit as well as its long-term profit. This result is driven by two reinforcing effects. First, the ability to issue unsolicited ratings enables the rating agency to charge higher fees for their solicited ratings. The reason is that the rating agency can use its ability to issue unfavorable unsolicited ratings as a credible "threat" that looms over issuers

[6] As we will discuss in Section 2, we adopt the "adverse selection" approach to modeling reputation where, by assumption, players are uncertain about some key characteristic of other players (Mailath and Samuelson, 2006, Chapter 15).

that refuse to pay for its rating services. This threat increases the value of favorable solicited ratings and, hence, the fee that issuers are willing to pay for them.

The credibility of this threat stems from the fact that, by releasing unfavorable unsolicited ratings, the rating agency can demonstrate to investors that it resists the temptation to issue inflated ratings in exchange for a higher fee, which improves its reputation. This second effect, in the form of a reputational benefit, gives the rating agency an incentive to release an unsolicited ratings in case an issuer refuses to solicit a rating.[7] Note that this threat is only latent because, in equilibrium, high-quality issuers prefer to acquire favorable solicited ratings. Thus, in equilibrium, the credit rating agency issues unsolicited ratings along with solicited ratings. Since all favorable ratings are solicited, unsolicited credit ratings are lower than solicited ratings. However, they are not downward biased. Rather, they reflect the lower quality of issuers that do not solicit a rating.

The adoption of unsolicited credit ratings also has important welfare implications. We find that while rating agencies always benefit from such a policy—because of the higher fees that they can charge—society may not. In particular, we show that, for some parameter values, allowing rating agencies to issue unsolicited ratings leads to less stringent rating standards, thereby enabling more low-quality firms to finance negative NPV projects. This reduces social welfare and raises the cost of capital for high-quality borrowers. Such an outcome is obtained when the increase in rating fees associated with the adoption of unsolicited ratings is sufficiently large so that it outweighs the additional reputational benefit from truthfully revealing the firm's quality. When this increase in rating fees is small (which happens, for example, when the loss in market value due to an unfavorable unsolicited rating is low), we obtain the opposite result: the ability to issue unsolicited ratings leads to more stringent rating standards, which prevents firms from raising funds for negative NPV investments and, hence, improves social welfare. These results suggest that the question of whether credit

[7] This reputational benefit associated with unsolicited ratings may also explain why credit rating agencies issue sovereign debt ratings for which they do not receive any direct compensation.

rating agencies should be allowed to issue unsolicited ratings and, thus, to earn higher fees has no unambiguous answer.

Finally, we find that credit rating standards are countercyclical: the rating agency is more likely to issue inflated ratings during periods of economic expansion than during recessions. This is true whether or not the rating agency is allowed to issue unsolicited ratings. Consistent with the evidence in He, Qian, and Strahan (2009) and Ashcraft, Goldsmith-Pinkham, and Vickery (2010), this result implies that credit rating agencies loosen their rating standards during periods of high economic growth, which leads to an increase in default rates of highly rated securities.

Our paper contributes to the growing literature on the role of credit rating agencies and the phenomenon of ratings inflation. Mathis, McAndrews, and Rochet (2009) examine the incentives of a credit rating agency to inflate its ratings in a dynamic model of endogenous reputation acquisition. They show that reputational concerns can generate cycles of confidence in which the rating agency builds up its reputation by truthfully revealing its information only to later take advantage of this reputation by issuing inflated ratings. In Bolton, Freixas, and Shapiro (2011), ratings inflation emerges from the presence of a sufficiently large number of naive investors who take ratings at face value. Opp, Opp, and Harris (2010) argue that ratings inflation may result from regulatory distortions when credit ratings are used for regulatory purposes such as bank capital requirements. Finally, Sangiorgi, Sokobin, and Spatt (2009) and Skreta and Veldkamp (2009) focus on "ratings shopping" as an explanation for inflated ratings. While both papers assume that rating agencies truthfully disclose their information to investors, the ability of issuers to shop for favorable ratings introduces an upward bias. In Skreta and Veldkamp (2009), investors do not fully account for this bias, which allows issuers to exploit this winner's curse fallacy. In contrast, Sangiorgi, Sokobin, and Spatt (2009) demonstrate that when investors are rational, shopping-induced ratings inflation does not have any adverse consequences. While these papers share some important features with ours, the main contribution of our paper is to explicitly address the effect of

unsolicited ratings on the rating policy adopted by credit rating agencies and their impact on ratings inflation.

Our paper is also related to the broader literature on reputation as an incentive mechanism. This literature is enormous and we will not do it justice here. Firms have been shown to face reputational concerns in many aspects of their business, including repaying debt (Diamond, 1989), fighting new entrants (Kreps and Wilson, 1982; Milgrom and Roberts, 1982), not holding up suppliers (Banerjee and Duflo, 2000), meeting earnings targets (Fisher and Heinkel, 2008) and producing quality products (Cabral, 2000; Hörner, 2002). Reputation is also known to matter for underwriters (Chemmanur and Fulghieri, 1994a), banks (Chemmanur and Fulghieri, 1994b), and workers (Tadelis, 1999). For reputation to be interesting from an economist's viewpoint, the benefit of "cheating" (not repaying debt, for example) must be weighed against the cost of a lost reputation. These papers show that costs of reputation loss can be large enough to ensure "good behavior."

A number of empirical papers have shown that unsolicited ratings are significantly lower than solicited ratings, both in the U.S. market and outside the U.S.[8] These studies explore the reasons for this difference based on two hypotheses. The "self-selection hypothesis" argues that high-quality issuers self-select into the solicited rating group, while low-quality issuers self-select into the unsolicited rating group. Under this hypothesis, unsolicited ratings are unbiased. In contrast, the "punishment hypothesis" argues that lower unsolicited ratings are a punishment for issuers that do not pay for rating services and are therefore downward biased. More specifically, given the same rating level, an issuer whose rating is unsolicited should ex post perform better than one whose rating is solicited.

The findings of these papers provide conflicting evidence. On the one hand, using S&P bond ratings on the international market, Poon (2003) reports that issuers who chose not to obtain rating services from S&P have weaker financial profiles, which is consistent with

[8] A partial list includes Poon (2003), Gan (2004), Poon and Firth (2005), Van Roy (2006), and Bannier, Behr, and Güttler (2010).

the "self-selection hypothesis." Gan (2004) finds no significant difference between the performance of issuers with solicited and unsolicited ratings. This result leads her to reject the "punishment hypothesis" in favor of the "self-selection hypothesis." On the other hand, Bannier, Behr, and Güttler (2010) cannot reject the "punishment hypothesis" for their sample. Our analysis reconciles this conflicting empirical evidence. We show that while unsolicited ratings are lower, they are not necessarily downward biased. Rather, they reflect the lower quality of issuers. As a result, issuers with unsolicited ratings should have weaker financial profiles, but we should not observe any significant differences between their ex post performance and that of issuers with solicited ratings, once we control for their rating level. This argument, however, does not rule out the fact that rating agencies use unfavorable unsolicited ratings as a threat in order to pressure issuers to pay higher fees for more favorable ratings. In fact, our analysis shows that the "punishment hypothesis" and the "self-selection hypothesis" are not inconsistent with each other, but rather complement each other. We show that the rating agency's ability to issue unfavorable unsolicited ratings to high-quality firms acts as a "latent punishment" that may not be observed by investors. This happens because, in equilibrium, the rating agency optimally sets the fee that it charges for favorable solicited ratings at a level at which issuers prefer to purchase them rather than risk obtaining unfavorable unsolicited ratings.

The remainder of this paper is organized as follows. Section 2 introduces the model. Section 3 describes the equilibrium of the model and analyzes the optimal rating policy in a solicited-only rating system. Section 4 solves for the equilibrium strategies in a rating system that incorporates unsolicited ratings. Section 5 compares the rating agency's fees and rating standards under the two rating systems and derives implications for social welfare. Section 6 summarizes our contribution and concludes. All proofs are contained in the Appendix.

2 The Model

We consider an economy endowed with three types of risk-neutral agents: firms (or "issuers"), a monopolistic credit rating agency (CRA), and investors.[9] The game has two periods, denoted by $t \in \{1, 2\}$. The riskless rate is normalized to zero.

At the beginning of each period, a firm has access to an investment project with probability β. The project requires an initial investment of I units of capital. Firms have no capital and therefore must raise funds from outside investors in perfectly competitive capital markets. If the project is undertaken, it yields an end-of-period payoff of $R > I$ if successful ($\omega = S$) and a payoff of 0 if it fails ($\omega = F$). The outcome of the project, that is whether the project succeeds or fails, is observable to outside investors. If the firm does not invest, the project vanishes and the firm becomes worthless. Absent a project, the firm has no financing needs and does not access the capital market. Such a firm has a (default) value of $\bar{V} \geq 0$.

The quality of an investment project is characterized by its success probability. A type-G project (denoted by $\theta = G$) has a success probability of q, whereas a type-B project ($\theta = B$) has a success probability of zero.[10] Investors believe ex ante that a fraction α of projects are "good" (i.e., of type G) and a fraction $1 - \alpha$ are "bad" (i.e., of type B). We assume that, on average, firms have access to positive NPV projects and that the average project value exceeds the value of a firm without a project, i.e., $\alpha\, q\, R - I > \bar{V} \geq 0$. We use $\theta = N$ to denote a firm without a project.

Financial markets are characterized by asymmetric information. While firm insiders know the quality of their own project, outside investors cannot tell a firm with a good project from

[9] The organizational structure of the credit rating industry is not critical to our analysis. All we need is that, in equilibrium, the CRA extracts some of the surplus that it generates to ensure that reputation is an effective disciplining device. This is a plausible scenario since, in markets where reputation matters, a "good" reputation is acquired slowly over time and is necessarily in limited supply, making these markets inherently imperfectly competitive. In contrast, perfectly competitive markets are populated by anonymous players, and reputation building plays no role.

[10] We focus on the case where type-B projects have zero success probability for expositional simplicity. It is straightforward, although a bit messier, to extend the analysis to the case where type-B projects succeed with a positive probability of less than q.

a firm with a bad one. This creates a role for the CRA: by releasing a "credit rating," the CRA can reduce the information asymmetry between firms and investors and, possibly, allow firms to raise capital at better terms.

The credit rating process is as follows. At the beginning of each period, a (randomly selected) firm that obtained a project decides whether or not to request a credit rating from the CRA.[11] The CRA is endowed with an information production technology that allows it to observe an informative signal $\sigma \in \{G, B\}$ about the firm's type at no cost.[12] The quality of the CRA's information depends on whether the firm requests a rating or not. In particular, we assume that the CRA's signal is correlated with the quality of the firm's investment project as follows: if a rating has been requested, $\sigma = \theta$ with probability one; if no rating has been requested, $\sigma = \theta$ with probability $\delta \in (1/2, 1)$. Thus, a type-B firm (type-G firm) that does not request a rating will be mistaken for a type-G firm (type-B firm) by the CRA with probability $1 - \delta$. This means that the precision of the CRA's signal is higher for solicited ratings than for unsolicited ratings that are issued without being requested by the firm. This assumption captures the fact that, when soliciting a rating, firms make their books available for inspection by the rating agency and hence disclose private information to the agency that is not available to other market participants.In contrast, unsolicited ratings are typically based only on public information.

Based on its information about the project quality, the CRA then proposes a credit rating, r, to the firm at a certain fee, ϕ. The credit rating proposed to the firm can either be "high" ($r = H$) or "low" ($r = L$). The fee requested for the rating service can depend on the rating offered to the firm as well as on the information that the CRA has about the firm's type.

[11] We assume that credit ratings can only be issued for firms with investment projects. This can be justified by the fact that, in reality, a credit rating is not just a "notch" on a certain grading scale, but a comprehensive report describing the firm's business activities, projected cash flows, risk factors, etc., that is, an assessment of the firm's investment opportunity set.

[12] Our main results also go through in a setting where CRAs can observe the signal at positive cost (as long as this cost is not too large). This is driven by the fact that, in equilibrium, CRAs are better off releasing a rating after acquiring information about the rated firm, rather than issuing a rating blindly and thus putting their reputation at risk, as long as the cost of information acquisition is not too high.

The latter includes the signal σ and any information that the CRA can infer from the firm's decision on whether or not to request a rating. We denote this information by $\mathcal{F}$ and write $\phi^r_{\mathcal{F}}$ for the fee that the CRA charges for the rating $r \in \{H, L\}$ based on $\mathcal{F}$. The rating and fee schedule pair $\{r, \phi^r_{\mathcal{F}}\}$ is privately proposed by the CRA to the issuing firm and is not observable to investors.

The firm can either accept the CRA's offer and pay the specified fee or decline the offer. If the firm accepts the offer, the CRA collects the rating fee and publicizes the rating as a "solicited credit rating" $r \in \{H, L\}$ to investors. If the firm declines the offer, it does not pay the fee. The CRA can then choose to either issue an "unsolicited rating" $r \in \{h, l\}$ or not to issue a rating at all (denoted by $r = \emptyset$).[13] Note that if the CRA decides to issue an unsolicited rating, it does not have to be the same as the one proposed to the firm.[14]

Credit ratings are important to firms because they affect the terms at which they can raise capital from investors. Investors' valuation of a firm depends on the firm's credit rating and on the credibility of the CRA which issued the rating. The latter is important because the rating agency cannot commit to truthfully reveal its information about a firm's quality to investors. Rather, the it may have an incentive to misreport its information, which is not directly observable to investors. Investors must therefore decide to what extent they should trust the CRA and its ratings, based on available information.

To capture these ideas in our model, we adopt the "adverse selection" approach to modeling reputation introduced by Kreps and Wilson (1982) and Milgrom and Roberts (1982). In particular, we assume that there are two types of CRA: ethical ones (denoted by $\tau = e$) and opportunistic ones ($\tau = o$). An ethical CRA is "committed" to truthfully reveal its information about a firm that requests a rating, whether ratings are solicited or unsolicited. It always offers to issue an H-rating for firms known to be good and an L-rating for firms

[13] The absence of a rating, $r = \emptyset$, can be interpreted as a period of time in which the rating activity of the CRA is "lower than usual."

[14] We use lower-case letters for unsolicited ratings to differentiate them from solicited ratings. This reflects the current practice of rating agencies to identify unsolicited ratings as such.

known to be bad. An opportunistic CRA, on the other hand, chooses a credit rating policy that maximizes its expected profit. Investors do not observe the CRA's type and believe that, at the beginning of period 1, the CRA is of the ethical type with probability μ_1 (and is of the opportunistic type with probability $1-\mu_1$). As investors get more information about the credit ratings released by the CRA and observe its performance over time, they update their beliefs about the CRA's type. The probability that the CRA is ethical measures investors' confidence in the CRA and, hence, the CRA's "reputation."

For simplicity, we assume that the CRA has all the bargaining power and extracts the entire surplus of the firm.[15] The opportunistic CRA maximizes the value of its expected profit over the two periods. Firms are assumed to maximize the current market value of their shares.[16] Investors are risk neutral and behave competitively.

3 The Solicited-Only Credit Rating System

In this section, we solve for the equilibrium in the rating system with solicited ratings only. In this case, the CRA's rating policy in period t is characterized by a pair $\left\{p^r_{\mathcal{F},t}, \phi^r_{\mathcal{F},t}\right\}$, where $p^r_{\mathcal{F},t}$ denotes the probability that a rating $r \in \{H, L\}$ is offered to a firm and $\phi^r_{\mathcal{F},t}$ denotes the fee charged for this rating. Both quantities can depend on the information $\mathcal{F}$ that the CRA has about the firm.

Absent the option of issuing unsolicited ratings, firms that decline to purchase a rating remain unrated. As we will show below, this applies (in equilibrium) to all firms that are offered an L-rating by the CRA. These firms are better off not acquiring a rating, since an L-rating would reveal that they are of the bad type and, thus, that their value is lower than the value of a firm without a project, $\bar{V}$. Therefore, our discussion focuses on the case where

[15] It is easy to extend the model to the case in which the CRA extracts (through bargaining) only a fraction of the firm's surplus.

[16] The assumption that firms only care about their short-term market value is not critical to our analysis. Introducing a component based on a firm's long-term profit would not affect our results qualitatively as long as the short-term component is nonzero.

the CRA either issues an H-rating or the firm remains unrated.

To further simplify our exposition, we also conjecture (and verify below) that in equilibrium all firms with a positive NPV project request a rating (and thereby disclose their type to the CRA), and that these firms are offered a favorable H-rating by the CRA at an acceptable fee. The fact that all type-G firms request a rating means that type-B firms cannot conceal their bad projects from the CRA by not requesting a rating. Thus, in equilibrium the CRA learns the true type of a firm's project whether or not the firm requests a rating. This implies that the CRA's information set includes the firm's type θ and that its rating policy will not depend on the quality of its signal σ. We therefore simplify our notation by setting $p^H_{\mathcal{F},t} = 1$ for all firms known to be of good quality and by letting p_t denote the probability that the CRA offers an H-rating to a type-B firm. Finally, we note that the equilibrium fee charged for an H-rating will not depend on the firm's type θ. The reason is that firms only care about their market valuations and that these valuations are determined by investors who do not observe θ. We therefore set $\phi^H_{\mathcal{F},t} = \phi_t$ for all firms.[17]

We begin our analysis by discussing how the CRA's rating policy affects its reputation. Since an ethical CRA always assigns an H-rating (L-rating) to a type-G (type-B) firm, whereas an opportunistic CRA may prefer a different rating policy, the observation of a credit rating and the subsequent performance of the rated firm is informative about the CRA's type. Accordingly, investors update their beliefs about the CRA's type twice in each period. The first updating takes place after the CRA releases a rating; the second updating occurs when investors observe the outcome (i.e., success or failure) of the firm's investment project (if an investment has been made).

Let μ_t denote the CRA's reputation at the beginning of period $t \in \{1, 2\}$. The first round of updating occurs after the release of a rating $r_t \in \{H, \emptyset\}$. Using Bayes' rule, we derive the

[17] As discussed above, the fee that the CRA charges for an L-rating is irrelevant for our analysis.

CRA's reputation after issuing an H-rating as:

$$\mu_t^H \equiv \text{prob}\,[\tau = e | r_t = H] = \frac{\mu_t\,\alpha}{\mu_t\,\alpha + (1-\mu_t)\,(\alpha + (1-\alpha)\tilde{p}_t)}, \tag{1}$$

where $\tilde{p}_t$ denotes the investors' beliefs about the CRA's rating strategy p_t. Note that issuing an H-rating *lowers* the CRA's reputation (i.e., $\mu_t^H < \mu_t$) if the opportunistic CRA issues such a rating for some type-B firms (in addition to all type-G firms).

After observing an H-rating (and updating the CRA's reputation), investors update the probability that the firm's investment project is of the good type as follows:

$$\alpha_t^H \equiv \text{prob}\,[\theta = G | r_t = H] = \mu_t^H + \left(1 - \mu_t^H\right) \frac{\alpha}{\alpha + (1-\alpha)\,\tilde{p}_t}. \tag{2}$$

Accordingly, firm valuation is equal to the expected payoff from the investment project conditional on receiving an H-rating:

$$V_t^H = \alpha_t^H\, q\, R, \tag{3}$$

which exceeds the amount I invested in the project since $\alpha_t^H \geq \alpha$.

It is easy to verify that the CRA's reputation positively affects the value of a firm with a favorable credit rating.

Lemma 1. *The value of an H-rated firm is an increasing function of the CRA's reputation, i.e., $dV_t^H/d\mu_t^H \geq 0$.*

In a rating system without unsolicited ratings, a lack of rating activity by the CRA (that is, the observation of an unrated firm, $r_t = \emptyset$) is also informative about the CRA's type and, hence, affects its reputation. This happens because the absence of a rating can mean either that a firm does not have access to an investment project and, hence, does not have any financing needs, or that the CRA offered to issue an L-rating for the firm which was then

declined. From Bayes' rule, we have:

$$\mu_t^{\emptyset} \equiv \text{prob}\left[\tau = e | r_t = \emptyset\right] = \frac{\mu_t \left(1 - \beta + (1-\alpha)\beta\right)}{\mu_t \left(1 - \beta + (1-\alpha)\beta\right) + (1-\mu_t)\left(1 - \beta + (1-\alpha)\beta\left(1 - \tilde{p}_t\right)\right)}. \quad (4)$$

The above equation shows that if the opportunistic CRA issues an H-rating for some type-B firms (in addition to all type-G firms), a lack of rating activity *increases* the CRA's reputation (i.e., $\mu_t^{\emptyset} > \mu_t$).

Absence of rating activity also affects the value of unrated firms. From the investors' perspective, the value of an unrated firm is the weighted average of the value of a firm without an investment project, $\bar{V}$, and the value of a firm with a project that was offered an L-rating by the CRA which was then declined by the firm. Our analysis below shows that the latter category only consists of type-B firms which have zero value. The value of an unrated firm is therefore equal to:

$$V_t^{\emptyset} = \left(1 - \beta_t^{\emptyset}\right) \bar{V}, \quad (5)$$

where $1 - \beta_t^{\emptyset}$ represents the investors' beliefs that an unrated firm is of type $\theta = N$, that is:

$$\beta_t^{\emptyset} \equiv \text{prob}\left[\theta \neq N | r_t = \emptyset\right] = \mu_t^{\emptyset} \frac{(1-\alpha)\beta}{1 - \beta + (1-\alpha)\beta} + \left(1 - \mu_t^{\emptyset}\right) \frac{(1-\alpha)\beta\left(1 - \tilde{p}_t\right)}{1 - \beta + (1-\alpha)\beta\left(1 - \tilde{p}_t\right)}. \quad (6)$$

If an investment is made, which in equilibrium happens only if the firm obtains an H-rating, the project payoff is realized at the end of the period and becomes known to investors. After observing the outcome of the investment project, investors update once more the CRA's reputation. Since firms with good projects are successful with probability q, whereas firms with bad projects always fail, the CRA's updated reputation depends on whether the investment project succeeds ($\omega_t = S$) or not ($\omega_t = F$). Project success reveals the firm as being of

type G and the CRA's reputation becomes:

$$\mu_t^{H,S} \equiv \text{prob}\left[\tau = e | r_t = H, \omega_t = S\right] = \frac{\mu_t \, \alpha \, q}{\mu_t \, \alpha \, q + (1 - \mu_t) \, \alpha \, q}. \tag{7}$$

The above equation shows that project success increases the CRA's reputation (i.e., $\mu_t^{H,S} > \mu_t^H$), since opportunistic CRAs may issue H-ratings with positive probability to bad firms, which have a lower success probability. If the project fails, the CRA's updated reputation is:

$$\mu_t^{H,F} \equiv \text{prob}\left[\tau = e | r_t = H, \omega_t = F\right] = \frac{\mu_t \, \alpha \, (1 - q)}{\mu_t \, \alpha \, (1 - q) + (1 - \mu_t) \, (\alpha \, (1 - q) + (1 - \alpha) \, \tilde{p}_t)}. \tag{8}$$

Project failure has an adverse effect on the CRA's reputation, since an ethical CRA never issues an H-rating for a firm with a bad project, which implies that $\mu_t^{H,F} < \mu_t^H$.

Note that, when updating the CRA's reputation, investors take into account that the failure of an H-rated firm may be the result of "bad luck" (i.e., a good firm failing), rather than of "bad ratings" (i.e., inflated ratings for bad firms). Thus, $\mu_1^{H,F} > 0$ as long as the success probability of good firms, q, is strictly less than one.

We now turn to deriving the objective function of the opportunistic CRA. Proceeding backwards, in the second (and last) period, the CRA only cares about the profit that it generates from issuing a solicited rating in that period. Thus, the CRA's objective function is given by:[18]

$$\pi_2(\mu_2) = \beta \, (\alpha + (1 - \alpha) \, p_2) \, \phi_2. \tag{9}$$

Note that the period 2 profit depends on the CRA's reputation at the beginning of the period, μ_2, through its effect on the fee ϕ_2 that the CRA can charge firms for an H-rating.

In the first period, the opportunistic CRA chooses its rating policy to maximize the sum

[18] For notational simplicity, this expression as well as the expression for the CRA's objective function in period 1, π_1, reflect the conjecture that firms never acquire an L-rating at a positive fee and that the fee charged by the CRA for an H-rating does not exceed the maximum fee that firms are willing to pay for it (which will be confirmed to be correct in equilibrium).

of the expected profit obtained in periods 1 and 2:

$$\begin{aligned}\pi_1 \;=\;& \alpha\beta\left(\phi_1 + q\,\pi_2\big(\mu_1^{H,S}\big) + (1-q)\,\pi_2\big(\mu_1^{H,F}\big)\right)\\ &+ (1-\alpha)\beta\left(p_1\left(\phi_1 + \pi_2\big(\mu_1^{H,F}\big)\right) + (1-p_1)\,\pi_2\big(\mu_1^{\emptyset}\big)\right)\\ &+ (1-\beta)\,\pi_2\big(\mu_1^{\emptyset}\big).\end{aligned} \tag{10}$$

The three components of the opportunistic CRA's expected profit, π_1, represent the three cases in which the firm has a good project ($\theta = G$), a bad project ($\theta = B$), or no project ($\theta = N$). If a type-G firm requests a rating, which happens with probability $\alpha\beta$, the CRA always offers to issue an H-rating and thus earns a fee of ϕ_1 in the first period. The expected second-period profit depends on whether the project succeeds ($\omega_1 = S$) or not ($\omega_1 = F$), since the project outcome affects the CRA's reputation, μ_1^{H,ω_1}, $\omega_1 \in \{S, F\}$. If the firm has a bad project, which happens with probability $(1-\alpha)\beta$, the CRA's expected profit depends on whether the CRA offers to issue an H-rating (with probability p_1) or an L-rating (with probability $1 - p_1$). In the former case, the CRA earns a fee of ϕ_1 in the first period and obtains an expected profit of $\pi_2\big(\mu_1^{H,F}\big)$ in the second period based on the updated reputation $\mu_1^{H,F}$, taking into account that bad projects always fail. In the latter case, the firm declines to acquire the offered L-rating and the CRA does not earn a rating fee in the first period. Its expected second-period profit is then a function of its updated reputation $\mu_1^{\emptyset}$. Finally, if the firm has no project, which happens with probability $1 - \beta$, the firm remains unrated. In this case, the CRA's profit is given by the expected fee it earns in the second period, conditional on its reputation when no rating is issued in the first period.

Having characterized the CRA's objective function, we now turn to solving for the equilibrium of our economy. The equilibrium concept we use is that of a Perfect Bayesian Equilibrium (PBE). Formally, a PBE of our economy consists of the firm's decision on whether to request a rating, the opportunistic CRA's rating policy $\big\{p^r_{\mathcal{F},t}, \phi^r_{\mathcal{F},t}\big\}$, the firm's decision on whether to acquire the offered rating (and, hence, raise capital and invest in the project),

the investors' evaluation of the firm V_t^r, and a system of beliefs formed by investors such that: (i) the choices made by the firm and the CRA and maximize their respective utility, given the equilibrium choices of the other players and the set of equilibrium beliefs formed by investors in response to these choices; (ii) the beliefs of investors are rational given the equilibrium choices made by the CRA and the firm, and are formed using Bayes' rule; and (iii) any deviation from the equilibrium strategy by any party is met by beliefs of the other parties that yield a lower expected utility for the deviating party, compared to that obtained in equilibrium.

Proposition 1. *In the solicited-only credit rating system, there exists an equilibrium characterized by the following strategies:*

(i) Type-G firms always request a rating; type-B firms request a rating with probability $\lambda \in [0,1]$. Firms acquire an H-rating for a fee of up to $V_t^H - I - V_t^{\emptyset}$, $t \in \{1,2\}$. Firms never acquire an L-rating rating for a positive fee. Firms raise funds and invest in the project if and only if they obtain an H-rating.

(ii) In period 1, the opportunistic CRA charges a fee of $\phi_1 = V_1^H - I - V_1^{\emptyset}$ for a solicited H-rating. Type-G firms that request a rating are offered an H-rating with probability one; type-B firms that request a rating and firms that have financing needs but do not request a rating are offered an H-rating with probability $p_1 > 0$, and an L-rating with probability $1 - p_1$. In period 2, the opportunistic CRA offers an H-rating to all firms that seek financing and charges a fee of $\phi_2 = V_2^H - I - V_2^{\emptyset}$ for it.

These strategies are supported by the out-of-equilibrium beliefs that firms with an L-rating and firms seeking to raise funds without a rating are of type B with probability one.

In a credit rating system with solicited ratings only, the opportunistic CRA faces the following dynamic trade-off. On the one hand, it wants to maximize its current fees by offering an H-rating to all firms with financing needs. On the other hand, it wants to

preserve, or rather improve, its reputation. Reputation is valuable to the CRA because a better reputation increases its credibility in the eyes of investors and, hence, the value of the securities that are marketed with an H-rating. In this way, a better reputation allows the CRA to charge firms a higher fee for an H-rating in the second period. The optimal rating policy balances these two effects.

The CRA's equilibrium behavior changes over time. In the second (and last) period, the opportunistic CRA has no reputational concerns anymore and thus finds it optimal to assign an H-rating to all firms seeking financing. In the first period, the CRA always issues an H-rating for good firms. Note that while such a policy allows the CRA to pocket the fee ϕ_1, it is costly in terms of its reputation: releasing an H-rating reduces the CRA's reputation from μ_1 to μ_1^H. This reflects the fact that, in equilibrium, an H-rating is more likely to be released by an opportunistic CRA than an ethical one, since an opportunistic CRA releases H-ratings also to bad firms with positive probability, whereas an ethical CRA never does so. This loss of reputation is mitigated by the fact that projects of good firms succeed with positive probability and the CRA's reputation recovers if the project is revealed as successful ($\omega_1 = S$). However, it never reaches the level that the CRA could achieve by refusing to release an H-rating, i.e., $\mu_1^{H,S} < \mu_1^{\emptyset}$. If the project fails ($\omega_1 = F$), the CRA is exposed to a further loss of reputation, since $\mu_1^{H,F} < \mu_1^{H,S}$. Thus, by issuing an H-rating for a good firm the CRA jeopardizes its reputation.

The opportunistic CRA also issues H-ratings for some bad firms. The equilibrium value of p_1 trades off the benefits and costs from releasing an H-rating rather than an L-rating. The benefit of this strategy is again that the CRA can pocket the fee ϕ_1. The cost of this strategy is the loss of future profits due to a lower reputation (described above), which is now aggravated by the fact that the project of a bad firm fails with probability one. On the other hand, if the CRA decides to offer the firm an L-rating, the firm will decline the offer and remain unrated, which increases the CRA's reputation since $\mu_1^{\emptyset} > \mu_1^{H,F}$. This increase in reputation follows directly from the fact that a lack of rating activity is more likely to be

observed for an ethical CRA than an opportunistic one.

The opportunistic CRA's incentive to engage in ratings inflation (by issuing H-ratings for bad firms) ultimately depends on the effectiveness of reputation as a disciplining device, which in turn depends on the loss of reputation caused by the failure of highly rated firms. Since good firms fail with positive probability, this loss of reputation is dampened by the investors' inability to unambiguously attribute a failure to "bad ratings" (i.e., to ratings inflation) rather than to "bad luck."

Proposition 1 shows that the opportunistic CRA offers an H-rating to bad firms with *strictly positive* probability. The reason is that if it were to mimic the rating strategy of the ethical CRA and never issue an H-rating for bad firms, reputation would play no role and the failure of highly rated firms would always be ascribed to "bad luck" rather than to "bad ratings" (which would not occur in equilibrium). Thus, absent the disciplining effect of reputation, the opportunistic CRA would always have an incentive to engage, to some degree, in ratings inflation. This argument shows that the imperfect (ex post) observability of a firm's project quality by investors—the project outcome does not fully reveal the firm's type—essentially limits the effectiveness of reputation as a disciplining device and that ratings inflation is therefore an endemic phenomenon of the credit rating process.

In our model, the equilibrium quality of credit ratings (i.e., the "credit rating standard") can be characterized by $1 - p_1$, the probability that the opportunistic CRA refuses to issue an H-rating for a bad firm. The following proposition presents comparative statics results for the CRA's credit rating standard with respect to changes in the model primitives R and μ_1.

Proposition 2. *In the solicited-only credit rating system, the credit rating standard* $(1 - p_1)$ *is decreasing in the payoff* R *of successful investment projects, increasing in the CRA's reputation* μ_1 *for low values of* μ_1*, and decreasing in* μ_1 *for high values of* μ_1*.*

An increase in the project payoff R increases the maximum fee that firms are willing to

pay for an H-rating and, thus, the surplus that the CRA can extract from H-rated firms. This makes it more profitable for the opportunistic CRA to issue inflated ratings for bad firms and leads to a lower credit rating standard (i.e., a greater p_1). This property has the interesting implication that, if the project payoff is positively related to the business cycle, credit rating standards are countercyclical. This means that rating agencies are more likely to issue inflated ratings during periods of economic expansion, which may lead to lending booms that are associated with lower-quality investments and greater subsequent failures of highly rated securities.

In addition, when the CRA's reputation is sufficiently small (i.e., when μ_1 is close to zero) or when it is sufficiently large (i.e., when μ_1 is close to one), the informativeness of the CRA's rating record about its type is relatively small. This means that releasing an H-rating has only a minor impact on the CRA's reputation, weakening its disciplinary role. As a result, the CRA's reputational concerns become weaker, leading to a less stringent rating standard.

4 The Credit Rating System with Unsolicited Ratings

In a credit rating system that incorporates unsolicited ratings, rating agencies have the ability to issue ratings even if not requested by firms. To allow for this possibility, we modify our basic model as follows. If a firm declines the CRA's offer to purchase a rating $r \in \{H, L\}$ for a fee $\phi^r_{\mathcal{F}}$, the CRA can then decide to publish an unsolicited rating $r \in \{h, l\}$ at no cost to the firm. The opportunistic CRA's rating policy in period t can thus be characterized by the triplet $\{\hat{p}^r_{\mathcal{F},t}, \hat{\phi}^r_{\mathcal{F},t}, \hat{u}^r_{\mathcal{F},t}\}$, where $\hat{p}^r_{\mathcal{F},t}$ denotes the probability that a rating $r \in \{H, L\}$ is offered to the firm, $\phi^r_{\mathcal{F},t}$ denotes the fee charged for this rating, and $\hat{u}^r_{\mathcal{F},t}$ denotes the probability that the CRA issues an unsolicited rating $r \in \{h, l\}$ if the firm refuses to acquire a solicited rating.[19]

For ease of exposition, we again focus our discussion on the case where no firm pays for an

[19] We use the "hat" symbol to differentiate the CRA's strategy in the rating system with unsolicited ratings from its strategy in the solicited-only system.

L-rating, rating fees are identical across firms (i.e., $\hat{\phi}^H_{\mathcal{F},t} = \hat{\phi}_t$), and all good firms request a rating (and thus prevent bad firms from concealing their type) and are offered an H-rating at an acceptable fee (i.e., $\hat{p}^H_{G,t} = 1$). As in the previous section, we let $\hat{p}_t$ denote the probability that the opportunistic CRA offers an H-rating to a type-B firm. Further, we restrict our attention to equilibria in which the ethical CRA does not issue unsolicited h-ratings.[20] This implies that the opportunistic CRA will not issue such ratings either, which allows us to simplify our notation by setting $\hat{u}^h_{\theta,t} = 0$ and $\hat{u}^l_{\theta,t} = \hat{u}_t$.

The possibility of releasing unsolicited credit ratings changes the CRA's strategy space, affecting the investors' updating process about the CRA's reputation and, hence, firm valuations. The basic difference is that firms that are offered an L-rating are no longer able to pool with type-N firms by rejecting the offer if the CRA decides to issue an unsolicited l-rating for them (which, as we demonstrate below, will indeed be part of the CRA's equilibrium strategy).

Issuing an unsolicited rating not only affects the value of the firm, it is also informative about the CRA's type. After observing an unsolicited l-rating, investors update the CRA's reputation as follows:

$$\hat{\mu}^l_t \equiv \text{prob}\left[\tau = e | r_t = l\right] = \frac{\mu_t\left(1-\alpha\right)}{\mu_t\left(1-\alpha\right) + (1-\mu_t)(1-\alpha)(1-\tilde{p}_t)\tilde{u}_t}, \tag{11}$$

where, as before, $\tilde{p}_t$ denotes the investors' conjecture about the opportunistic CRA's equilibrium choice of $\hat{p}_t$, and $\tilde{u}_t$ denotes their conjecture about $\hat{u}_t$. The above expression takes into account that an unsolicited rating can only be issued for firms that refused to acquire a solicited rating, which only applies to firms that were offered an L-rating.

Interestingly, the possibility of releasing unsolicited ratings affects the CRA's reputation

[20] We specify out-of-equilibrium beliefs that support such equilibria in Proposition 3.

also when no rating is released (i.e., when $r_t = \emptyset$):

$$\hat{\mu}_t^{\emptyset} \equiv \text{prob}\,[\tau = e | r_t = \emptyset] = \frac{\mu_t(1-\beta)}{\mu_t(1-\beta) + (1-\mu_t)(1-\beta+(1-\alpha)\beta(1-\tilde{p}_t)(1-\tilde{u}_t))}. \tag{12}$$

The above expression reflects the fact that while an ethical CRA issues a rating for all firms that have access to an investment project, an opportunistic CRA may choose not to do so. By offering an L-rating to a firm with a project of type $\theta \in \{G, B\}$ and by refraining from issuing an unsolicited rating once the offer has been rejected by the firm, the opportunistic CRA can make sure that no rating is observed for the firm. This does, however, not happen in equilibrium, as we will show below.[21]

It is easy to verify that the possibility of releasing unsolicited ratings impacts the CRA's reputation after it issues an H-rating only through its effect on (the investors' beliefs about) the opportunistic CRA's equilibrium choice of $\hat{p}_t$. The expressions for $\hat{\mu}_t^H$, $\hat{\mu}_t^{H,S}$, and $\hat{\mu}_t^{H,F}$ are therefore identical to those in equations (1), (7), and (8), respectively. Further, the updated probability that a firm with an H-rating is of type G, $\hat{\alpha}_t^H$, is again given by the expression in equation (2) and the value of an H-rated firm is equal to:

$$\hat{V}_t^H = \hat{\alpha}_t^H q\, R. \tag{13}$$

The objective function of the opportunistic CRA in a credit rating system with unsolicited ratings is similar to the one derived for the solicited-only rating system. In the second period, the CRA's profit again equals the fee that it earns by selling an H-rating to a firm (equation (9)). In the first period, the objective function now takes into account the possibility that

[21] Note also that, for liability reasons, we assume that the opportunistic CRA cannot charge a fee in exchange for not releasing an unfavorable unsolicited rating.

the CRA issues an unsolicited rating. It has to be modified as follows:

$$\begin{aligned}\hat{\pi}_1 &= \alpha\beta\left(\hat{\phi}_1 + q\,\hat{\pi}_2\big(\hat{\mu}_1^{H,S}\big) + (1-q)\,\hat{\pi}_2\big(\hat{\mu}_1^{H,F}\big)\right) \\ &\quad + (1-\alpha)\beta\left(\hat{p}_1\left(\hat{\phi}_1 + \hat{\pi}_2\big(\hat{\mu}_1^{H,F}\big)\right) + (1-\hat{p}_1)\left(\hat{u}_1\,\hat{\pi}_2\big(\hat{\mu}_1^{l}\big) + (1-\hat{u}_1)\,\hat{\pi}_2\big(\hat{\mu}_1^{\emptyset}\big)\right)\right) \\ &\quad + (1-\beta)\,\hat{\pi}_2\big(\hat{\mu}_1^{\emptyset}\big). \qquad (14)\end{aligned}$$

The following proposition characterizes the equilibrium in a credit rating system that allows rating agencies to issue unsolicited ratings.

Proposition 3. *In the credit rating system with unsolicited ratings, there exists an equilibrium characterized by the following strategies:*

(i) Type-G firms always request a rating; type-B firms request a rating with probability $\hat{\lambda} \in [0,1]$. Firms acquire an H-rating for a fee of up to $\hat{V}_t^H - I$, $t \in \{1,2\}$. Firms never acquire an L-rating rating for a positive fee. Firms raise funds and invest in the project if and only if they obtain an H-rating.

(ii) In period 1, the opportunistic CRA charges a fee of $\hat{\phi}_1 = \hat{V}_1^H - I$ for a solicited H-rating. Type-G firms that request a rating are offered an H-rating with probability one; type-B firms that request a rating and firms that have financing needs but do not request a rating are offered an H-rating with probability $\hat{p}_1 > 0$, and an L-rating with probability $1-\hat{p}_1$. If a firm rejects the offer, the CRA issues an unsolicited l-rating for the firm with probability one (i.e., $\hat{u}_1 = 1$). In period 2, the opportunistic CRA offers an H-rating to all firms that seek financing and charges a fee of $\hat{\phi}_2 = \hat{V}_2^H - I$ for it.

These strategies are supported by the out-of-equilibrium beliefs that (i) firms with an L-rating and firms seeking to raise funds without a rating are of type B with probability one, and (ii) that the ethical CRA does not issue unsolicited h-ratings to type-G firms that refuse to acquire a solicited rating.

The ability to issue unsolicited credit ratings affects the opportunistic CRA's equilibrium strategy as follows. Similar to the case with solicited ratings only, the CRA offers—in exchange for a fee of $\hat{\phi}_1$—to issue a solicited H-rating for good firms with probability one and for bad firms with strictly positive probability $\hat{p}_1$. However, firms that decline the offer now receive an unsolicited l-rating (at no cost). As in the solicited-only case, releasing an H-rating lowers the CRA's reputation, where the loss of reputation is mitigated (aggravated) if the project turns out to be a success (failure). In contrast, issuing an unsolicited l-rating has a positive effect on the CRA's reputation, even more so than not issuing a rating. This can be seen from equations (1), (11), and (12), which show that in equilibrium $\hat{\mu}_1^H < \hat{\mu}_1^\emptyset < \hat{\mu}_1^l$. This result reflects the fact that, in equilibrium, unsolicited l-ratings are more likely to be released by an ethical CRA than by an opportunistic CRA: the former issues unsolicited l-ratings for all type-B firms, whereas the latter only for a fraction $1 - \hat{p}_1$ of type-B firms. Thus, the issuance of an unsolicited l-rating proves to be a more effective way for the CRA to convince investors of its ethical behavior than the absence of a solicited H-rating: it sends a strong signal to investors that the CRA resisted the temptation to issue a (possibly) inflated H-rating.

The beneficial effect of unsolicited l-ratings on the CRA's reputation makes them a credible threat to firms that refuse to acquire a solicited rating. The threat is credible precisely because these ratings improve the CRA's reputation. This is true for type-B firms as well as for type-G firms, since neither type of firm can raise the necessary funds to finance its project after receiving an l-rating, which makes any further updating of the CRA's reputation by investors impossible.[22] This threat, however, remains "latent" and is not carried out in equilibrium, since all firms are willing to acquire a solicited H-rating (for a fee of $\hat{\phi}_1$) if they

[22] It is straightforward to show that this argument remains valid in the more general setting in which l-rated firms are still able to obtain financing (and succeed with a (small) positive probability). The reason is that, in equilibrium, investors attribute the success of an l-rated firm to "good luck" rather than to an incorrect rating. This means that the CRA's reputation following the issuance of an l-rating is unaffected by the subsequent observation of a successful project outcome (i.e., $\hat{\mu}_t^l = \hat{\mu}_t^{l,S}$), making the CRA's threat credible even when firms are still able to invest after obtaining an unfavorable unsolicited rating.

are offered one. This means that unsolicited ratings are not *directly* punitive in the sense that they are not downward biased relative to the firm's true quality, as the following corollary shows.

Corollary 1. *In equilibrium, unsolicited ratings are only issued for type-B firms. Thus, unsolicited ratings are associated with lower firm valuations, compared to solicited ratings. They are, however, not downward biased relative to the firms' true quality.*

Several empirical papers have shown that unsolicited ratings are significantly lower than solicited ratings (e.g., Poon, 2003; Gan, 2004; Poon and Firth, 2005; Van Roy, 2006; Bannier, Behr, and Güttler, 2010).[23] However, the reason for this difference is not well understood. Using S&P's bond ratings on the international market, Poon (2003) reports that issuers who chose not to obtain rating services from S&P have weaker financial profiles. His analysis indicates, however, that the difference in ratings cannot be explained by this self-selection bias and he concludes that unsolicited ratings are downward biased. Gan (2004) uses an ex post regression approach and finds no significant difference between the performance of issuers with solicited and unsolicited ratings. This result leads her to reject the "punishment hypothesis"—that is, the hypothesis that rating agencies use unfavorable unsolicited ratings to punish firms that refuse to solicit a rating—in favor of the self-selection hypothesis. Bannier, Behr, and Güttler (2010), however, cannot reject the punishment hypothesis for their sample.

Our paper suggests an alternative explanation for these findings, which reconciles the conflicting empirical evidence. While unsolicited ratings are lower, they are not downward biased. Rather, they reflect the lower quality of issuers. As a result, while issuers with unsolicited ratings should have weaker financial profiles, we should not observe any significant differences between their ex post performance and that of issuers with solicited ratings, once

[23]For example, using international data from 1998 to 2000, Poon (2003) shows that while solicited ratings are more common for investment-grade issues (55% of ratings in this category are solicited), unsolicited ratings are the dominant rating type for speculative-grade issues (68% of ratings in this category are unsolicited).

we control for their rating level. This argument, however, does not imply that rating agencies do not use unsolicited ratings to threaten issuers to pay higher fees for more favorable ratings. In fact, our analysis shows that, although "punishment" is an out-of-equilibrium outcome and thus not observed by investors, it still plays an important role in the credit rating process as a credible threat. As we will show in Section 5, the presence of such a credible threat allows CRAs to charge higher fees for solicited ratings and, thus, to extract more surplus from firms.

We conclude this section by deriving comparative statics results for the opportunistic CRA's credit rating standard which can be characterized by the probability that a bad firm does not receive a favorable H-rating, $1 - \hat{p}_1$.

Proposition 4. *In a credit rating system with unsolicited ratings, the credit rating standard* $(1 - \hat{p}_1)$ *is decreasing in the payoff* R *of successful investment projects, increasing in the CRA's reputation* μ_1 *for low values of* μ_1*, and decreasing in* μ_1 *for high values of* μ_1*.*

The intuition for these results is analogous to that given for the solicited-only rating system. In particular, credit ratings are again more likely to be inflated during periods of economic expansion (i.e., when the project payoff R is high), which are then followed by an increase in default rates of highly rated securities.

5 Fees, Rating Standards, and Social Welfare

In this section, we compare the fee structure and the rating standard of the credit rating system with unsolicited ratings to those of the solicited-only rating system and derive implications for social welfare.

We begin with the rating fees that the CRA can charge under these two systems. The following proposition shows that the ability to release unsolicited l-ratings allows the opportunistic CRA to charge higher fees for solicited H-ratings.

Proposition 5. *For a given reputation* μ_1 *of the CRA, the fee charged for solicited* H*-ratings*

is higher in a rating system that allows for unsolicited ratings than in a solicited-only credit rating system, i.e., $\hat{\phi}_1 > \phi_1$.

Proposition 5 provides one of the key insights of this paper. The ability to issue unsolicited ratings is valuable to the CRA because it enables the CRA to charge higher fees and, hence, to extract more surplus from rated firms. This happens because in a solicited-only credit rating system firms have the option to avoid a low rating by refusing to be rated by the CRA. In this case, the value of the default option for a firm is the value of an unrated firm, given by equation (5). The CRA's opportunity to issue unsolicited l-ratings eliminates this option and lowers the value of a firm's default option to the value of a bad firm, which is zero. This increases the value of a favorable H-rating and, hence, the fee that the firm is willing to pay for it.[24]

We now turn to a comparison of the CRA's choice of rating standards under the two different rating systems and discuss their implications for social welfare. In our model, rating standards are fully characterized by the equilibrium values of p_1 and $\hat{p}_1$ (that is, by the probabilities with which the opportunistic CRA issues inflated H-ratings for bad firms).

Proposition 6. *For low values of* $\bar{V}$*, the credit rating standard is more stringent in the rating system that incorporates unsolicited ratings (i.e.,* $p_1 > \hat{p}_1$*). For high values of* $\bar{V}$*, it can be more stringent in the solicited-only system (i.e.,* $p_1 < \hat{p}_1$*).*

We know from Proposition 5 that the ability to issue unsolicited ratings enables the CRA to charge higher fees for solicited H-ratings. Thus, compared to the solicited-only rating system, the opportunistic CRA's marginal benefit from issuing an inflated H-rating to a type-B firm is greater in the case when unsolicited ratings are permitted.

At the same time, by releasing an unsolicited l-rating to truthfully reveal a bad firm's type, the CRA can boost its reputation to a greater extent than it could in the absence of

[24]Note that this result critically depends on the fact that the issuance of an unsolicited l-rating is a credible threat to firms. As discussed in the previous section, releasing an l-rating is an optimal response for the CRA to a firm's decision not to obtain a solicited rating, independent of the quality of the firm's investment project.

unsolicited ratings. In order to obtain an intuitive understanding of this result, note that, without the possibility of issuing unsolicited ratings, CRAs can signal their ethical behavior to investors only by refusing to release an H-rating for a firm, in which case the firm remains unrated. However, the set of unrated firms, which contains firms with bad projects that refuse to acquire an L-rating and firms that do not have a project, is much larger than the set of firms that obtain an unsolicited l-rating. This makes it more difficult for investors to infer the CRA's action from the observed outcome. Thus, the possibility of releasing unsolicited ratings increases the CRA's marginal cost in terms of a reputation loss associated with the issuance of an inflated rating.

In equilibrium, the CRA's choice of $\hat{p}_1$, relative to that of p_1, balances these two effects and trades off the benefit of a higher rating fee against the cost of a larger loss of reputation. When the difference between the marginal costs in the two systems (that is, the marginal reputation cost of an H-rating with unsolicited ratings minus that without unsolicited ratings) outweighs the difference between the marginal benefits (that is, the marginal benefit in terms of fees of an H-rating with unsolicited ratings minus that without unsolicited ratings), the CRA optimally chooses to issue less inflated ratings in the rating system with unsolicited ratings (that is, $\hat{p}_1 < p_1$ in this case). This is typically the case when the value of an unrated firm is low (that is, when $\bar{V}$ is low), because this value represents the extent to which the value of remaining unrated in the solicited-only system exceeds that in the system with unsolicited ratings (which is zero). Thus, a low value of $\bar{V}$ means that the difference between the fees that the CRA charges for an H-rating in the two systems is small (see Propositions 1 and 3). In contrast, the ability to release unsolicited l-ratings provides a clear reputation benefit for the CRA and, thus, leads the CRA to choose a more stringent rating standard in the rating system with unsolicited ratings. Conversely, when $\bar{V}$ is large, the CRA finds it more lucrative to inflate its ratings in a system with unsolicited ratings because of the higher fee that it can charge for solicited H-ratings. The presence of unsolicited ratings therefore causes the CRA to adopt a less stringent rating standard.

Proposition 6 also challenges the argument that the higher fees associated with a rating system that allows for unsolicited ratings compromises the agencies' rating standards. Our analysis shows that this is not always the case. In particular, we demonstrate that rating standards can be higher in a system with unsolicited ratings than in a solicited-only system, even when the fees in the former system exceed those in the latter. The reason is that, in a system with unsolicited ratings, CRAs benefit more from the increased reputation associated with releasing unsolicited l-ratings. Thus, under certain conditions, this disciplinary role of reputation leads to a higher rating standard.

Assuming that social welfare is utilitarian (i.e., the social welfare function is equally weighted), social welfare in our model equals the expected NPV of all investment projects undertaken by firms. The following result therefore follows immediately from Proposition 6.

Proposition 7. *For low values of $\bar{V}$, the adoption of unsolicited credit ratings leads to an improvement in social welfare. For high values of $\bar{V}$, it can lead to a reduction in social welfare.*

Proposition 7 sheds some light on the recent debate on whether the adoption of unsolicited ratings should be encouraged or not, and on how such a change would affect social welfare. Our analysis shows that the answer to these questions depends on the state of the economy. During a recession when the value of a firm's growth options is low (i.e., when $\bar{V}$ is low), the issuance of unsolicited ratings leads to more stringent rating standards and, thus, improves social welfare by preventing firms from investing in negative NPV projects. Such a rating system would, however, induce rating agencies to adopt lax rating standards during expansionary periods because of the higher fees they can charge for favorable ratings in this environment.

6 Conclusion

In this paper, we develop a dynamic rational expectations model to address the question of why credit rating agencies issue unsolicited ratings and why these ratings are, on average, lower than solicited ratings. We analyze the implications of this practice for credit rating standards, rating fees, and social welfare. Our model incorporates three critical elements of the credit rating industry: (i) the rating agencies' ability to misreport the issuer's credit quality, (ii) their ability to issue unsolicited ratings, and (iii) their reputational concerns. We focus on a monopolistic rating agency that interacts with a series of potential issuers. In equilibrium, the agency trades off a higher short-term profit from selling inflated ratings to low-quality issuers against a lower long-term profit associated with a reduction in its reputation.

Our analysis shows that the rating agency issues unsolicited ratings for two reasons. First, it enables the rating agency to charge higher fees for solicited ratings, because it can credibly threaten to punish issuers that refuse to solicit a rating with an unfavorable unsolicited rating. This increases the value of a favorable rating and, hence, the fee that an issuer is willing to pay for it. Second, by issuing a low unsolicited rating, the rating agency can demonstrate to investors that it resists the temptation to issue inflated ratings, which improves its reputation.

We demonstrate that, in equilibrium, unsolicited ratings are lower than solicited ratings, because all favorable ratings are solicited. This does not mean, however, that unsolicited ratings have a downward bias. Rather, they reflect the lower quality of firms that do not request a rating.

Comparing credit rating systems with and without unsolicited ratings, we find that while rating agencies benefit from having the option to issue unsolicited ratings, such a system can actually lead to less stringent credit rating standards, thereby reducing social welfare.

Appendix

Proof of Lemma 1. This result follows immediately from the definition of V_t^H in equation (3) and the updated probability α_t^H in equation (2). ■

Proof of Proposition 1. A type-G firm has no incentive to deviate from its equilibrium strategy by not requesting a rating. Doing so would lower its probability of receiving an H-rating to p_1, since it would be mistaken for a type-B firm by the CRA. A type-B firm, on the other hand, is indifferent between requesting and not requesting a rating, since its type is known to the CRA in either case: if it requests a rating, the signal σ perfectly reveals its type; if it does not request a rating, its action of not submitting a request reveals its type since in equilibrium the only firms with investment projects that do not request a rating are those of bad quality. Thus, any probability $\lambda \in [0, 1]$ is an equilibrium. This result also allows us to write the CRA's strategy as a function of the firm's type, i.e., $\{p^r_{\mathcal{F},t}, \phi^r_{\mathcal{F},t}\} = \{p^r_{\theta,t}, \phi^r_{\theta,t}\}$.

The investors' valuation of an H-rated firm gross of investment expenses, V_t^H, is given by equation (3), which is based on the updated probabilities μ_t^H and α_t^H. In equilibrium, the investors' beliefs about the CRA's rating policy have to coincide with its actual policy. Thus, $\tilde{p}_1 = p_1 > 0$ in equations (1) and (2). The investors' valuation of an unrated firm, $V_t^\emptyset$, is given by equation (5), where the updated probability $\beta_t^\emptyset$ in equation (6) is again based on the equilibrium value $\tilde{p}_1 = p_1 > 0$. Since firms maximize the market value of their shares, the maximum amount that they are willing to pay for an H-rating is therefore given by the difference in (net) valuations, $V_t^H - I - V_t^\emptyset > 0$, taking into account the investment expenses I of an H-rated firm.

Firms never pay for an L-rating. This is supported by the out-of-equilibrium belief that an L-rated firm is of type B with probability one, which implies that the investors' valuation of such a firm is zero. Thus, firms are better off remaining unrated.

Firms with an H-rating can raise sufficient capital to finance the investment project, since $V_t^H \geq \alpha\, q\, R > I$, $t \in \{1, 2\}$. On the other hand, unrated firms are not able to raise the

necessary funds, since by doing so, they would reveal to investors that they are of type B and, hence, that their project has a negative NPV.

In period 2, the opportunistic CRA chooses a rating policy $\{p^r_{\theta,2}, \phi^r_{\theta,2}\}$ to maximize its expected profit, which is given by:

$$\pi_2(\mu_2) = \beta \left(\alpha\, p^H_{G,2}\, \phi^H_{G,2} + (1-\alpha)\, p^H_{B,2}\, \phi^H_{B,2}\right). \tag{A1}$$

Clearly, this expression is maximized by offering an H-rating to all firms that seek financing (i.e., $p^H_{G,2} = p^H_{B,2} = 1$) and by setting the fee to the maximum amount that these firms are willing to pay for it (i.e., $\phi^H_{G,2} = \phi^H_{B,2} = V^H_2 - I - V^\emptyset_2$). The fee charged for an L-rating is inconsequential, since firms refuse to acquire such a rating at any positive fee.

In period 1, the opportunistic CRA maximizes (a generalized version of) the objective function in equation (10):

$$\begin{aligned} \pi_1 \;=\; & \alpha\beta \left(p^H_{G,1}\left(\phi^H_{G,1} + q\,\pi_2\big(\mu_1^{H,S}\big) + (1-q)\,\pi_2\big(\mu_1^{H,F}\big)\right) + \big(1 - p^H_{G,1}\big)\,\pi_2\big(\mu_1^\emptyset\big)\right) \\ & + (1-\alpha)\beta \left(p^H_{B,1}\left(\phi^H_{B,1} + \pi_2\big(\mu_1^{H,F}\big)\right) + \big(1 - p^H_{B,1}\big)\;\pi_2\big(\mu_1^\emptyset\big)\right) \\ & + (1-\beta)\,\pi_2\big(\mu_1^\emptyset\big). \end{aligned} \tag{A2}$$

Since the fee charged for an H-rating in the first period does not affect the CRA's reputation in the second period, it is again optimal for the CRA to set the fee to the maximum amount that firms are willing to pay for an H-rating (i.e., $\phi^H_{G,1} = \phi^H_{B,1} = V^H_1 - I - V^\emptyset_1$). The probability with which the CRA offers an H-rating to the two types of firms, however, does affect its reputation and thus the fee that it can charge in the second period.

We prove the optimality of the strategy $p^H_{G,1} = 1$ and $p^H_{B,1} > 0$ by contradiction. First, suppose that $p^H_{B,1} = 0$ (and that $p^H_{G,1} > 0$). Then, only type-G firms receive an H-rating, which means that the failure of an H-rated firm does not reveal any new information to investors. Thus, $\mu_1^{H,F} = \mu_1^H$. Further, the opportunistic CRA is (weakly) less likely to issue

an H-rating than the ethical CRA, which implies that $\mu_1^H \geq \mu_1$ and that $\mu_1^\emptyset \leq \mu_1$. Thus, the marginal benefit of the opportunistic CRA from issuing an H-rating to a type-B firm, which is given by:

$$\frac{d\pi_1}{dp_{B,1}^H} = (1-\alpha)\beta\left(\phi_{B,1}^H + \pi_2\big(\mu_1^{H,F} = \mu_1^H\big) - \pi_2\big(\mu_1^\emptyset\big)\right), \tag{A3}$$

is strictly positive. This follows from the fact that $\phi_{B,1}^H > 0$ and that the second-period profit π_2 is increasing in the CRA's reputation, which implies that $\pi_2\big(\mu_1^{H,F} = \mu_1^H\big) \geq \pi_2\big(\mu_1^\emptyset\big)$. The strategy $p_{B,1}^H = 0$ can therefore not be optimal for the opportunistic CRA.

Next, suppose that $p_{G,1}^H < 1$. The fact that $p_{B,1}^H > 0$ implies that the opportunistic CRA (weakly) prefers to offer an H-rating to bad firms, i.e.,

$$\phi_{B,1}^H + \pi_2\big(\mu_1^{H,F}\big) \geq \pi_2\big(\mu_1^\emptyset\big). \tag{A4}$$

However, since the CRA's reputation is higher when an H-rated firm succeeds than when it fails (i.e., $\mu_1^{H,S} > \mu_1^{H,F}$) and since $\phi_{G,1}^H = \phi_{B,1}^H$, it follows from the above inequality that:

$$\phi_{G,1}^H + q\,\pi_2\big(\mu_1^{H,S}\big) + (1-q)\,\pi_2\big(\mu_1^{H,F}\big) > \pi_2\big(\mu_1^\emptyset\big). \tag{A5}$$

This shows that the opportunistic CRA strictly prefers to offer an H-rating to a type-G firm, contradicting the assumption that $p_{G,1}^H < 1$. ■

Proof of Proposition 2. The marginal benefit of the opportunistic CRA from issuing an H-rating to a type-B firm is given by:

$$\begin{aligned}\frac{d\pi_1}{dp_1} &= (1-\alpha)\beta\left(\phi_1 + \pi_2\big(\mu_1^{H,F}\big) - \pi_2\big(\mu_1^\emptyset\big)\right)\\ &= (1-\alpha)\beta\left(\big(\alpha_1^H + \beta\, c_R\big)\, q\, R - I - \Big(1 - \beta_1^\emptyset + \beta\, c_V\Big)\,\bar{V}\right),\end{aligned} \tag{A6}$$

where:

$$c_R = \frac{\alpha}{1-(1-\alpha)\,\mu_1^{H,F}} - \frac{\alpha}{1-(1-\alpha)\,\mu_1^{\emptyset}}, \tag{A7}$$

$$c_V = \frac{(1-\alpha)\,\beta\,\mu_1^{\emptyset}}{1-\beta+(1-\alpha)\,\beta\,\mu_1^{\emptyset}} - \frac{(1-\alpha)\,\beta\,\mu_1^{H,F}}{1-\beta+(1-\alpha)\,\beta\,\mu_1^{H,F}}, \tag{A8}$$

and the probabilities $\mu_1^{\emptyset}$ and $\mu_1^{H,F}$ are defined by equations (4) and (8), respectively. Note that $d\pi_1/dp_1$ is a function of $\tilde{p}_1$, the investors' belief about the CRA's rating choice p_1, but not of the actual p_1.

An interior solution $p_1^* \in (0,1)$ is characterized by the fact that $d\pi_1/dp_1 = 0$ at $p_1 = \tilde{p}_1 = p_1^*$. From the proof of Proposition 1, we know that $d\pi_1/dp_1 \geq 0$ for all parameter values. For values of $\bar{V}$ close to zero, this inequality can only hold if the coefficient of R in equation (A6) is strictly positive. This proves that the marginal benefit $d\pi_1/dp_1$ is an increasing function of the payoff R. Further, equations (2) and (6) show that both α_1^H and $\beta_1^{\emptyset}$ are decreasing in $\tilde{p}_1$; also, from the above definitions of c_R and c_V—and the expressions for $\mu_1^{\emptyset}$ and $\mu_1^{H,F}$ in equations (4) and (8)—it follows that c_R is a decreasing function of $\tilde{p}_1$ and that c_V is an increasing function of $\tilde{p}_1$. These results imply that $d\pi_1/dp_1$ is a decreasing function of $\tilde{p}_1$. Since in equilibrium $\tilde{p}_1 = p_1^*$, it therefore follows from the Implicit Function Theorem that the equilibrium probability with which the CRA offers an H-rating to a type-B firm, p_1^*, is increasing in R.[25]

The comparative statics results with respect to the CRA's reputation μ_1 follow from the fact that for $\mu_1 = 0$ and $\mu_1 = 1$ no updating of the CRA's reputation takes place. Thus, $\mu_1^{H,F} = \mu_1^{\emptyset}$ and, consequently, $\pi_2\big(\mu_1^{H,F}\big) = \pi_2\big(\mu_1^{\emptyset}\big)$ when $\mu_1 \in \{0,1\}$, implying that the CRA's marginal benefit in equation (A6) is proportional to the fee ϕ_1, which is strictly positive for all $\tilde{p}_1 \in [0,1]$. This proves that the equilibrium value of p_1 converges to one as μ_1 goes to either zero or one. The CRA's credit rating standard, $1-p_1$, is therefore increasing in μ_1 for

[25] Note that this is trivially true in a weak sense for the corner solution $p_1 = 1$.

values of μ_1 close to zero, and decreasing in μ_1 for values of μ_1 close to one. ■

Proof of Proposition 3. The arguments proving the optimality of the firms' strategies specified in part (i) of the proposition are identical to those given in the proof of Proposition 1 and are therefore omitted for brevity. The only difference is that in the case with unsolicited ratings firms are willing to pay more for a solicited rating: since firms that refuse to acquire an H-rating now receive an unsolicited l-rating, the maximum amount they are willing to pay for an H-rating is given by the difference between the value of an H-rated firm net of investment expenses, which is $\hat{V}_t^H - I$, and the value of an l-rated firm, which is zero since in equilibrium only type-B firms with negative NPV projects receive such a rating.

Similarly, the optimality of the CRA's choice of rating fee and probabilities $\hat{p}_{G,1}^H$, $\hat{p}_{B,1}^H$, $\hat{p}_{G,2}^H$, and $\hat{p}_{B,2}^H$ follows immediately from the arguments provided in the proof of Proposition 1. Thus, we are left to show that it is optimal for the opportunistic CRA to issue an unsolicited l-rating if a firm declines the offer to acquire a solicited rating. This follows from the fact that the CRA's updated reputation after issuing an unsolicited l-rating, $\hat{\mu}_1^l$, strictly exceeds its reputation when no rating is issued, $\hat{\mu}_1^\emptyset$, for any $\hat{p}_{B,1}^H = p_1 > 0$ (see equations (11) and (12)). Note that this is true for type-B as well as for type-G firms, since neither type of firm can raise the necessary capital to invest after receiving an unsolicited l-rating, which means that no further updating of the CRA's reputation takes place. This proves that the strategies $\hat{u}_{G,1}^l = \hat{u}_{B,1}^l = 1$ are indeed part of the CRA's equilibrium rating policy. ■

Proof of Corollary 1. This result follows immediately from Proposition 3. ■

Proof of Proposition 4. The proof of these comparative statics results is analogous to the proof of Proposition 2 when $\mu_1^\emptyset$ is replaced by $\hat{\mu}_1^l$ and $\bar{V}$ is set equal to zero. ■

Proof of Proposition 5. In the solicited-only credit rating system, the fee charged for an

H-rating in the first period is:

$$\phi_1 = V_1^H - I - V_1^\emptyset = \alpha_1^H q\, R - I - \big(1 - \beta_1^\emptyset\big)\bar{V}, \tag{A9}$$

whereas in the credit rating system with unsolicited ratings, the fee is:

$$\hat{\phi}_1 = \hat{V}_1^H - I = \hat{\alpha}_1^H q\, R - I. \tag{A10}$$

If $p_1 \geq \hat{p}_1$, then $\alpha_1^H \leq \hat{\alpha}_1^H$, which implies that $\phi_1 < \hat{\phi}_1$. On the other hand, if $p_1 < \hat{p}_1$, then it follows from the fact that $d\pi_1/dp_1$ and $d\hat{\pi}_1/d\hat{p}_1$ are decreasing functions of p_1 and $\hat{p}_1$, respectively (see the proofs of Propositions 2 and 4), that, for $p_1 = \hat{p}_1$, the CRA's marginal benefit from issuing an H-rating to a type-B firm in the credit rating system with unsolicited ratings must exceed that in the solicited-only system, that is:

$$\phi_1 + \pi_2\big(\mu_1^{H,F}\big) - \pi_2\big(\mu_1^\emptyset\big) < \hat{\phi}_1 + \hat{\pi}_2\big(\hat{\mu}_1^{H,F}\big) - \hat{\pi}_2\big(\hat{\mu}_1^l\big). \tag{A11}$$

Now consider the case where $\bar{V} = 0$, which defines an upper bound for the fee ϕ_1, since ϕ_1 is a decreasing function of $\bar{V}$. In this case, $\pi_2\big(\mu_1^{H,F}\big) = \hat{\pi}_2\big(\hat{\mu}_1^{H,F}\big)$ when $p_1 = \hat{p}_1$. Moreover, it is easy to verify that $\mu_1^\emptyset < \hat{\mu}_1^l$, which implies that $\pi_2\big(\mu_1^\emptyset\big) < \hat{\pi}_2\big(\hat{\mu}_1^l\big)$. Thus, it follows from equation (A11) that $\phi_1 < \hat{\phi}_1$ in case $p_1 < \hat{p}_1$ as well, which concludes the proof. ■

Proof of Proposition 6. In the solicited-only credit rating system, the marginal benefit of the opportunistic CRA from issuing an H-rating to a type-B firm is given by:

$$\frac{d\pi_1}{dp_1} = (1-\alpha)\beta\left(\phi_1 + \pi_2\big(\mu_1^{H,F}\big) - \pi_2\big(\mu_1^\emptyset\big)\right), \tag{A12}$$

whereas in the credit rating system with unsolicited ratings, the marginal benefit is equal to:

$$\frac{d\hat{\pi}_1}{d\hat{p}_1} = (1-\alpha)\beta\left(\hat{\phi}_1 + \hat{\pi}_2\big(\hat{\mu}_1^{H,F}\big) - \hat{\pi}_2\big(\hat{\mu}_1^l\big)\right). \tag{A13}$$

First, consider the case where $\bar{V}$ is equal to its lower bound of zero and suppose that $p_1 = \hat{p}_1$. In this case, it follows immediately from the fee structure specified in Propositions 1 and 3 and the updated probabilities in equations (2) and (8) that $\phi_1 = \hat{\phi}_1$ and that $\pi_2\big(\mu_1^{H,F}\big) = \hat{\pi}_2\big(\hat{\mu}_1^{H,F}\big)$. Further, the expressions for $\mu_1^{\emptyset}$ and $\hat{\mu}_1^{l}$ in equations (4) and (11) imply that $\mu_1^{\emptyset} < \hat{\mu}_1^{l}$ and, thus, that $\pi_2\big(\mu_1^{\emptyset}\big) < \hat{\pi}_2\big(\hat{\mu}_1^{l}\big)$. Hence, the marginal benefit in the solicited-only case, $d\pi_1/dp_1$, exceeds the marginal benefit in the case with unsolicited ratings, $d\hat{\pi}_1/d\hat{p}_1$, for all $p_1 = \hat{p}_1 \in (0, 1]$. Combined with the fact that $d\pi_1/dp_1$ and $d\hat{\pi}_1/d\hat{p}_1$ are decreasing functions of p_1 and $\hat{p}_1$, respectively (see the proofs of Propositions 2 and 4), this implies that $p_1 > \hat{p}_1$ for low values of $\bar{V}$.

Next, consider the case where $\bar{V}$ is close to its upper bound of $\alpha q R - I$. In this case, for a given level of the CRA's reputation, the fees that it can charge for an H-rating in the two periods are lower in the solicited-only rating system than in the system with unsolicited ratings. Thus, $\phi_1 < \hat{\phi}_1$ and $\pi_2\big(\mu_1^{H,F}\big) < \hat{\pi}_2\big(\hat{\mu}_1^{H,F}\big)$ when $p_1 = \hat{p}_1$. Further, if α is sufficiently large, it follows from equations (2) and (3) that:

$$\hat{V}_2^H\big(\hat{\mu}_1^l\big) - V_2^H\big(\mu_1^{\emptyset}\big) = \left(\frac{\alpha}{1-(1-\alpha)\,\hat{\mu}_1^l} - \frac{\alpha}{1-(1-\alpha)\,\mu_1^{\emptyset}}\right) q\,R < \left(1-\beta_1^{\emptyset}\right)\bar{V} = V_1^{\emptyset}, \quad \text{(A14)}$$

where $V_2^H(\mu)$ denotes the investors' valuation of a firm that received an H-rating from a CRA with reputation μ in period 2. This implies that the marginal benefit in the case with unsolicited ratings, $d\hat{\pi}_1/d\hat{p}_1$, exceeds the marginal benefit in the solicited-only case, $d\pi_1/dp_1$, for all $p_1 = \hat{p}_1 \in (0, 1]$. From the fact that $d\pi_1/dp_1$ and $d\hat{\pi}_1/d\hat{p}_1$ are decreasing functions of p_1 and $\hat{p}_1$, respectively, it then follows that $p_1 < \hat{p}_1$. This proves that there exist parameter values such that the credit rating standard is more stringent in the solicited-only rating system. ■

Proof of Proposition 7. If the social welfare function is equally weighted, social welfare is lower the more type-B firms obtain an H-rating and invest in their negative NPV projects.

Thus, social welfare is directly related to the credit rating standard in our model. The result in Proposition 7 therefore follows immediately from Proposition 6. ■

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