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Abstract

Credit rating agencies play a crucial role in financial markets. There are two competing views regarding their behavior: some argue that they engage in rating inflation, while others suggest that they deflate ratings. This article offers a rationale that reconciles the two opposite arguments. We find that both rating inflation and rating deflation can occur in equilibrium. Furthermore, we show that credit rating is procyclical: rating inflation is more likely to happen in a boom while rating deflation is more likely to happen in a recession.

Nobody establishes a rating agency in order to help anybody.

—The Polish prime minister, Donald Tusk.[1]

[The investment] could be structured by cows and we would rate it.

—Analyst from one of the main CRAs in an email, April 5, 2007.[2]

1 Introduction

The "Big Three" credit rating agencies (CRAs), Standard and Poor's, Moody's, and Fitch, have played a critical role in the capital markets by assessing and spreading information about default likelihoods and recovery rates of securities. Credit ratings

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[1] "EU leaders blame the euro crisis on American credit rating agencies" by Daniel Hannan, The Telegraph, July 7th, 2011.

[2] Securities and Exchange Commission (2008, page 12)

assigned by them have profound impacts on the welfare of both borrowers and investors. Favorable ratings allow firms or countries to borrow at better terms and thus positively affect their values or economies. The ratings allow uninformed investors to quickly evaluate the risk properties of numerous individual securities by a well-known simple rating symbol, and are thus used extensively in their investment decisions. In fact, many investment policies or government regulations are built on credit ratings. For example, some institutional investors, such as pension funds and money market funds, can invest only in investment-grade securities; others, such as insurance companies and commercial banks, are restricted to use different capital amount based on the ratings of assets they hold. Therefore, the quality of credit ratings is essential for the effective operation of the financial market, and huge losses could arise if rating agencies fail to provide accurate and timely ratings.

The "Big Three" have been widely criticized during the recent global financial crisis, including their roles in both the subprime crisis and the on-going European debt crisis. But the criticism itself appears inconsistent. On the one hand, the CRAs are accused of being too cozy with the companies and the financial products they rate (rating inflation) and bearing a responsibility for the crisis. Well-known examples are: numerous structured finance securities or toxic assets were given the highest possible credit ratings before the subprime crisis; Lehman Brothers remained AAA rating right before its bankruptcy, so were Enron (2001) and World.com (2002). On the other hand, the CRAs are accused of being too focused on a company's or a country's bottom lines and downgrading their ratings without listening to their explanations (rating deflation). For example, in 2007, as housing prices began to tumble, Moody's downgraded 83 percent of the $869 billion mortgage-backed securities it had rated at the AAA level in 2006; on August 5, 2011, S&P downgraded U.S. debt for the first time in U.S. history, by one notch from AAA to AA+; since the spring of 2010, one or more of the Big Three put Greece, Portugal, and Ireland to "junk" status, and in January 2012, amid continued eurozone instability, S&P downgraded nine eurozone countries, stripping France and Austria of their triple-A ratings.

Accordingly, existing studies on credit ratings are also mixed and divided into two opposing views (Bae, Kang, and Wang, 2010). The first is the rating deflation view, which argues that there exists a secular tightening trend of rating standards, followed by a downward trend in credit ratings over time. For example, Blume, Lim, and MacKinlay (1998) use a panel data on firms's credit ratings for a sample period of 1978-1995 to show this result; and Amato and Furfine (2004), Jorion, Shi, and Zhang (2009), and Baghai, Servaes, and Tamayo (2010) confirm the same result using more recent sample periods. The second view, inspired by the recent subprime crisis, is rating inflation. A burgeoning literature, both theoretical (e.g., Bolton, Freixas, and Shapiro, 2012; Mathis, McAndrews, and Rochet, 2009; Skreta and Veldkamp, 2009) and empirical (e.g., Becker and Milbourn, 2011; Griffin and Tang, 2012; He, Qian, and Strahan, 2012), argues that the issuer-pay business model, the rating shopping, and the competition among rating agencies have reduced CRAs' incentive to provide accurate informative and timely ratings, leading to rating inflation.

In this article, we offer a rationale that reconciles the aforementioned two seemingly inconsistent views on CRAs. In a simple two-period reputation model, we show that (i) both rating inflation and rating deflation can occur in equilibrium, and (ii) credit ratings are procyclical: rating inflation is more likely to occur in a boom while rating deflation is more likely to occur in a recession.

In our model, a CRA can be either an honest or an opportunistic type; an investor can be either a sophisticated or naive type; and a security can be either a good or a bad type. The CRA receives a noisy signal about the quality of the security and issues a good or a bad rating upon the request of the security issuer. The issuer will pay for and publish the good ratings, but not the bad ones. The honest CRA always reports the true signal, while the opportunistic CRA chooses the rating to maximize its expected payoffs. The sophisticated investors update their beliefs rationally, while the naive investors take the ratings at face value.

The opportunistic CRA faces the trade-off between the current benefit, which is the rating fee paid by the issuer upon receiving a favorable rating, and the future reputation cost. If the reputation cost is sufficiently small, the CRA will inflate the rating; if the reputation cost is sufficiently large, the CRA will deflate the rating in order to preserve the reputation; only when the reputation cost is in the intermediate range, the CRA will rate truthfully. We then relate the result to business cycles. During the boom, the default probability of the security is low, thus the reputation loss of lying is low, and the opportunistic CRA tends to inflate the rating. During the recession, the default probability of the security is high, thus the reputation cost is high when a good-rating security fails, and the CRA will more likely deflate the rating to preserve its reputation.

Scrutiny on CRAs during the recent financial crisis has generated many new studies. Most of them focus on the issue of rating inflation. Bolton, Freixas, and Shapiro (2012) combine three sources for rating inflation: CRAs understating risk to attract business; issuers' rating shopping behavior, and the existence of trusting or naive investors. They show that competition can make the rating inflation problem even worse as it facilitates rating shopping, and rating inflation are more likely to happen during boom when investors are more optimistic. Complementary to Bolton, Freixas, and Shapiro (2012), we find that in addition to rating inflation, rating deflation is also possible in equilibrium. Furthermore, we show that rating is procyclical. Bar-Isaac and Shapiro (2013) also discuss credit ratings over business cycles, but they demonstrate that rating quality is countercyclical, that is, a CRA is more likely to issue less accurate ratings in a boom than in a recession. Fulghieri, Strobl, and Xia (2013) study the incentives of CRAs to issue unsolicited ratings, and they show that unsolicited ratings are lower than solicited ones. Like Bar-Isaac and Shapiro (2012), they also find that the rating standard is countercyclical. Our procyclical-rating result differs from both Bar-Isaac and Shapiro (2013) and Fulghieri, Strobl, and Xia (2013).[3]

The rest of the paper is organized as follows. Section 2 presents the model. Section 3 shows how both rating inflation and rating deflation may occur in equilibrium. Section 4 introduces economic states to the model and demonstrates that ratings are procyclical. Section 5 concludes.

2 Model

We consider a model that builds on Bolton et al. (2012). There are three kinds of risk-neutral agents: a CRA, issuers, and a unit mass of investors. Issuers seek external funding by selling a security to investors. There are two types of securities: good ($\widetilde{g}$) or bad ($\widetilde{b}$). Good securities do not fail, while bad ones fail with probability p. Both types of securities generate the same return R if not fail, and zero otherwise. All investors and issuers believe ex ante that a security is good with probability $\frac{1}{2}$. Assume $(1-\frac{p}{2})R < r$, where r is the reservation return that the investors need for one unit of the investment. Thus, without further information, the investors are not willing to buy the security.

There are two periods, and there is an issuer in each period. At the beginning of period 1, in order to sell the security, the issuer approaches the CRA for a rating. The CRA first posts a fee ϕ, then receives a private signal $\tau \in \{g, b\}$ with the following information content:

$$\Pr(g \mid \widetilde{g}) = \Pr(b \mid \widetilde{b}) = \mu, \text{ where } \frac{1}{2} < \mu < 1.$$

After that, the CRA produces a credit rating: $m = G$ (good) or $m = B$ (bad). Assume $(1-(1-\mu)p)R > r$; that is, an investor with reliable information that the security is good is willing to purchase it. After observing the rating, the issuer chooses either to buy and publish the rating or not to do so.

[3]Other related studies include: Bar-Isaac and Shapiro (2011); Goel and Thakor (2010); Mariano (2012); Mathis, McAndrews, and Rochet (2009); Opp, Opp, and Harris (2010); and Skreta and Veldkamp (2009).

Proportion β of the investors are naive, while the rest are sophisticated, with $0 < \beta \leq 1$. Both types of investors observe the rating published. The sophisticated investors know that the CRA can be either the honest type (H) or the opportunistic type (O), and that the ex ante probability of having an honest type is η. But the naive investors regard the CRA trustworthy and thus take its rating at face value. The honest CRA will always report the true signal it receives about a security, whereas the opportunistic CRA reports the rating which maximizes its expected payoffs.

If the security is issued, at the end of the period, both types of investors observe whether it is a success or a failure. The sophisticated investors will then find out whether or not the CRA lied by checking the report, the data and the facts. If the CRA is found lying, the sophisticated investors know that the CRA is an opportunistic type for sure. If the CRA is not found lying, the sophisticated investors update their beliefs about the CRA's type accordingly. But the naive investors remain naive: Once the "G" rating security failed, they punish the CRA by ignoring its future reports. Thus, the naive investors are naive both ex ante and ex post: ex ante they take the rating at face value, and ex post they take the results of the security at face value as well.

An investor can purchase either one or zero unit of the security. Define:

$$v \equiv (1 - (1 - \mu)p)R - r. \tag{1}$$

That is, v represents the value to a naive and trusting investor when the CRA reports $m = G$, whether truthfully or not. Also, let

$$\omega_t = R(1 - (1 - \alpha_t)p) - r, \tag{2}$$

where $\alpha_t \equiv \Pr(\widetilde{g} \mid G, t)$ is a sophisticated investor's posterior belief that the project is good after observing a "G" rating at period t, $t = 1, 2$. Thus, ω_t represents the expected value of a security to the sophisticated investor when the CRA reports $m = G$.

Following Laffont and Tirole (1993) and Bolton et al.(2012), the second-period payoff is weighted by a parameter δ, which can be larger than 1. As in Bolton et al.(2012), the parameter value δ represents the importance of the future reputation relative to the current gains for the CRA.

The timing of the game is as follows:

1. At the beginning of period 1, the issuer approaches the CRA for a rating for its security.

2. The CRA posts its rating fee ϕ, then receives a private signal, and makes a rating of $m = G$ or $m = B$.

3. The issuer receives the rating and decides whether to buy and publish it. If the security is not issued, there is zero payoff to all parties in period 1.

4. If the security is issued, investors observe its price and rating, and each decides whether to purchase one unit or not. At the end of period 1, the investment outcome, success or failure, is realized.

5. The game then moves to the beginning of period 2, whether or not a security is issued in period 1. In the second period, the game in the first period is repeated.

We will consider only pure strategies, so that the decisions by all agents are deterministic. Let y (resp. z) be the probability that the opportunistic CRA gives a G (resp. B) rating to a security with good (resp. bad) signal in the first period. Then, with pure strategies, $y, z \in \{0, 1\}$.

3 Equilibrium Analysis

We will discuss three possible equilibria: (1) truthful rating ($y = 1, z = 1$), where the opportunistic CRA always reports the true signals in period 1; (2) rating inflation ($y = 1, z = 0$), where the opportunistic CRA gives G rating in period 1 regardless of the signals; and (3) rating deflation ($y = 0, z = 1$), where the opportunistic CRA issues rating $m = B$ in period 1 no matter what signals it receives.[4] As it will become clear later, the opportunistic CRA will always give the G rating in period 2.

3.1 Preliminaries

To facilitate the equilibrium characterization, we start by considering how the investors will update their beliefs and how the CRA will charge fees with different ratings in different periods.

3.1.1 Period 1

In period 1, note first that the issuer will not pay for a B rating, which makes the rating fee for a B rating equal to zero. Thus, when observing no rating (N) for the first period, the sophisticated investors infer that the rating which the CRA gives for the security must be a B. Thus no security is issued for period 1. Sophisticated investors update

[4] The case of false reporting ($y = 0, z = 0$) is impossible for the CRA.

their beliefs about the CRA's type using this information:

$$\begin{aligned}
&\eta_1^N \equiv \Pr(H \mid N) = \Pr(H \mid B) \\
= &\frac{\Pr(B \mid H)\Pr(H)}{\Pr(B \mid H)\Pr(H) + \Pr(B \mid O)\Pr(O)} \\
= &\frac{[(1-\mu)\frac{1}{2} + \mu\frac{1}{2}]\eta}{[(1-\mu)\frac{1}{2} + \mu\frac{1}{2}]\eta + \{[\mu(1-y) + (1-\mu)z]\frac{1}{2} + [\mu z + (1-\mu)(1-y)]\frac{1}{2}\}(1-\eta)} \\
= &\frac{\eta}{\eta + (1-\eta)(z+1-y)},
\end{aligned}$$

where $\Pr(H) = \eta$, $\Pr(O) = 1-\eta$,

$$\begin{aligned}
\Pr(B \mid H) &= \Pr(B \mid H, \tilde{g})\Pr(\tilde{g}) + \Pr(B \mid H, \widetilde{b})\Pr(\widetilde{b}) = (1-\mu)\frac{1}{2} + \mu\frac{1}{2}, \\
\Pr(B \mid O) &= \Pr(B \mid O, \tilde{g})\Pr(\tilde{g}) + \Pr(B \mid O, \widetilde{b})\Pr(\widetilde{b}) \\
&= [\mu(1-y) + (1-\mu)z]\frac{1}{2} + [\mu z + (1-\mu)(1-y)]\frac{1}{2}.
\end{aligned}$$

Next, when observing a G rating in period 1, the sophisticated investors believe that the security in consideration is a good type with probability:

$$\begin{aligned}
&\alpha_1 \equiv \Pr(\widetilde{g} \mid G) = \frac{\Pr(G \mid \tilde{g})\Pr(\tilde{g})}{\Pr(G \mid \tilde{g})\Pr(\tilde{g}) + \Pr\left(G \mid \tilde{b}\right)\Pr\left(\tilde{b}\right)} \\
= &\frac{\mu\eta + [\mu y + (1-\mu)(1-z)](1-\eta)}{\mu\eta + [\mu y + (1-\mu)(1-z)](1-\eta) + (1-\mu)\eta + [(1-\mu)y + \mu(1-z)](1-\eta)} \\
= &\frac{\mu\eta + [\mu y + (1-\mu)(1-z)](1-\eta)}{\eta + (1-\eta)(y+1-z)},
\end{aligned}$$

where

$$\begin{aligned}
\Pr(G \mid \tilde{g}) &= \Pr(G \mid \tilde{g}, H)\Pr(H) + \Pr(G \mid \tilde{g}, O), \\
\Pr\left(G \mid \tilde{b}\right) &= \Pr\left(G \mid \tilde{b}, H\right)\Pr(H) + \Pr\left(G \mid \tilde{b}, O\right)\Pr(O).
\end{aligned}$$

Thus the sophisticated investors are willing to pay a price no more than $\omega_1 = R(1 - (1-\alpha_1)p) - r$.

Notice that the issuer can post only a single price. When receiving the G rating, the issuer will post either price v to sell only to the naive investors, or price $\omega_1 \leq v$ to sell to all investors, with payoffs βv and ω_1, respectively. Under our assumption that the monopoly CRA can extract all the surplus from the issuers, the rating fee that CRA can charge for a G rating in the first period is:

$$\phi_1 = \max\{\beta v, \omega_1\}.$$

At the end of the first period, for a G-rated security (which is issued), the investment outcome, success (S) or failure (F), is realized and observed by all players. The naive investors will continue to believe the CRA if they see a success, and otherwise they will no longer pay attention to the CRA's ratings. For the sophisticated investors, if the CRA lied (i.e., reported G when the signal is b), their updated belief on the probability that CRA is an honest type becomes $\eta_1^L = 0$; if the CRA did not lie, their updated belief is:

$$\begin{aligned}\eta_1^S &= \eta_1^F \equiv \Pr(H \mid G, g) = \frac{\Pr(G, g \mid H)\Pr(H)}{\Pr(G, g \mid H)\Pr(H) + \Pr(G, g \mid O)\Pr(O)} \\ &= \frac{\eta}{\eta + y(1-\eta)}.\end{aligned}$$

3.1.2 Period 2

In the second period, there is no more reputation concern so that the opportunistic CRA always inflates the rating. If the CRA is not found lying in the first period, and after observing the G rating, the sophisticated investors update beliefs that the security is a good type:

$$\begin{aligned}\alpha_2^i &\equiv \Pr(\tilde{g} \mid G) = \frac{\Pr(G \mid \tilde{g})\Pr(\tilde{g})}{\Pr(G \mid \tilde{g})\Pr(\tilde{g}) + \Pr\left(G \mid \tilde{b}\right)\Pr\left(\tilde{b}\right)} \\ &= \frac{\mu\eta_1^i + (1-\eta_1^i)}{2-\eta_1^i},\ i = N, L, S, F,\end{aligned}$$

corresponding to the four possible situations in period 1: no security was issued; the CRA was caught lying; the CRA reported truthfully and the security was a success or a failure. The probability that the sophisticated investors assign to the security in period 2 as being a good type is:

$$\alpha_2^N = \frac{\eta\mu + (1-\eta)(z+1-y)}{\eta + 2(1-\eta)(z+1-y)}, \quad \alpha_2^L = \frac{1}{2}, \quad \alpha_2^S = \alpha_2^F = \frac{\eta\mu + (1-\eta)y}{\eta + 2(1-\eta)y}.$$

Therefore, the fees charged in period 2 by the CRA are, with $\omega_2^i = R(1-(1-\alpha_2^i)p) - r$ for $i = S, F, N$:

- $\phi_2^S = \max\{\beta v, \omega_2^S\}$ if the first period outcome is a success and the CRA did not lie;
- $\phi_2^{LS} = \beta v$ if the first period outcome is a success and the CRA lied;
- $\phi_2^F = (1-\beta)\omega_2^F$ if the first period outcome is a failure and the CRA did not lie; and

- $\phi_2^N = \max\{\beta v, \omega_2^N\}$ if in the first period the investors observed no rating.

For later analysis, we define

$$
\begin{aligned}
w &\equiv R\{1-[1-\frac{1-(1-\mu)\eta}{2-\eta}]p\}-r, \\
k &\equiv R\{1-[1-\frac{\eta\mu+2(1-\eta)}{4-3\eta}]p\}-r.
\end{aligned}
$$

Notice that $\frac{1}{2} < \frac{\eta\mu+2(1-\eta)}{4-3\eta} \leq \frac{1-(1-\mu)\eta}{2-\eta} < \mu$. We assume $k > 0$ for the rest of the analysis. It follows that $w \geq k > 0$.

3.2 Equilibrium

We next discuss the three possible equilibrium strategies by the CRA in period 1: truthful rating, rating inflation, and rating deflation.

3.2.1 Truthful rating

Suppose that the CRA reports truthfully in equilibrium, that is, $y = 1, z = 1$. The sophisticated investors' beliefs are consistent with the CRA's strategy, and we thus have, for $i = S; F; N$:

$$
\begin{aligned}
\alpha_1^T &= \mu, \quad \omega_1^T = v, \quad \phi_1^T = v, \quad \eta_1^{i,T} = \eta, \\
\alpha_2^{i,T} &= \frac{1-(1-\mu)\eta}{2-\eta}; \quad \omega_2^{i,T} = R[1-(1-\alpha_2^{i,T})p]-r = w, \\
\phi_2^{S,T} &= \phi_2^{N,T} = \max\{\beta v, w\}, \quad \phi_2^{F,T} = (1-\beta)w.
\end{aligned}
$$

With the truthful-rating strategy, conditional on receiving a good signal of the security, the CRA will report "G", and it earns:

$$
\begin{aligned}
\pi^T(G \mid g) &= \phi_1^T + \delta\{[1-(1-\mu)p]\phi_2^{S,T} + (1-\mu)p\phi_2^{F,T}\} \\
&= \phi_1^T + \delta[\phi_2^{S,T} + (1-\mu)p(\phi_2^{F,T} - \phi_2^{S,T})] \\
&= v + \delta\{\max\{\beta v, w\} + (1-\mu)p[(1-\beta)w - \max\{\beta v, w\}]\},
\end{aligned}
$$

as the security will succeed with probability $1-(1-\mu)p$ and fail with probability $(1-\mu)p$. Conditional on receiving a bad signal, the CRA will report $m = B$, and its payoff is:

$$\pi^T(B \mid b) = \delta\phi_2^{N,T} = \delta\max\{\beta v, w\}.$$

If the CRA deviates to reporting "B" when it receives the "g" signal, its payoff is:

$$\pi^T(B \mid g) = \delta\phi_2^{N,T} = \delta\max\{\beta v, w\}.$$

If it deviates to reporting "G" when it receives the "b" signal, its payoff is:

$$\pi^T(G \mid b) = \phi_1^T + \delta(1-\mu p)\beta v = v + \delta(1-\mu p)\beta v.$$

The CRA will report truthfully if and only if

$$\pi^T(G \mid g) - \pi^T(B \mid g) \geq 0, \tag{3}$$

and

$$\pi^T(B \mid b) - \pi^T(G \mid b) \geq 0. \tag{4}$$

Condition (3) holds if and only if

$$\delta \leq \frac{v}{(1-\mu)p[\max\{\beta v, w\} - (1-\beta)w]} \equiv \bar{\delta}^T, \tag{5}$$

and condition (4) holds if and only if

$$\delta \geq \frac{v}{\max\{\beta v, w\} - (1-\mu p)\beta v} \equiv \underline{\delta}^T. \tag{6}$$

Since $\mu > 1/2$ and

$$\max\{\beta v, w\} - (1-\beta)w < \beta v,$$

we have

$$\begin{aligned}
\bar{\delta}^T &= \frac{v}{(1-\mu)p[\max\{\beta v, w\} - (1-\beta)w]} \\
&> \frac{v}{(1-\mu)p\beta v} > \frac{v}{\mu p \beta v} \geq \frac{v}{\max\{\beta v, w\} - (1-\mu p)\beta v} = \underline{\delta}^T.
\end{aligned}$$

We have thus established:

Lemma 1 *There exist values $\underline{\delta}^T$ and $\bar{\delta}^T$, with $\underline{\delta}^T < \bar{\delta}^T$ as defined in (5) and (6), such that truthful rating by the CRA is an equilibrium if and only if $\underline{\delta}^T \leq \delta \leq \bar{\delta}^T$.*

3.2.2 Rating inflation

The CRA may choose to inflate ratings; that is, $y = 1, z = 0$. The sophisticated investors' beliefs are consistent with the CRA's strategy in equilibrium. In this case,

$$\begin{aligned}
\alpha_1^I &= \frac{1-(1-\mu)\eta}{2-\eta}, \quad \omega_1^I = R[1-(1-\alpha_1^I)p] - r = w, \quad \phi_1^I = \max\{\beta v, w\}; \\
\eta_1^{S,I} &= \eta_1^{F,I} = \eta, \quad \alpha_2^{S,I} = \alpha_2^{F,I} = \frac{1-(1-\mu)\eta}{2-\eta}; \\
\omega_2^{S,I} &= \omega_2^{F,I} = R[1-(1-\alpha_2^{S,I})p] - r = w; \\
\phi_2^{S,I} &= \max\{\beta v, w\}, \quad \phi_2^{F,I} = (1-\beta)w.
\end{aligned}$$

With the rating-inflation strategy, conditional on a bad signal, the CRA will report $m = G$. In this case, the CRA can collect the rating fee, but it will be found lying by the sophisticated investors and thus they will not buy in period 2, while the naive investors will only purchase in period 2 if the security succeeds in period 1 (which occurs with $1 - \mu p$). Therefore, the CRA's payoff is:

$$\pi^I(G \mid b) = \phi_1^I + \delta(1-\mu p)\beta v = \max\{\beta v, w\} + \delta(1-\mu p)\beta v.$$

Also, with the rating-inflation strategy, the CRA will report $m = G$ conditional on a good signal, and the CRA's payoff in this case is:

$$\begin{aligned}\pi^I(G \mid g) &= \phi_1^I + \delta\{[1-(1-\mu)p]\phi_2^{S,I} + (1-\mu)p\phi_2^{F,I}\} \\ &= \phi_1^I + \delta[\phi_2^{S,I} - (1-\mu)p(\phi_2^{S,I} - \phi_2^{F,I})] \\ &= \max\{\beta v, w\} + \delta\{\max\{\beta v, w\} - (1-\mu)p[\max\{\beta v, w\} - (1-\beta)w]\}.\end{aligned}$$

In the rating-inflation regime, the sophisticated investors believe that the opportunistic CRA always reports G. Once they find that there is no reporting, they know it must be a B rating, and they hold the belief that the CRA giving the B-rating is an honest type. Therefore,

$$\alpha_2^{N,I} = \mu, \quad \omega_2^{N,I} = v, \quad \phi_2^{N,I} = v.$$

Then the payoff for the CRA to deviate to report B is:

$$\pi^I(B) = \delta\phi_2^{N,I} = \delta v.$$

Notice that $\pi^I(G \mid g) \geq \pi^I(G \mid b)$. Hence, the rating-inflation strategy is an equilibrium if and only if

$$\pi^I(G \mid b) - \pi^I(B) \geq 0,$$

or,

$$\max\{\beta v, w\} + \delta(1-\mu p)\beta v - \delta v \geq 0,$$

which holds if and only if

$$\delta \leq \frac{\max\{\beta v, w\}}{v - (1-\mu p)\beta v} \equiv \delta^I. \tag{7}$$

Therefore, rating-inflation is an equilibrium strategy if and only if (7) holds. Notice that

$$0 < \delta^I < \underline{\delta}^T \tag{8}$$

since

$$\begin{aligned}\delta^I &= \frac{\max\{\beta v, w\}}{v - (1-\mu p)\beta v} \\ &\leq \frac{v}{v - (1-\mu p)\beta v} \leq \frac{v}{\max\{\beta v, w\} - (1-\mu p)\beta v} = \underline{\delta}^T.\end{aligned}$$

We therefore have:

Lemma 2 *Rating inflation is an equilibrium if and only if* $\delta \leq \delta^I$, *where* $0 < \delta^I \leq \underline{\delta}^T$.

Thus, when the reputation concern is small, the CRA has incentive to inflate ratings for short-term gains.

3.2.3 Rating deflation

The CRA may choose to deflate the ratings, that is, $y = 0, z = 1$. In such an equilibrium,

$$\begin{aligned}
\phi_1^D &= 0, \quad \alpha_2^{N,D} = \frac{\eta\mu + 2(1-\eta)}{4 - 3\eta}, \\
\omega_2^{N,D} &= R[1 - (1 - \alpha_2^{N,D})p] - r = k, \quad \phi_2^{N,D} = \max\{\beta v, k\}.
\end{aligned}$$

Note that $\phi_1^D = 0$ since the issuer will not pay for a B rating. With the rating-deflation strategy, conditional on receiving a good signal, the CRA reports $m = B$, with payoff:

$$\pi^D(B \mid g) = \delta\phi_2^{N,D} = \delta \max\{\beta v, k\}.$$

Conditional on receiving a bad signal, the CRA also reports $m = B$, and its payoff is:

$$\pi^D(B \mid b) = \delta\phi_2^{N,D} = \delta \max\{\beta v, k\}.$$

In the rating-deflation regime, the CRA may deviate to report $m = G$. Since the sophisticated investors believe that the opportunistic CRA always deflates the ratings in this regime, once they see G report, they believe that the CRA is an honest type. Then

$$\begin{aligned}
\alpha_2^{i,D} &= \mu, \quad \omega_2^{i,D} = v, \text{where } i = S, F, \\
\phi_2^{S,D} &= v, \quad \phi_2^{F,D} = (1 - \beta)v.
\end{aligned}$$

Therefore, this deviation when receiving a g signal brings payoff:

$$\begin{aligned}
\pi^D(G \mid g) &= v + \delta\{[1 - (1-\mu)p]\phi_2^{S,D} + (1-\mu)p\phi_2^{F,D}\} \\
&= v + \delta[v - (1-\mu)p\beta v].
\end{aligned}$$

Or, after receiving a bad signal, the CRA may deviate to report $m = G$, and the payoff from this deviation is:

$$\pi^D(G \mid b) = v + \delta(1 - \mu p)\beta v.$$

Notice that $\pi^D(G \mid g) \geq \pi^D(G \mid b)$. Therefore, the rating-deflation strategy is an equilibrium strategy if and only if

$$\pi^D(B \mid g) - \pi^D(G \mid g) = \delta \max\{\beta v, k\} - \{v + \delta[v - (1-\mu)p\beta v]\} \geq 0,$$

or

$$\delta \max\{\beta v, k\} - v - \delta[v - (1-\mu)p\beta v] \geq 0. \tag{9}$$

Lemma 3 *Assume that*

$$\beta > \frac{1}{1 + (1-\mu)p} \equiv \hat{\beta}. \tag{10}$$

Then, given β*, there exists a number*

$$\delta^D \equiv \frac{v}{\max\{\beta v, k\} - v + (1-\mu)p\beta v} \tag{11}$$

such that rating-deflation is an equilibrium if and only if $\delta \geq \delta^D$*, with* $\delta^D \geq \bar{\delta}^T$*.*

Proof. Since $\max\{\beta v, k\} \geq \beta v$, $\max\{\beta v, k\} - v + (1-\mu)p\beta v > 0$ if

$$\beta v - v + (1-\mu)p\beta v > 0,$$

which holds if $\beta > \hat{\beta}$. Then, when $\beta > \hat{\beta}$, (9) holds if and only if

$$\delta \geq \frac{v}{\max\{\beta v, k\} - v + (1-\mu)p\beta v} \equiv \delta^D;$$

and δ^D exists for any given $\beta > \hat{\beta}$. Furthermore, since $\max\{\beta v, k\} \leq \max\{\beta v, w\} \leq v$ and $v \geq w$, we have

$$\begin{aligned}
& (1-\mu)p[\max\{\beta v, w\} - (1-\beta)w] \\
\geq\; & (1-\mu)p[\max\{\beta v, w\} - (1-\beta)v] = (1-\mu)p[\max\{\beta v, w\} - v] + (1-\mu)p\beta v \\
\geq\; & \max\{\beta v, w\} - v + (1-\mu)p\beta v \geq \max\{\beta v, k\} - v + (1-\mu)p\beta v.
\end{aligned}$$

It follows that

$$\begin{aligned}
\delta^D &= \frac{v}{\max\{\beta v, k\} - v + (1-\mu)p\beta v} \\
&\geq \frac{v}{(1-\mu)p[\max\{\beta v, w\} - (1-\beta)w]} = \bar{\delta}^T.
\end{aligned}$$

■

Thus, for the rating-deflation equilibrium to exist, the proportion of naive investors need to be large enough, and the CRA need to have sufficiently strong concerns for reputation.

Summarizing the findings from Lemmas 1, 2 and 3, we have our first main result below, providing the equilibrium characterization:

Proposition 1 *There exists five critical values δ^I, $\underline{\delta}^T$, $\bar{\delta}^T$, δ^D, and $\hat{\beta}$, with $0 < \delta^I \leq \underline{\delta}^T < \bar{\delta}^T \leq \delta^D$ and $\frac{1}{2} < \hat{\beta} < 1$, such that in equilibrium the opportunistic CRA has the following first-period strategies: (i) it inflates the rating if and only if $\delta \leq \delta^I$, setting rating fee $\phi_1^I = \max\{\beta v, w\}$; (ii) it reports the true signal if and only if $\underline{\delta}^T \leq \delta \leq \bar{\delta}^T$, setting $\phi_1^T = v$; and (iii) provided that $\beta > \hat{\beta}$, it deflates the rating if and only if $\delta \geq \delta^D$, setting $\phi_1^D = 0$.*

When choosing rating strategy, the opportunistic CRA faces a trade-off between the current benefit and the future reputation cost. Proposition 1 shows that when the reputation parameter δ is sufficiently low such that the reputation loss will be small, the CRA inflates the rating; when the reputation parameter and the proportion of naive investors are sufficiently high such that the reputation loss is large, the CRA deflates the rating in order to preserve the reputation; only when the reputation parameter is in the intermediate range, the CRA will provide truthful ratings.

Rating deflation helps to preserve reputation, due to the following reason: The private signal of the CRA is noisy. Even if the CRA reports truthfully the good signal, the security may fail with probability $(1-\mu)p$. When a G-rating security is a failure, the naive investors will punish the CRA by ignoring its report in the future. If the proportion of naive investors is sufficiently high ($\beta > \hat{\beta}$) and if future profit is sufficiently important, by reporting $m = B$, the CRA gives up the current rating fee but preserves its reputation because it will not be perceived as having inflated the rating, given that the security is not issued at all.

It is interesting that the existence of naive investors can motivate both rating-inflation and rating-deflation. While the opportunistic CRA may take advantage of the naive investors' ex ante trust to inflate ratings (Bolton et al., 2012), our analysis shows that the ex post punishment by the naive investors once a G-rating security fails may also prompt the opportunistic CRA to deflate ratings. However, as we shall see shortly, the existence of naive investors is a necessary condition for rating deflation, but not for rating inflation.

The next result states how changes in the two key parameters of our model, β and μ, may affect the equilibrium outcome.

Corollary 1 *(i) The opportunistic CRA is more likely to inflate or deflate its rating when the portion of naive investors (β) is higher.*[5] *(ii) Suppose that $\beta > \frac{w}{v}$. Then, the opportunistic CRA is more likely to provide truthful rating when the private signal is more accurate (i.e., μ is higher).*

[5]The rating deflation arguement is within interval $\beta \in (\widehat{\beta}, 1]$.

Proof. (i) Since

$$\delta^I = \frac{\max\{\beta v, w\}}{v-(1-\mu p)\beta v}, \qquad \delta^D = \frac{v}{\max\{\beta v, k\} - v + (1-\mu)p\beta v},$$

we have $\frac{\partial \delta^I}{\partial \beta} > 0$, and $\frac{\partial \delta^D}{\partial \beta} < 0$. It follows that the regions of parameter values that support the rating inflation equilibrium and the rating deflation equilibrium are larger when β is higher. (ii) When $\beta > \frac{w}{v}$, it is straightforward to verify that $\frac{\partial \delta^I}{\partial \mu} < 0$, $\frac{\partial \underline{\delta}^T}{\partial \mu} < 0$, $\frac{\partial \bar{\delta}^T}{\partial \mu} > 0$, and $\frac{\partial \delta^D}{\partial \mu} > 0$. Therefore the opportunistic CRA is more likely to provide truthful rating when μ is higher. ■

In the rating-inflation regime, the parameter value β determines the potential revenue from the naive investors. Keeping other things constant, a higher β implies a larger δ^I, and hence there is a larger region of parameter values under which the CRA inflates the rating. In the rating-deflation regime, the parameter value β determines the punishment intensity if the G-rating security fails. Holding other things constant, a higher β implies a smaller δ^D, and thus there is a larger region of parameter values under which the CRA deflates the rating.

Notice that if $\beta = 1$, or if all investors are naive, then $\delta^I = \underline{\delta}^T = \frac{1}{\mu p}$, and $\bar{\delta}^T = \delta^D = \frac{1}{(1-\mu)p}$. That is, the four critical values, δ^I, $\underline{\delta}^T$, $\bar{\delta}^T$, and δ^D, are reduced to two, but the three regimes for rating-inflation, truthful-rating and rating-deflation still exist. However, if $\beta = 0$, or if all investors are sophisticated, then $\delta^I = \frac{w}{v}$ and $\underline{\delta}^T = \frac{v}{w}$; there is rating inflation if $\delta < \frac{w}{v}$, and there is truthful rating if $\delta \geq \frac{v}{w}$, but there is no rating deflation. Hence the presence of naive investors is necessary for equilibrium rating deflation but not necessary for rating inflation.

Corollary 1 also says that when the private signal is more accurate (μ is higher), the CRA will be more likely to report the true signal, provided that the proportion of naive investors is sufficiently large ($\beta > \frac{w}{v}$). This is intuitive, because a more accurate private signal implies a higher cost of mis-reporting, increasing the incentive for truthful rating.

We also notice that when p is small (more likely in boom), rating inflation is more likely to happen; when p is large (more likely in recession), rating deflation is more likely to happen. We formalize this observation in the next section.

4 Ratings and Business Cycle

In this section we introduce state variables to discuss the relationship between credit ratings and the business cycle. Suppose there are two states $s \in \{h, l\}$, where h corresponds to high economic activities or a boom, and l to low economic activities or a recession. We assume that the probability of failure for the securities is lower under boom than under recession: $p_h < p_l$. For simplicity, everything else is assumed to be the same in the two state. It follows that $v_h > v_l$, $w_h > w_l$, and $k_h > k_l$.

Let θ_s be the probability that the current state s will remain in the next period. Then $1-\theta_s$ is the transition probability from the current state s to the other state. For $-s \in \{h, l\}$ and $-s \neq s$, if $\theta_s = 1 - \theta_{-s}$, the state in each period is an i.i.d draw from the same distribution; if $\theta_s > 1 - \theta_{-s}$, there is a positive correlation between states; and if $\theta_s < 1 - \theta_{-s}$, there is a negative correlation between states. A higher θ_s means a longer duration for the state s and a slow move to the other state. The following is the transition matrix:

$$\begin{array}{ccc} & h & l \\ h & \theta_h & 1-\theta_h \\ l & 1-\theta_l & \theta_l \end{array}$$

The transition matrix and the nature of the state in each period are assumed to be public information. Denote:

$$\begin{aligned} \overline{v}_s &\equiv \theta_s v_s + (1-\theta_s) v_{-s}, \\ \overline{w}_s &\equiv \theta_s w_s + (1-\theta_s) w_{-s}, \\ \overline{k}_s &\equiv \theta_s k_s + (1-\theta_s) k_{-s}. \end{aligned}$$

Then, given that the current state is s, $\overline{v}_s$ is the expected willingness to pay by a trusting naive investor for the G-rated security in the next period; $\overline{w}_s$ is the expected willingness to pay by a sophisticated investor, when the CRA was truthful in the current period, for the G-rated security in the next period; and $\overline{k}_s$ is the expected willingness to pay by a sophisticated investor, when the CRA gave a B-rating in the current period, for the G-rated security in the next period. We further define, for $s \in \{h, l\}$:

$$\begin{aligned} \delta_s^I &\equiv \frac{\max\{\beta v_s, w_s\}}{\overline{v}_s - (1-\mu p_s)\beta \overline{v}_s}, \\ \underline{\delta}_s^T &= \frac{v_s}{\max\{\beta \overline{v}_s, \overline{w}_s\} - (1-\mu p_s)\beta \overline{v}_s}, \\ \bar{\delta}_s^T &\equiv \frac{v_s}{(1-\mu)p_s[\max\{\beta \overline{v}_s, \overline{w}_s\} - (1-\beta)\overline{w}_s]}, \\ \delta_s^D &\equiv \frac{v_s}{\max\{\beta \overline{v}_s, \overline{k}_s\} - \overline{v}_s + (1-\mu)p_s \beta \overline{v}_s}. \end{aligned}$$

Then, similarly as in the previous section, we have

$$\delta_s^I \leq \underline{\delta}_s^T < \bar{\delta}_s^T \leq \delta_s^D.$$

Also, let

$$\hat{\beta}_s = \frac{1}{1 + (1 - \mu)p_s} \text{ for } s = h, l,$$

then $\hat{\beta}_l < \hat{\beta}_h$. Using the same arguments leading to Proposition 1, we immediately have:

Lemma 4 *Suppose that the state in period 1 is $s \in \{h, l\}$. Then the opportunistic CRA's equilibrium strategy in period 1 is: (i) it inflates the rating if and only if $\delta_s \leq \delta_s^I$, setting the rating fee $\phi_{1,s}^I = \max\{\beta v_s, w_s\}$; (ii) it reports the true signal if and only if $\underline{\delta}_s^T \leq \delta_s \leq \overline{\delta}_s^T$, setting $\phi_{1,s}^T = v_s$; and (iii) provided that $\beta > \hat{\beta}_h$, it deflates the rating if and only if $\delta_s \geq \delta_s^D$, setting $\phi_{1,s}^D = 0$.*

Similar to Proposition 1, when the reputation parameter δ_s is sufficiently small, the CRA inflates the rating; when the reputation parameter and the proportion of naive investors are sufficiently large ($\beta_s > \hat{\beta}_h$), the CRA deflates the rating; when the reputation parameter is in the intermediate range, the CRA reports the true signal.

Proposition 2 below states our second main result, connecting ratings to business cycles.

Proposition 2 *Rating inflation is more likely to happen in a boom; and there exists $\overline{\beta} \in (0, 1)$, such that for $\beta > \overline{\beta}$, rating deflation is more likely to happen in a recession.*

Proof. We can rewrite $\delta_s^I \equiv \delta_s^I(\theta_s, p_s)$ and $\delta_s^D \equiv \delta_s^D(\theta_s, p_s)$, where $s \in \{h, l\}$.

(1) We show that $\delta_h^I(\theta_h, p_h) > \delta_l^I(\theta_l, p_l)$, which would imply that the equilibrium condition for rating inflation is more likely to be satisfied in state h than in state l.

First, since $\frac{\partial \bar{v}_h}{\partial \theta_h} > 0$, $\frac{\partial \bar{v}_l}{\partial \theta_l} < 0$, and given

$$\delta_s^I = \frac{\max\{\beta v_s, w_s\}}{\overline{v}_s - (1 - \mu p_s)\beta \overline{v}_s} = \frac{\max\{\beta v_s, w_s\}}{[1 - (1 - \mu p_s)\beta]} \frac{1}{\overline{v}_s},$$

we have

$$\frac{\partial \delta_h^I(\theta_h, p_h)}{\partial \theta_h} < 0 \text{ and } \frac{\partial \delta_l^I(\theta_l, p_l)}{\partial \theta_l} > 0.$$

It follows that $\delta_h^I(\theta_h, p_h) \geq \delta_h^I(1, p_h)$ and $\delta_l^I(1, p_l) \geq \delta_l^I(\theta_l, p_l)$.

Next, since $p_h < p_l$, $\frac{w_h}{v_h} > \frac{w_l}{v_l}$, we have

$$\delta_h^I(1, p_h) = \frac{\max\{\beta v_h, w_h\}}{v_h - (1 - \mu p_h)\beta v_h} > \frac{\max\{\beta v_l, w_l\}}{v_l - (1 - \mu p_l)\beta v_l} = \delta_l^I(1, p_l).$$

Therefore

$$\delta_h^I(\theta_h, p_h) \geq \delta_h^I(1, p_h) > \delta_l^I(1, p_l) \geq \delta_l^I(\theta_l, p_l),$$

or $\delta_h^I(\theta_h, p_h) > \delta_l^I(\theta_l, p_l)$.

(2) We show that there exists $\overline{\beta} \in (0,1)$, suvh that for $\beta > \overline{\beta}$, $\delta_h^D(\theta_h, p_h) > \delta_l^D(\theta_l, p_l)$. This would imply that the equilibrium condition for rating deflation is more likely to be satisfied in state l than in state h.

First, suppose that $\max\{\beta\overline{v}_s, \bar{k}_s\} = \beta\overline{v}_s$. Then,

$$\delta_s^D \equiv \frac{v_s}{\max\{\beta\overline{v}_s, \bar{k}_s\} - \overline{v}_s + (1-\mu)p_s\beta\overline{v}_s} = \frac{v_s}{\beta - 1 + (1-\mu)p_s\beta}\frac{1}{\overline{v}_s}.$$

Hence, since $\frac{\partial \overline{v}_h}{\partial \theta_h} > 0$ and $\frac{\partial \overline{v}_l}{\partial \theta_l} < 0$, we have $\frac{\partial \delta_h^D(\theta_h, p_h)}{\partial \theta_h} < 0$ and $\frac{\partial \delta_l^D(\theta_l, p_l)}{\partial \theta_l} > 0$.

Next, suppose that $\max\{\beta\overline{v}_s, \bar{k}_s\} = \bar{k}_s$. Then, $\delta_s^D = \frac{v_s}{\bar{k}_s - \overline{v}_s + (1-\mu)p_s\beta\overline{v}_s}$. Since

$$\begin{aligned}
\frac{\partial[\bar{k}_s - \overline{v}_s + (1-\mu)p_s\beta\overline{v}_s]}{\partial \theta_s} &= (k_s - k_{-s}) - [1 - (1-\mu)p_s\beta](v_s - v_{-s}) \\
&= R(p_{-s} - p_s)\{(1 - \alpha_2^{N,D}) - [1 - (1-\mu)p_s\beta](1-\mu)\}
\end{aligned}$$

and

$$(1 - \alpha_2^{N,D}) - [1 - (1-\mu)p_s\beta](1-\mu) > (1 - \alpha_2^{N,D}) - (1-\mu) = \mu - \alpha_2^{N,D} > 0,$$

we have $\frac{\partial \delta_h^D(\theta_h, p_h)}{\partial \theta_h} < 0$ and $\frac{\partial \delta_l^D(\theta_l, p_l)}{\partial \theta_l} > 0$. It follows that $\delta_h^D(\theta_h, p_h) \geq \delta_h^D(1, p_h)$ and $\delta_l^D(1, p_l) \geq \delta_l^D(\theta_l, p_l)$.

Next, we show that there exists $\overline{\beta} \in (0,1)$ such that for $\beta > \overline{\beta}$, $\delta_h^D(1, p_h) > \delta_l^D(1, p_l)$. If $\max\{\beta v_s, k_s\} = \beta v_s$, or $\beta \geq \frac{k_h}{v_h}$, then

$$\begin{aligned}
\delta_h^D(1, p_h) &= \frac{v_h}{\beta v_h - v_h + (1-\mu)p_h\beta v_h} = \frac{1}{\beta - 1 + (1-\mu)p_h\beta} \\
&> \frac{1}{\beta - 1 + (1-\mu)p_l\beta} = \delta_l^D(1, p_l).
\end{aligned}$$

Define $\overline{\beta} \equiv \max\{\frac{k_h}{v_h}, \hat{\beta}_h\}$. Then there exists $0 < \overline{\beta} < 1$ such that for $\beta \geq \overline{\beta}$, $\delta_h^D(\theta_h, p_h) > \delta_l^D(\theta_l, p_l)$. ■

Remarkably, regardless of whether the states are independent or correlated across periods, we have $\delta_h^I > \delta_l^I$ and $\delta_h^D > \delta_l^D$; that is, the range of parameter values for the equilibrium of rating inflation is larger in a boom, whereas the range of parameter values for the equilibrium of rating deflation is larger in a recession. In this sense, CRA's credit ratings are procyclical: rating inflation is more likely to happen in a boom, while rating deflation is more likely to happen in a recession.

The intuition for the procyclical-rating result is as follows. Since the probability of failure for the bad security is lower in a boom than in a recession ($p_h < p_l$), the expected payoff of issuing the security (and hence also the CRA's rating fee) is higher in the boom than in the recession ($v_h > v_l$, $w_h > w_l$, and $k_h > k_l$). Consequently, relative to in a recession, in a boom the current gain from rating inflation is higher, and the expected reputation cost of rating inflation is also lower. Therefore, the opportunistic CRA has more incentive to inflate the ratings in a boom. On the other hand, the current loss from rating deflation is lower in a recession than in a boom. Thus, the opportunistic CRA is more likely to deflate ratings in a recession in order to reap the future gain.

5 Conclusion

CRAs have been under intense scrutiny since the recent global financial crisis. They were initially criticized for their favorable pre-crisis ratings of insolvent financial institutions like Lehman Brothers and AIG, as well as risky mortgage-related securities that contributed to the collapse of the U.S. housing market. When the crisis started, the CRAs began to massively downgrade the ratings for many securities, companies, as well as countries.

Exiting literature as well as business practitioners have two competing views regarding the CRAs' behavior: some argue that they engage in rating inflation, while others think they deflate the ratings. This article provides an analysis that reconciles the two opposite arguments. We find that both rating inflation and rating deflation can occur in equilibrium. In addition, we find that credit rating is procyclical: rating inflation is more likely to happen in a boom while rating deflation is more likely to happen in a recession.

Our procyclical rating result is consistent with some recent empirical works. Several recent papers have documented evidences that ratings inflation is more likely to happen during booms. Ashcraft, Goldsmith-Pinkham, and Vickery (2010) point out the issuance volume of MBS went up sharply between 2005-2007 while rating accuracy decreased, and later rating downgrades for the 2005-2007 cohorts were significantly larger than for the previous one. Benmelech and Dlugosz (2009) show that there were massive pre-crisis upgrading compared to the massive downgrading during the subprime crisis. In an earlier study, Ferri, Liu, and Stiglitz (1999) demonstrate that during the East Asian financial crisis, CRAs' ratings were procyclical: Having failed to predict the emergence of the crisis, CRAs became excessively conservative. They downgraded East Asian crisis countries more than these countries' economic fundamentals would justify.

As a response to the CRAs' moral hazard problem, the US government has attempted to improve or tighten the regulation. Subtitle C in Title IX of The Dodd–

Frank Wall Street Reform and Consumer Protection Act focuses entirely on the regulation of CRAs, referred to as Nationally recognized Statistical Rating Organizations (NRSROs). Some key elements of the provisions in Title IX Subsection C are:

- Disclosure. NRSROs are required to disclose their rating track records, their rating methodologies, and their use of third parties for due diligence efforts.
- Liability. Investors can bring private rights of action against CRAs for a knowing or reckless failure to conduct a reasonable investigation of the facts or to obtain analysis from an independent source.
- Deregister. The SEC has the authority to deregister any agency for providing bad ratings over time.

These requirements are likely to increase CRAs' efforts and reduce the moral hazard problem. For example, the disclosure principle allows investors to have more information, and thus to make more rational judgements when using credit ratings. However, these requirements mainly target rating inflation, and may exacerbate the problem of rating deflation. Facing legal liability, CRAs may reduce the number of ratings as well as increase the downward bias in ratings (Goel and Thakor, 2010), which could hurt the issuers. It seems that more studies are needed with regard to the consequences of the legislation.

Most of the recent literature, both theoretical and empirical, focus on the rating inflation occurred before the financial crisis. But we do observe the phenomenon that when the crisis started, the CRAs became much more conservative by massively downgrading the ratings. Is the downgrading merely a correction to the previous rating inflation? Or does it involve rating deflation, downgrading more than the fundamentals would justify? Are there rating cycles, and are ratings procyclical? Given that credit ratings serve as public coordinating devices and that downgrading has major impacts in financial markets (Boot, Milbourn, and Schmeits, 2005), this article calls for more research on these critical issues.

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