Repeated Interaction and Rating Inflation: A Model of Double Reputation*

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Abstract

Financial intermediaries, such as credit rating agencies, have an incentive to maintain a *public* reputation for credibility amongst investors. However, in a market where credit rating agencies are interacting repeatedly with only a few issuers (sellers), they also have an incentive to develop a second, *private* reputation for leniency. We develop a dynamic model that analyzes how credit rating agencies can create such a "*double reputation*". A key factor in our model is that issuers have privileged knowledge regarding the quality of rated assets compared to investors. In markets with a repeated interaction between issuers and rating agencies, this information asymmetry leads to different reputation updates following each rating process. We show that under certain conditions, it is optimal for the rating agency to inflate ratings as a strategic tool to create a "double reputation", whereby investors' beliefs regarding the credibility of the rating agency are higher than those of the issuers. Our results explain why rating inflation occurred specifically in markets for MBSs and CDOs and not in others. The results suggest that stronger regulation is needed in concentrated markets in order to avoid rating inflation.

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1 Introduction

The financial crisis that erupted in 2007 exposed a dramatic failure in the rating of mortgage related securities such as mortgage backed securities (MBSs) and collateralized debt obligations (CDOs). Prior to the crisis, a large proportion of these assets received top ratings – for example, 80-95% of a typical subprime MBS deal was assigned the highest possible AAA rating (Ashcraft, Goldsmith-Pinkham, and Vickery, 2010). However, when the crisis erupted, these assets were severely downgraded, in many cases below investment grade.[1]

Critics have claimed that rating agencies knowingly ignored risks when rating mortgage related securities. These claims have been supported by recent empirical literature. Apparently, rating agencies ignored available data on risks when rating mortgage deals. In many cases "out of the model" adjustments were made in order to ensure higher ratings.[2] The failure has drawn attention to potential conflict of interest in the rating agencies' "issuer pays" business model, and have raised the possibility that ratings were inflated in order to attract more deals and increase market share.[3]

One of the main differences between mortgage related securities, whose ratings have failed, and "plain" corporate bonds, which did not incur such severe downgrades and defaults,[4] is the structure of the markets in which these two types of assets are issued. Corporate bonds are issued by many different firms who try to raise debt, and therefore

[1]For example, 90 percent of the CDOs that were rated AAA by S&P during the years 2005-2007 have been downgraded as of June 30, 2009, with 80 percent downgraded below investment grade. For AAA rated MBSs, the percentages were 63 and 52 respectively (White, 2010, p. 221). Benmelech and Dlugosz (2009) offer additional data on the rating collapse of CDOs and MBSs.

[2]Ashcraft, Goldsmith-Pinkham, and Vickery (2010) examined a sample of nearly 90% of the MBS deals issued in the period of 2001-2007, and report that during 2005-2007 the fraction of highly-rated MBS in each deal remained flat, despite a significant increase in the average risk of new MBS deals. In addition, MBS deals backed by loans with observably risky characteristics did not get lower ratings. Their analysis suggests MBS ratings did not fully reflect publicly available data. Griffin and Tang (2009) examined a sample of 916 CDOs and report that the formal rating model accounted for only half of the determination of credit rating. They report that 84% of the "adjustments" to the model are positive and that, on average, adjustments account for an additional 12.1% of AAA at the time of issue. They estimate that without out-of-the-model adjustments the average ratings of the AAA rated tranches in their sample would have been rated BBB, resulting in a 20.1% lower valuation.

[3]For example, the SEC report of an e-mail correspondence from a rating agency official asserting "We are meeting with your group this week to discuss adjusting criteria for rating CDOs of real estate assets this week because of the ongoing threat of losing deals." (The U.S. Securities and Exchange Commission (2008), p. 26).

[4]Obviously during a financial crisis there are more defaults, and therefore more credit downgrades, than in other times. A comparison by Standard and Poor's (2010) shows that ratings of assets other than MBSs and CDOs were not downgraded more than in previous stress periods such as 1991 and 2001. S&P therefore claims that the ratings of theses assets served as predictors of the relative likelihood of default even during the current crisis.

their market is characterized by thousands of issuers, many of them acting only once. In contrast, mortgage related securities are issued by a relatively small number of specialized firms and big investment banks. During the years 2005-7, the peak of the securitization era, such firms repeatedly originated mortgages in order to securitize them and issue MBSs.[5] In 2006, for example, the top ten subprime MBS issuers were responsible for almost 65% of market volume, and the top 25 were responsible for 95% of market volume (Ashcraft and Schuermann, 2008, Table 2.3).[6]

In this paper, we claim that this difference in market structure is a key factor to understanding the observed rating inflation of MBSs and CDOs compared to plain corporate bonds. In markets with a large number of issuers, most of them issuing only one asset, reputation concerns lead rating agencies to give truthful ratings in order to build a credible reputation. In such markets, credibility is rewarding, because truthful ratings solve the adverse selection problem between issuers and investors and create a surplus which the CRA can extract.[7]

In contrast, in a market with a small number of issuers who repeatedly require ratings of new deals, rating inflation may occur. Since issuers are acting repeatedly, they are better informed about the truthfulness of the ratings, simply because they have privileged information on the real quality of the rated deal. These issuers can therefore spot rating inflation and reward it by high fees, while investors notice that the rating is not truthful only if a default occurs. As a result, rating agencies may have an incentive to provide favorable ratings, in order to create a "double reputation": the issuers recognize that the CRA is lenient and inflates ratings, while investors still believe that the CRA is credible. Due to the double reputation, the CRA is rehired for a high fee.

Our results are supported by a recent empirical paper by He, Qian, and Strahan (2010). The authors examine a large sample of MBS deals issued during the years 2000-7 and rated by Moody's and S&P. He, Qian, and Strahan (2010) show that tranches sold by firms who

[5]This activity was known as the "originate to distribute" business model.

[6]In a similar examination, over a sample of 642 CDOs and residential MBSs deals, the SEC reports that 12 arrangers accounted for 80% of the deals, in both number and dollar volume (The U.S. Securities and Exchange Commission, 2008, p. 32).

[7]Rating agencies often claim that this reputation concern is enough to ensure their credibility. See, for example, S&P's statement in the SEC public hearing on November 15, 2002: "[T]he ongoing value of Standard & Poor's credit ratings business is wholly dependent on continued market confidence in the credibility and reliability of its credit ratings. No single issuer fee or group of fees is important enough to risk jeopardizing the agency's reputation and its future." (http://www.sec.gov/news/extra/credrate/standardpoors.htm)

issued a large number of deals performed significantly worse and were downgraded faster compared to those sold by firms who issued only a small number of deals. This effect is concentrated during the years 2004-6. Their results suggest that larger issuers received more favorable ratings. Obviously, larger issuers have better information on the rating history of their own assets, so these finding are exactly predicted by our model. Faltin-Traeger (2009) examines the hiring decisions of issuers in a large sample of asset backed securities. He reports that an issuer is more likely to choose the CRA which provided the most favorable rating in its previous deals and that the CRA it chooses is less likely to rate its subsequent deals lower than other CRAs. These results support our idea that rating inflation in mortgage related assets is associated with repeated interaction between issuers and CRAs.

Our model is also able to explain why the *profit margins* of rating agencies are much higher in the rating of mortgage related assets compared to plain bonds. According to our model, issuers pay higher fees for ratings in these markets *because* they expect to get more favorable ratings. In other words, the high fees are a result of rating inflation. These results differ from other papers, in which rating inflation is a result of high fees.[8] Moreover, the relatively more *complex and opaque* nature of securitized assets such as MBSs and CDOs compared to plain bonds implies that the information asymmetry between issuers and investors in such markets is greater. Hence it is more difficult for investors to realize whether the ratings are reasonable or not. This, in turn, supports our "double reputation" argument, which is more plausible when issuers are more informed that investors.

We develop our results in a simple two period communication model. The model includes an issuer who attempts to sell an asset to an investor. The asset is risky, and can vary in quality, which is defined as the probability that the asset does not default. The asset's expected return is lower than the investor's outside option, and because the investor cannot identify the quality of the asset, there would be no trade unless some intermediary indicates that the asset is of high quality. An intermediary, or credit rating agency (CRA), can be hired by the issuer to rate the asset. The rating agency's fee depends on the issuer's expected revenue, which in turn depends on the price the investor is willing to pay, which in turn depends on the rating. We assume that the fee to the rating agency is paid in advance in every period and is not contingent on the rating, so

[8] For example, Bolton, Freixas, and Shapiro (2009)

there is no “ratings shopping” in our model.

We allow the rating agency to develop reputation. Following the literature beginning with Kreps and Wilson (1982) and Milgrom and Roberts (1982), this is done by using “commitment” types. The rating agency may be one of two types: either it is a regular profit maximizing type (strategic), or a “corrupt” type, who publishes only good ratings. We assume that the strategic type has some small incentive to be truthful, but that incentive is always smaller than its profit maximizing incentive. We define the rating agency’s reputation as the belief that it is a strategic type: a low reputation means that the rating agency is likely to give mostly good but uninformative ratings. The issuer may prefer a low reputation since it wants to receive good ratings, but an investor pays a low premium for a good rating made by a rating agency with a low reputation.

In order to analyze the importance of repeated interaction between issuers and rating agencies, we distinguish between two market structures: in the former, the issuer acts only once, and therefore there is a different issuer in every period. Under such conditions, the second issuer does not have an informational advantage over the investor: both of them can only observe the previous return and the rating agency’s past rating, and update their beliefs of the rating agency’s type accordingly. In the latter, the issuer sells two assets consecutively. This issuer, unlike the issuer who acts only once, has an informational advantage over the investor in the second period, because it knows whether the rating of the previous period was truthful or inflated. The issuer uses the additional information to update its beliefs on the type of the rating agency.

We find the perfect Bayesian equilibrium with mixed strategies for both of these markets. We show that in the former market, a strategic rating agency is always truthful in equilibrium. In such a market, because the investor and the issuer are equally informed, the rating agency always has a single commonly known reputation. In this case the rating agency would like to appear as truthful as possible, since truthful ratings increase the surplus of the players and the fee paid to the CRA.

In the second market, however, a strategic CRA inflates ratings with a positive probability if both its initial reputation is high, and the bad asset’s default probability is low. Rating inflation in such a market is profitable due to the formation of a “double reputation”: the issuer believes that the rating agency is corrupt with a high probability, while the investor believes that the rating agency is strategic (and truthful in the second period) with a high probability. Such a double reputation increases the expected surplus of the issuer and therefore the fee paid to the CRA for the second rating. Rating inflation is of course risky for the CRA, because the CRA may be exposed as untrustworthy by the investor if the bad asset defaults, and thus suffer a low common reputation and a small fee in the second period. But our results show that if the probability of such event is low enough (below half), then the CRA prefers to distort information with positive probability, in spite of this risk.

Our analysis shows that rating inflation can occur due to reputational concerns and not only due to short-term conflict of interest. It suggests that regulatory intervention is needed in some markets to ensure truthful ratings. One possible remedy is to hold CRAs liable for inflated ratings, as it increases the cost incurred by a CRA in case rating inflation is publicly exposed. Such cost may deter rating inflation if it is high enough, as it outweighs the possible gains from rating inflation. We discuss regulation in more detail in section 6.

The remainder of the paper is organized as follows: the next section includes a survey of the related literature; section 3 describes the basic monopolistic model; Section 4 describes the equilibrium of this model with and without repeated interaction between issuers and CRAs; Section 5 extends our results to the case of competition between rating agencies; section 6 discusses the policy implications of our analysis and section 7 concludes.

2 Related Literature

In the past three years the economic literature on credit rating agencies has significantly increased as a response to the financial crisis of 2007 and its exposure of systematic rating inflation in mortgage related assets. Several explanations were offered, but most of them rely on the phenomena of "ratings shopping", where issuers request from several rating agencies a "shadow" rating, and then decide which of these ratings (if any) becomes public. Since most of the money that is paid to the CRA is received only if the rating is published, this implies that in effect the fee is contingent on the rating. Skreta and Veldkamp (2009) and Faure-Grimaud, Peyrache, and Quesada (2009) show that even when rating agencies are truthful, rating inflation can occur if ratings shopping is possible. In Skreta and Veldkamp (2009) rating inflation depends on the fact that rating agencies receive imperfect signals on the asset's quality, and "naive" investors cannot understand the implications of ratings shopping.[9] In Faure-Grimaud, Peyrache, and Quesada (2009) rating inflation occurs only when issuers (firms) are uncertain of their asset's quality.

In other papers, the business model used by rating agencies creates an incentive for them to misreport their information, and give a good rating to bad assets. Bolton, Freixas, and Shapiro (2009) show that ratings shopping induces a competition among rating agencies to give better ratings, and may create rating inflation if investors are naive enough. In Mathis, McAndrews, and Rochet (2009) inflated ratings result from fees being contingent on ratings, even for a monopolistic agency. Both of these papers consider reputation concerns as an incentive for the rating agency to provide truthful ratings, but show that under certain conditions such concerns are outweighed by short-term incentives, which are a result of rating-contingent-fees, that lead to inflated ratings. These papers show that when fees are not contingent on ratings, truthful reporting is established, because reputation becomes the prominent concern of rating agencies. In contrast, our model assumes that fees are not contingent on ratings in every period, and shows how reputation concerns may actually encourage rating inflation. These differences in analysis have significant regulation implications, as discussed in section 6 below.

In addition, unlike the models presented in Skreta and Veldkamp (2009) and Bolton, Freixas, and Shapiro (2009), our model does not require the assumption that investors are boundedly-rational or "naive". In Skreta and Veldkamp (2009) and Bolton, Freixas, and Shapiro (2009) it is profitable to achieve inflated ratings only if the investors (or a significant fraction of them) do not realize this rating inflation and accept the published ratings at face value. In contrast, in our model, the fact that investors are less informed than the issuers is enough to produce rating inflation even if investors are completely rational and the information structure is common knowledge.

Opp, Opp, and Harris (2010) show that rating inflation may occur when ratings are used for regulating financial institutions. Under such regulation, investors are willing to pay for a "label" of good rating and are less concerned by the informational value of the rating. This, in turn, may lead rating agencies to give a favorable report rather than acquire costly information and perform a proper rating process. According to our model

[9] Sangiorgi, Sokobin, and Spatt (2009) use a similar argument to Skreta and Veldkamp (2009) to explain the process of "notching" in the rating of structured assets which are backed by rated assets, and also to explain the fact that unsolicited ratings tend to be lower than solicited ones.

ratings can still be inflated even when investors are solely concerned by the informative value of the rating.

The closest paper to ours is Bouvard and Levy (2009). As in our paper, they present a model where a rating agency has two opposing reputational concerns, and show that rating inflation may occur even when fees are not contingent upon rating. Bouvard and Levy present a model in which rating agencies are always truthful, and rating inflation is a result of underinvestment in a costly auditing process that detects bad assets. In contrast, we present a communication model where an informed rating agency chooses whether to report its information or not. Reputation has a different meaning in both models: in Bouvard and Levy, the rating agency develops a reputation of being *strict*, and its payoff is non-monotone in reputation. Therefore, a rating agency with a high reputation may exert less effort in order to appear more lenient. On the contrary, the rating agency in our model develops a reputation of being *informative*. If the rating agency has only one reputation then it always has an incentive to be truthfull and improve its reputation, because an informative rater is associated with higher expected surplus to the players. Manipulating information is only profitable in our model if the rating agency has the ability to create a double reputation – a central result in our paper, which is not addressed by Bouvard and Levy.

Our paper is also related to the literature on communication in dynamic settings, starting with Sobel (1985). Sobel has shown how dynamic concerns may lead an informed sender to be truthful even when his preferences oppose those of the receiver, in an attempt to build a reputation of credibility (in order to cash it out at a later stage). Benabou and Laroque (1992) extend that model and show that when such a sender is only partially informed it distorts information in order to manipulate the beliefs of the receiver. Morris (2001) shows that even when the sender's preferences are aligned with those of the receiver, it may lie in order to improve its reputation.[10] In all these papers, the sender may be a "good" type, with preferences that are aligned with those of the receiver, or a "bad" type with opposing or biased preferences. We generalize their model by introducing two receivers with different preferences. Thus, in our model each type of rating agency is preferred by a different receiver. This framework allows us to study the implications of information differences between different receivers.

[10] Ely and Välimäki (2003) extend Morris (2001) and show that such reputational concerns may result in loss of all surplus to the sender.

Finally, our paper is also related to static models of communication with two audiences. Farrell and Gibbons (1989) present a model of cheap talk with two audiences, but focus mainly on the question of whether messages should be public (to both audiences) or private, a question not addressed in this paper. Gertner, Gibbons, and Scharfstein (1988) and Austen-Smith and Fryer (2005) present models of signalling with two audiences. A sender sends only one signal, and has an incentive to send a high signal to the first audience and a low signal to the second audience. When only the first audience is present, there is a regular separating equilibrium. With two audiences, on the contrary, some or all types pool in equilibrium.[11] In both papers, the signal is interpreted identically by both audiences, while in our setting there is an information advantage of one audience over the other that the sender can use to its advantage.

3 The Basic Model – Single Rating Agency

The game consists of three players: a buyer/investor (b), a seller/issuer (s), and an intermediary/credit rating agency (CRA). For simplicity, we assume that all players are risk neutral with a discount factor equal to 1.

In each period, the issuer has an asset it wishes to securitize and sell to the investor. The asset's quality is unknown to the investor, and the issuer can hire a rating agency to rate the asset.

3.1 Assets

The buyer can invest in a safe asset which gives a known return normalized to zero. Alternatively, he can buy the asset that the issuer offers, which has return R. This asset is one of two equally likely qualities, $a \in \{G, B\}$. A good asset ($a = G$) always gives a positive return, which is normalized to one. A bad asset ($a = B$) gives a positive return $R = 1$ with probability π, and a negative return with probability $1 - \pi$.

The issuer knows the asset's quality, but cannot credibly communicate it to the investor. We restrict our attention to the case where the expected return of the bad asset equals $E(R|a = B) = -\ell < -1$. In this case, the expected return of the risky asset is

[11] Gertner, Gibbons, and Scharfstein (1988) explain why high-profit firms may not separate from low-profit ones by issuing more debt, while Austen-Smith and Fryer (2005) explain why certain Black students underinvest in education.

$E(R) = 0.5(1 - \ell) < 0$, and therefore there is no trade without a rating agency (due to adverse selection). We assume that ℓ is close to one, and formally:

Assumption 3.1. *$\ell = 1 + \epsilon$ for some small ϵ.*[12]

3.2 Credit Rating Agency

A credit rating agency can be hired by the issuer for a fee of $w > 0$. If the CRA is not hired its payoff is normalized to zero. We specifically assume that *w is paid to the CRA in the beginning of every period, in the time of hiring, and is therefore not contingent in any way on the rating.* If the CRA is hired it learns the asset's quality after a costless rating process. It then publishes a rating $r \in \{B, G\}$.

The CRA is one of two types, where $\theta \in \{C, S\}$. A corrupt CRA ($\theta = C$) always publishes a good rating. A strategic CRA ($\theta = S$), can choose to inflate ratings, in order to maximize its expected fee in the next period. Thus, a strategic CRA always gives good rating to a good asset ($\Pr(r = G|a = G) = 1$), but may also choose to give a good rating to bad assets.[13] We denote the strategy of the strategic CRA by $x \in [0, 1]$, where $x \equiv \Pr(r = G|a = B)$: $x = 0$ represents truthful rating, $x > 0$ characterizes some level of rating inflation, and $x = 1$ means that the strategic CRA always gives a good rating, and therefore is behaving exactly like the corrupt type.

The strategic type is simply a profit maximizing rating agency. However, we present the possibility of a credit rating agency that always gives good rating. This type may be thought of as an analyst that wishes to give good ratings in order to increase its chances to be hired by the issuers.[14] We describe the reputation of the CRA as the probability that it is the strategic type, and denote the prior by $\mu \equiv \Pr(\theta = S)$. Since a strategic

[12] This assumption is only for convenience: our results hold for $\ell < 3$ and even for higher levels if other parameters are constrained. For such levels, however, we have to assume the CRA's initial reputation is above some minimum, and the analysis is a bit more complicated.

[13] Our model does not allow rating deflation, i.e. the CRA cannot give a bad rating to a good asset. It is not plausible for credit rating agencies to give low ratings to good assets, since such action is not favored by either the issuer nor the investor. This intuition might be captured by a model that allows bad ratings for good asset, but also includes a third CRA type, which always gives bad ratings. For simplicity, we present the model above.

[14] The New York Times reports that, as part of an overall investigation regarding the interplay between eight large issuers and the credit rating agencies, the New York attorney general is currently investigating "the revolving door of employees of the rating agencies who were hired by bank mortgage desks to help create mortgage deals that got better ratings than they deserved." It mentions that "At the height of the mortgage boom, companies like Goldman offered million-dollar pay packages to workers...who had been working at much lower pay at the rating agencies, according to several former workers at the agencies." (New York Times, "Prosecutors Ask if 8 Banks Duped Rating Agencies," May 13, 2010)

type is always (weakly) more honest than the corrupt type, this definition maintains the association between reputation and "good" qualities.

3.3 Timing

At the beginning of the game, the CRA's type $\theta \in \{C, S\}$is drawn by nature, where $\Pr(\theta = S) = \mu$. The game consists of two periods. In each period the following game steps occur:

1. Nature determines asset quality $a \in \{B, G\}$.
2. Issuer and CRA agree on a price w for rating (CRA is hired if $w > 0$)
3. Issuer and CRA observe the asset's quality.
4. CRA publishes a rating $r \in \{B, G\}$.
5. Investor buys the asset for a price $p > 0$ or refuses to buy the asset.
6. The return over the asset is materialized and is observed by all players.
7. Issuer and investor update their beliefs regarding the CRA's type.

3.4 Preferences

The investor's payoff in case he buys the issued asset is $E(R|r) - p$, where $p \geq 0$ is the price of the asset, and $E(R|r)$ is the expected return given the rating r. For simplicity, we assume that the issuer can extract all the investor's surplus, and therefore $p = E(R|r) \geq 0$.[15] The investor's payoff in case he decides not to buy the risky asset is zero (the safe asset's return).

The issuer's payoff is $p - w$ in case the asset is sold, and zero otherwise.[16] Since the issuer and the CRA agree on the fee before *any of them* know the quality of the asset, the

[15] Any alternative assumption where p is an increasing function of the expected investor's surplus would not change the results qualitatively.

[16] We assume that the issuer cannot hold an asset until maturity, and therefore its payoff does not depend on the quality of the asset. This assumption gives the issuer an incentive to sell. It is a reasonable assumption given the "originate to distribute" of the issuers in the mortgage related securities, as well as the liquidity constraints of firms who issue corporate debt.

Alternatively, we could assume that the issuer cannot enjoy the high return of a good asset, which is a standard assumption, but may suffer the loss from a bad asset if it is not sold. In this case, the expected payoff of the issuer if the asset is not sold is $-\ell/2$. Such model gives the same qualitative results.

fee depends on $E(p)$, which is a function of the expected rating. One way to interpret this is that the issuer and the CRA have a known fee for a rating process, which is used every time the firm asks for a rating ("a retainer"), but that this fee is updated periodically, according to the surplus the issuer expects to gain from the rating process. In what follows we assume that the CRA can extract all the issuer's surplus, and therefore $w = E(p)$.[17] The CRA's payoff is simply its fee w if it is hired, and zero otherwise. The CRA agrees to work for any positive fee $w > 0$.

3.5 Repeated Interaction and Beliefs

A key part of our analysis is the effect of repeated interactions between issuers and credit rating agencies on rating decisions. We wish to analyze how the possibility of future business with a specific issuer may serve as an incentive to give a more favorable rating. We assume that all the players in the market observe the CRA's past record: they know the past ratings as well as returns of previous assets. These returns do not always reveal the true quality of previous assets, as even bad assets do not always default.

However, when an issuer hires the CRA more than once, he also knows the quality of his previously rated assets. By comparing the published ratings of his past assets to their actual quality, the issuer can learn the CRA's willingness (or unwillingness) to give favorable ratings. This information is not available to the investor. In markets where a large number of firms issue debt infrequently, we expect both issuers and investors to have approximately the same information regarding previous ratings. However, in concentrated markets with a small number of issuers, where each issuer attempts to sell many assets, issuers have significantly more information than investors on the quality of ratings. Thus, issuers and investors may form very different beliefs about the CRA's type.

We capture this idea by analyzing two opposing cases. In the first case we assume one-time issuers, each of them active in different period. The second issuer, like the investor, can only observe the published rating of the first asset and its materialized return. In the second case there is a single issuer that issues two assets one after the other. He has an informational advantage on the investor as he knows the quality of the first asset, and can compare that quality to the first asset's published rating. The former case represents a

[17] Once again, any alternative assumption where w is an increasing function of the expected issuer's surplus would not change the results qualitatively. We specifically make an assumption like this in the competitive model (see section 5).

market structure with many issuers, while the latter case represent a concentrated market, with only a few issuers (in the extreme case, one issuer).[18]

We denote the prior and posterior belief of player $i \in \{b, s\}$ that the CRA is of type S by μ^i and $\hat{\mu}^i$ respectively. At the beginning of the game the reputation of the CRA is common knownledge, and therefore $\mu^b = \mu^s = \mu$. After the first rating process, different posteriors are possible if the issuer has more information than the investor,.

When the two posteriors differ, they can be interpreted as a "double reputation": the posterior of the investor, $\hat{\mu}^b$, is commonly known to all players and represents the CRA's *"public reputation"*; the posterior of the issuer, $\hat{\mu}^s$, is known only to the issuer and the CRA, and represent a *hidden or "private reputation"*.

4 Equilibrium

In this section we describe the perfect Bayesian equilibrium in mixed strategies for the game described above. We focus on the rating decision of the CRA in the first period of the game, which takes into account the expected fees and prices in the second period. In what follows, we first present an assumption about the behavior of the CRA in the second period. Then we find the equilibrium for two cases. In the first case there is a different issuer in every period, meaning that the second issuer and the investor has the same information regarding the rating of the first period. In the second case, the issuer is issuing two assets one after the other, and is therefore better informed in the second period compared to the investor.

4.1 Rating Agency's Behavior in the Second Rating

In every period, the CRA is paid before the rating process, and therefore its only concern, when deciding on its rating strategy, is its strategy's impact on future fees. We thus rule out any short term conflicts of interest that could arise from rating-dependent-fees, including "ratings shopping". This implies that in the second period the strategic CRA is

[18] A general way to represent the concentration level of a market would be by a parameter q, which can be interpreted as the probability that the issuer in the second period is the same as the issuer in the first period. Therefore, with probability q the issuer in the second period is better informed than the investor, while with probability $1 - q$ this issuer has the same information as the investor. Higher q means more concentrated market. We focus our attention on the two extreme cases, where $q = 0$ and $q = 1$.

indifferent to all rating strategies.[19] In order to refine the set of equilibria, we specifically assume that a strategic CRA is truthful in the second period:

Assumption 4.1 (strategic CRA's behavior in the last period)**.** *In the last period of the game a strategic rating agency publishes the true quality of the assets, so* $r(a) = a$*.*

It is natural to assume a truthful behavior when there are no other incentives. One interpretation for this assumption is that the rating agency has some intrinsic incentive to tell the truth, but such incentive is always weaker than profit maximization, and is therefore expressed only in the last period.

4.2 Prices of Rated Assets

We denote by p^r the price of an asset that is rated r. This price depends on the belief of the investor that the CRA is strategic (μ^b) as well as on the strategic type's expected rating strategy (x). Since we assume that the price equals to the investor's expected surplus, the price equals to

$$p^r = \max\left\{E\left(R|r;x,\mu^b\right),0\right\} = \max\left\{\Pr\left(a=G|r;x,\mu^b\right) - \ell\Pr\left(a=B|r;x,\mu^b\right),0\right\}. \tag{1}$$

By construction the CRA gives a bad rating for bad assets only, and therefore $p^B = 0$. The price of an asset with a good rating p^G is positive if the investor believes that the rating delivers a minimal amount of information. Thus, when the investor knows the rating agency is corrupt ($\mu^b = 0$), the price is zero even following a good rating. This result holds also if $\mu^b > 0$ but the investor expects the strategic type to behave like the corrupt types and give only good ratings ($x = 1$). It is easy to show that, given assumption 3.1, an asset with a good rating is sold for a positive price if and only if $\mu^b > 0$ and $x^* < 1$.[20]

When the strategic CRA is believed to be completely truthful ($x = 0$), as is the case

[19] We assume that a corrupt CRA has internal incentives to give only good ratings which persist to the last period.

[20] As mentioned earlier, if ℓ is larger this result holds only when μ is greater than some positive threshold.

in the second period, we get the following prices:

$$p^G(x=0;\mu^b) = \begin{cases} \frac{1-(1-\mu^b)\ell}{2-\mu^b} & \mu^b > 0 \\ 0 & \mu^b = 0 \end{cases}; \tag{2}$$

$$p^B\left(x=0;\mu^b\right) = 0.$$

Notice that $p^G(x=0)$ is always strongly increasing in μ^b.

4.3 Payoff of the CRA

We assume that the CRA can charge the issuer for its full expected surplus from the rating. Because $p^B = 0$ (as discussed above), this surplus simply equals $\Pr(r = G) \cdot p^G$. In the second period, when the strategic CRA is truthful, the issuer expects a good rating with probability $1 - 0.5\hat{\mu}^s$. Substituting 2, the fee in the second period is

$$\hat{w} \equiv E(p|\hat{\mu}^s, \hat{\mu}^b) = \frac{2-\hat{\mu}^s}{2-\hat{\mu}^b} \cdot \frac{1-(1-\hat{\mu}^b)\ell}{2} \tag{3}$$

when $\mu^b > 0$, and zero otherwise. The fee that is paid to the CRA in the second period ($\hat{w}$) is therefore a function of the beliefs of the investor and issuer. It is increasing in μ^b and decreasing in μ^s. Higher *public* reputation increases the price that the investor is willing to pay following a good rating, and therefore increases the expected fee. In contrast, if the CRA has lower *private* reputation then the issuer is willing to pays it a higher fee as he believes that the CRA publishes good ratings with higher probability. These two opposing effects of reputations are the driving force behind our results. When the issuer and the investor do not have the same information, the CRA may have an incentive to manipulate information in order to create a double reputation: high public reputation and low private one.

Notice, that when the two posteriors are equivalent, i.e. $\hat{\mu}^b = \hat{\mu}^s$, the fee is increasing in reputation. Therefore, if the CRA cannot create a double reputation it prefers to improve its reputation. When the reputation is common knowledge, the fee of the CRA simply equals the expected surplus that is created by trade. This surplus increases as the *informativeness* of the rating increases. Therefore, the expected surplus is increasing in reputation. For example, when both players know that the CRA is strategic (and therefore gives a truthful rating in the second period), then with probability half the asset is good and receives a good rating, which results in $p^G = 1$. The total expected surplus is therefore 0.5, and this is the fee that is paid to the CRA.

Before we specifically find the equilibrium of the game, we first show that in every equilibrium the strategic CRA is more truthful than the corrupt CRA:

Lemma 4.2. *giving only good ratings is never an equilibrium strategy for the strategic CRA, i.e.* $x^* < 1$.

Proof. Assume by contradiction an equilibrium where the optimal strategy is $x^* = 1$. In such equilibrium the reputation of the CRA is not updated in the first period, and therefore, $\hat{\mu}^s = \hat{\mu}^b = \mu$. However, if the CRA observes a bad asset and chooses to give a bad rating its type is immediately identified so$\hat{\mu}^s = \hat{\mu}^b = 1$. Since w is strictly increasing in μ when $\mu^s = \mu^b$ (as evident from equation 3), this deviation is profitable. □

Notice that lemma 4.2 is enough to ensure that the price following a good rating is always positive, since this price is positive if $x^* < 1$ and $\mu > 0$. Therefore, in equilibrium the CRA is always hired in both periods, because it is always offered with a positive fee.

In the following subsections, we present the equilibrium of the game in two cases: in the first case the issuer in the second period does not have privileged information over the investor, and therefore $\hat{\mu}^s = \hat{\mu}^b$. In the second case the issuer does have privileged information, and therefore the CRA can try and create a double reputation.

4.4 Equilibrium with a One-time Issuer

We now describe the equilibrium of the game when the issuer and the investor have the same information in the second period: both of them know the published rating of the first period and the realized return. We focus on the fee in the second period, which is determined by the beliefs of the players regarding the CRA's type, and on the CRA's rating strategy in the first period, taking this fee into account.

When the investor and the issuer have the same information they also have the same beliefs regarding the CRA's type. Therefore, the CRA does not have an incentive to give a good rating to a bad asset:

Proposition 4.3. *In case issuers sell only one asset, and therefore the second issuer has the same information as the investor in the second period, a strategic CRA never inflates ratings in equilibrium ($x^* = 0$).*

Proof. Define the optimal strategy as x^*. From lemma 4.2 we know $x^* \neq 1$. Assume $0 < x^* < 1$. It follows that $Ew(r = G|x^*) = Ew(r = B|x^*)$. However, when $\hat{\mu}^b = \hat{\mu}^s = \hat{\mu}$, the fee of the CRA increases in $\hat{\mu}$ (as evident from 3). When a strategic CRA gives a bad rating to a bad asset, its type is revealed, so $\hat{\mu} = 1$ and $\hat{w}(r = B) = 0.5$. When a good rating is given, the reputation always decreases if $x^* < 1$, because the corrupt type gives good ratings with higher probability compared to the strategic type. In that case, $E\hat{w}(r = G) < 0.5$ because $\hat{\mu} < \mu \leq 1$. A contradiction, and therefore $x^* = 0$. □

When the issuer has the same information as the investor, the properties of the game resemble previous models of dynamic communication with a single audience, like Sobel (1985). Because there is only one reputation, the behavior of the CRA depends on the payoff as a function of that reputation. In our model the fee of the CRA strictly increases in a single reputation. Since any rating inflation decreases the reputation of the CRA, the strategic CRA chooses to be strictly truthful in this case, distinguishing himself from the corrupt type.

4.5 Equilibrium with Repeated Interaction

When the issuer in the second period is the same one as in the first period, he is better informed than the investor. The issuer knows not only the rating of the first period's asset but also the quality of this asset. The difference in information can lead to a double reputation in the second period. Our result suggest rating inflation ($x^* > 0$) under certain conditions as follows:

Proposition 4.4. *In case the issuer sells two assets, if the following conditions are satisfied:*

1. $\pi > \frac{1}{2}$;
2. $\mu > \frac{2(1+\pi)[1+\pi(\ell-1)]}{1+2\pi[1+\ell+\pi(\ell-1)])} > \frac{4}{5}$;

then the equilibrium strategy of the strategic CRA is to inflate ratings with positive probability, and specifically

$$x^* = \frac{\mu(3\ell\pi + \ell + \pi) - 2\ell(1+\pi)}{\mu\pi(1+2\ell)} > 0.$$

Proof. In the Appendix. □

Remark. When the conditions of proposition 4.4 apply, the optimal strategy x^* has the following properties: (1) $0 < x^* < \frac{1}{3}$; (2) $\frac{\partial x^*}{\partial \mu} > 0$; (3) $\frac{\partial x^*}{\partial \pi} > 0$; (4) $\frac{\partial x^*}{\partial \ell} < 0$.

The intuition behind proposition 4.4 is as follows: when a bad asset receives a bad rating, the type of the strategic CRA is revealed so $\hat{\mu}^s = \hat{\mu}^b = 1$. In that case, the payoff of the CRA in the second period is $\hat{w} = 0.5$ (since $\hat{p}^G = 1$ and $\Pr(r = G) = 0.5$). However, when a bad asset receives a good rating, there are two possible future payoffs: with probability $1 - \pi$ the asset defaults and the rating inflation becomes commonly known, leading to a low common reputation $\hat{\mu}^s = \hat{\mu}^b < \mu$ and a second period fee lower than 0.5. With probability π the asset does not default, and this case leads to a double reputation, $\hat{\mu}^s < \hat{\mu}^b < \mu$, which can result in a payoff higher than 0.5. When there is no default the issuer's posterior is lower than the investor's since he identifies that the rating is inflated, while the investor cannot rule out the event of a good asset that received an honest rating. However, the posterior of the investor is still lower than the prior in that case, because it is still more likely that a good rating is given by a corrupt CRA. If the probability of default is low enough, and the initial reputation high enough, some rating inflation is profitable to the CRA. The equilibrium's mixed strategy is determined by a regular indifference condition.

Propositions 4.3 and 4.4 together describe the main result of the paper: a rating agency may find it profitable to manipulate information only in markets that have a small number of issuers who obtain private information about the credibility of the CRA. In this case, misreporting is made because the CRA knows that the published rating is interpreted differently by the issuer and the investor.

5 Competition

In this section, we explore the possibility of creating a double reputation in a competitive setup. We present a model where an incumbent CRA faces a threat of potential entrant CRA in the second period, which has some commonly known reputation. As in the monopolistic case, we analyze two different cases: in the former issuers act only once, while in the latter they issue assets repeatedly. An important outcome of this section is that under certain conditions, *double reputation can be maintained in equilibrium under competition* and therefore the results in the competitive model are qualitatively similar to those of the monopolistic model. However, when a CRA faces a threat that it will not be rehired, rating inflation is less profitable. Therefore, there are conditions where a monopolistic CRA inflates ratings, but a CRA who faces a possible entrant gives truthful ratings.

The main difference in the results between the competitive and the monopolistic models is that under competition the decision of an issuer to *hire* a specific CRA out of several may *signal* its private information to the investor. If the public reputation of the entrant is high enough, the issuer prefers to rehire the incumbent following a good rating, only if this good rating was given to a bad assset (i.e. the rating is inflated) and not to a good asset. This is because only rating inflation (and no-default) leads to a profitable double reputation, where the issuer's beliefs regarding the incumbent's truthfullness are lower than the incumbent's public reputation. However, if the issuer rehires the incumbent in such case, the investor realizes that the rating in the previous period was inflated. The investor therefore updates its beliefs accordingly, so the public reputation of the incumbent plunges, and the double reputation disappears. In such case, the issuer prefers to hire the entrant even when the CRA successfully created a double reputation.

The fact that the incumbent CRA does not always enjoys a high fee in cases where double reputation is created, due to the hiring issues described above, decreases the possible gains from rating inflation under competition. For this reason, we show that while rating inflation does occur under competition, it happens under a smaller set of conditions compared to the monopolistic case.

It is worth noting that there is a debate in the literature on whether competition leads to more or less rating inflation. Some theoretical papers, such as Bolton, Freixas, and Shapiro (2009) and Skreta and Veldkamp (2009) show that more competition leads to more rating inflation due to ratings shopping (see section 2 for more details). Our model differs in that we assume that fees are not contingent on ratings, and therefore ratings shopping cannot occur. Thus, we achieve different results.[21] In what follows, we present a model of entry threat, and analyze the equilibrium under two possible market structures.

5.1 A Model with an Incumbent CRA who Faces Threat of Entry

We modify the game described in section 3 by adding a possible entrant CRA in the second period, with a commonly known reputation μ_e. Thus, the first period of the game is similar to the monopolistic model, but in the beginning of the second period the issuer chooses whether to rehire the incumbent CRA for another period, or to hire the entrant CRA. We keep assumption 4.1 about the strategies the CRAs' possible types in the second period. This means that the entrant is believed by all players to give truthful rating with probability μ_e and to give only good ratings with probability $1 - \mu_e$.

As in the basic model, we assume that the issuer can extract all the surplus of the investor. However, we cannot continue and assume that the CRA can extract all the surplus of the issuer, as in such case the issuer is always indifferent between hiring the incumbent and the entrant. In order to simplify the analysis, we assume that the CRA and the issuer split the expected surplus of the issuer as follows:

Assumption 5.1. *The CRA's fee equals a known fraction α of the issuer's expected payoff, where $\alpha \in (0, 1)$.*

Therefore, a strategic CRA chooses the rating strategy that maximizes the total expected payoff of the issuer, and the issuer prefers to hire the CRA that generates the highest expected payoff in the second period.[22] For simplicity, we assume that if the issuer is *indifferent* to the two CRAs in the beginning of the second period, *he rehires the incumbent.*

[21] A recent empirical work by Becker and Milbourn (2010) finds that competition may in fact decrease the informativeness of ratings even when ratings shopping is not present. However, Becker and Milbourn (2010) do not consider structured assets, which are in the center of our analysis.

[22] We assume that the wage is exogenous in order to minimize the modifications to the original monopolistic model, and allow an easy comparison between the results of the monopolistic and competitive cases. It is plausible to assume that a CRA can extract part of the issuer's surplus, and therefore that its fee is an increasing function of that surplus.

5.2 Competitive Equilibrium with One-time Issuers

We now turn to describe the Bayesian equilibrium of the model, when an issuer issues only one asset. In this case, as before, the issuer in the second period has the same information as the investor, and therefore the incumbent CRA has only one commonly known reputation in the second period, $\hat{\mu}^s = \hat{\mu}^b = \hat{\mu}$.

The results show that, as in the monopolistic case, when issuers have no private information the CRA does not have an incentive to inflate ratings:

Proposition 5.2. *In a model where an incumbent CRA faces a threat of entry, in case issuers sell only one asset, and therefore the second issuer has the same information as the investor in the second period:*

1. *In equilibrium, the issuer hires the entrant if and only if its reputation is higher than the reputation of the incumbent ($\mu_e > \hat{\mu}$); and*

2. *a strategic incumbent never inflates ratings in equilibrium ($x^* = 0$).*

Proof. In the Appendix. □

The intuition behind the proof is similar to the one of proposition 4.3. In the beginning of the second period, both CRAs have one commonly known reputation. In that case, the expected payoff of the issuer is increasing in reputation, because informative rating increases the surplus of the players. Therefore, the issuer hires the CRA with the highest reputation. The incumbent's fee is also increasing in reputation, for the same reason, and therefore it prefers to publish a bad rating and obtain a reputation of $\hat{\mu} = 1$ rather than publish a good rating and obtain a lower reputation, an act that (weakly) decreases its hiring probability as well as its fee in case it is hired.

5.3 Competitive Equilibrium with Repeated Interaction

If the issuer issues two assets one after the other, the incumbent may have a double reputation in the beginning of the second period, if it chooses to inflate ratings. However, there are cases where the issuer's hiring decision reveals its private information. In such cases, the issuer cannot benefit from the double reputation, and will not rehire the incumbent. Therefore, the incumbent does not have an incentive to inflate ratings. In other cases, double reputation can still benefit the issuer, and therefore rating inflation is profitable. Formally:

Proposition 5.3. *In a model where an incumbent CRA faces a threat of entry, in case the issuer sells two assets, if the following conditions are satisfied:*

1. $\pi > \frac{1}{2}$;
2. $\mu > \frac{2(1+\pi)[1+\pi(\ell-1)]}{1+2\pi[1+\ell+\pi(\ell-1)])} > \frac{4}{5}$.
3. $\mu_e \leq \underline{\mu_e}$

then the equilibrium strategy of the strategic incumbent is to inflate ratings with positive probability. The threshold $0 < \underline{\mu_e} < \hat{\mu}^b(r = G, \textit{no-default})$ *represents the maximal entrant's reputation for which the issuer rehires the incumbent following a good rating to a good asset.*

For relatively low levels of μ_e *the equilibrium strategy of the incumbent is similar to the monopolistic case, while for higher levels of* $\mu_e \leq \underline{\mu_e}$ *the incumbent inflates ratings less than a monopolistic CRA.*

Proof. In the Appendix. □

The intuition behind the proof is as follows. Conditions 1 and 2 are similar to those calculated in the monopolistic case (proposition 4.4). They assure that conditional on being rehired in the second period, the incumbent wishes to inflate ratings. An incumbent is always rehired if it publishes a bad rating, which identifies it as a strategic type ($\hat{\mu} = 1$). However, if it publishes a good rating the reputation of the incumbent decreases, and therefore it is not always rehired. As a result, rating inflation is always weakly less profitable in the competitive case compared to the monopolistic case, and there cannot be more rating inflation under competition compared to the monopolistic case. The presence of an entrant may decrease the willingness of the incumbent to inflate ratings, but that depends on the initial reputation of the entrant. Figure 1 presents the equilibrium strategy of the incumbent in the first period as a function of the entrant's reputation μ_e.

If μ_e is very low, it poses no threat to the incumbent - even if it inflates ratings and the inflation is publicly revealed due to default, it is favored by the issuer. Therefore, it behaves exactly as the CRA in the monopolistic model. If μ_e is higher, but still much lower than the initial reputation of the incumbent, then the incumbent is still preferred by

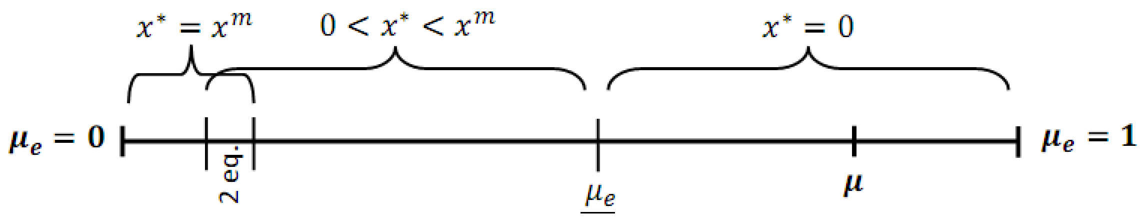

Figure 1: *Equilibrium strategy of the incumbent under competition, as a function of the entrant's reputation.* when μ_e is low, the entrant is never hired, and therefore the incumbent's strategy equals the monopolistic case; when μ_e is very high, double reputation cannot be maintained because the issuer's hiring strategy discovers its information, and therefore the incumbent never inflates; In intermediate levels, the entrant is hired only following a default, and the incumbent inflates ratings, but less than in the monopolistic case. There is a small region where either the first case or the last case may be an equilibrium.

the issuer following a good rating that is not followed by a default; but, if a default does occur following a good rating, the entrant is hired. In such case, inflation is less profitable because it yields no fee if the asset default. Therefore, the incumbent still inflates ratings but with a lower probability.[23] Finally, if the reputation of the entrant μ_e is even higher, the issuer does not always prefer to hire the incumbent following a good rating with no default. Notice, that if the incumbent gives a good rating to a *good* asset, it becomes less favorable for the issuer: while the investor suspects that the good rating was due to rating inflation, the issuer knows that the asset was good and therefore does not update its beliefs. Therefore

$$\hat{\mu}^b(r = G, \text{no-default}) < \mu = \hat{\mu}^s(r = G, a = G).$$

In such cases, the entrant is hired if its reputation is higher than $\underline{\mu_e}$, which is defined by

$$Ep(\underline{\mu_e}, \underline{\mu_e}) = Ep\left(\hat{\mu}^b(r = G, \text{no-default}), \mu\right).$$

In contrast, if a good rating is given to a *bad* asset, and there is no default, then the incumbent has, in the beginning of the second period, a double reputation where $\hat{\mu}^s < \hat{\mu}^b$, which is potentially very profitable to the issuer. However, if $\mu_e > \underline{\mu_e}$ such double reputation disappears once the incumbent is hired – If the issuer hires the incumbent

[23]There is a small interval where there are two equilibria: either the incumbent inflates in a monopolistic level, and is always rehired, or the incumbent chooses a lower probability of inflation and is not rehired in case of a good rating followed by a default. The expected payoff of the incumbent is the same in both equilibria.

following a good rating with no default, the investor understands that rating inflation has occurred, and adjust its beliefs accordingly. Following such update, the reputation of the incumbent is equivalent to the case when the asset defaults. To sum, if $\mu_e > \underline{\mu_e}$ a double reputation cannot be maintained in equilibrium, and therefore the incumbent has no incentive to inflate ratings.

6 Policy Discussion

The model's results show that reputational concerns may cause rating inflation in concentrated markets with a small number of issuers. These results are in contrast to the existing literature (see section 2), in which reputational concerns always provide certifiers with an incentive to give truthful ratings in order to increase their public reputation.[24] Previous literature focuses on the short-term conflict of interest that is inherent to the rating agencies' business model, due to rating contingent fees and "ratings shopping", as explained in Section 2 above. This conflict of interest may outweigh reputational concerns and lead to rating inflation. We chose to exclude that conflict of interest from our model, although it obviously played an important role in the failure of the rating agencies during 2005-7, in order to focus solely on reputational concerns. This allows us to provide a better explanation as to why rating inflation has occurred specifically in the markets for MBSs and CDOs. It is possible to incorporate such a conflict of interest into our model along the following lines. We have shown that in markets with many issuers, such as the markets for plain corporate bonds, reputational concerns lead to truthful rating. Truthful rating can be maintained in these markets despite a short-term conflict of interest, as long as reputational concerns are strong enough. In addition, we have shown that in concentrated markets, where "double reputation" can be formed, reputational concerns may lead to rating inflation. Our results therefore suggest that, in the markets for MBSs and CDOs, reputational concerns combined with short-term conflict of interest encouraged rating agencies to distort information and inflate ratings.

Following these results, our recommendations regarding the regulation of the credit rating industry differ to those made by existing literature. Most papers recommend that

[24] An exception is Bouvard and Levy (2009) , which also find that reputational concerns may distort CRA's rating. However, because their model significantly differs from ours, it does not support the same regulatory recommendations.

regulation should eliminate short-term conflicts of interest,[25] assuming that once fees are paid upfront and ratings shopping is be forbidden, reputational concerns can induce truthful rating. These recommendations are in line with the agreement that the New York State Attorney General made with the three major credit rating agencies in 2008. Under this agreement the rating agencies agreed to demand upfront fees and to disclose any rating deal, even when the rating is not published, when rating MBSs. Yet, our results show that in some markets rating inflation may persist even when fees are not contingent on the ratings, and when CRAs are obligated to publish all their ratings.

Our results, as those of the existing literature, are derived by the rating agencies' "issuer pays" model, in which the issuer hires the CRA and pays its fee. It is commonly believed that the rating industry cannot return to the "investor pays" model that was common until the 1970s. However, some authors have called for regulation of the fees that rating agencies charge, and even to limiting the issuer's ability to select the rating agency which rates his assets.[26] A legal amendment under this line was proposed in the United States by Senator Al Franken in 2010, but eventually did not pass the legislation process. Franken's amendment required that issuers pay the rating fees to a government authority, and that the officers of that authority would then choose an agency to make a rating. According to our model, such a solution may indeed prevent rating inflation: if the issuer cannot choose to rehire a specific CRA, and cannot determine its future wage, the CRA does not have any reputational incentives. However, while such a regulation measure decreases the incentives of CRAs to inflate ratings, it may also decrease their incentive to provide informative ratings. This in turn could lead to moral-hazard problems, which are beyond the scope of our model as it abstracts from the costs of rating.

A different regulatory approach could be to penalize CRAs when they are caught misreporting. Our model takes into account the reputation cost that follows a public disclosure of rating inflation, but assumes no additional costs, in accordance with existing jurisdiction. Until recently, the American law considered ratings as "opinions", thus providing CRAs the protection of the First Amendment of the U.S. Constitution. As a result, CRAs never lost when sued by investors or issuers who claimed that they had been injured by the actions of the agencies (Partnoy, 2006, pg. 83-89). As our model demonstrates, such a legal approach may encourage the CRA to inflate ratings since the expected gain of

[25]See, for example, Bolton, Freixas, and Shapiro (2009).
[26]See Mathis, McAndrews, and Rochet (2009).

"double reputation" may outweigh the cost from a future low reputation. If this situation were to change and CRAs were to suffer an additional cost whenever their rating inflation is publicly exposed, then rating inflation will become less profitable to them. According to our results no rating inflation takes place if this cost is high enough.

The recent financial reform bill ("Dodd-Frank Wall Street Reform and Consumer Protection Act"), that passed in the U.S. congress in the summer of 2010, can be interpreted as a step in this direction. This legislation grants investors the right to sue a CRA for damages if they prove that the CRA was grossly negligent in determining a rating and as a result contributed substantially to the investor's economic loss. The CRAs strongly oppose any legal amendment that may result in such liability. At the time these words are written, the extent of such liability remains unclear. If CRAs will be held liable to rating inflation, the cost of rating inflation will significantly increase. This regulation measure could therefore resolve, in principle, the problem of rating inflation.[27]

7 Concluding Remarks

This paper analyzes the reputational concerns of credit rating agencies. It does so using a dynamic model of communication with two audiences. Our results suggest that reputational concerns encourage truthful ratings in some markets, but discourage them in others. In markets with a large number of sellers who act infrequently, credit rating agencies have the proper incentive to be truthful. Presenting financial intermediaries to such markets can remedy adverse selection problems. In concentrated markets, where a small number of frequent sellers face a large number of buyers, sellers have privileged information both on the *quality of the assets* they offer, and on the *quality of the rating*s they receive. This "second level" of information asymmetry creates an incentive for intermediaries to distort information in favor of the better informed.

In the model we develop an "expert" intermediary decides whether or not to disclose its private information. The intermediary is faced by two opposing audiences: the first is an uninformed audience who benefits from full disclosure of information, and the second is

[27]It is important to note that in our model rating inflation is always exposed when there is default. However, when the signals of the CRAs are not perfect, default following a good rating may be a result of an honest mistake. Therefore, it is more difficult to discover whether intentional rating inflation does takes place (see Benabou and Laroque, 1992). The legislative amendment therefore must incorporate a legal mechanism that distinguishes between honest mistakes and intentional rating inflation. Discussing such a mechanism is beyond the scope of this paper, but is crucial to the success of the legislation.

an informed audience who benefits if the intermediary chooses a specific message. While we use this model to analyze rating agencies, we believe that this general model fits many other institutional circumstances. We present two examples, one from the area of political economy and one from the area of industrial organization:

- Voters may elect an informed politician in hope that she chooses the best policy according to her knowledge. However, a lobby group with substantial political power may prefer a specific policy to be implemented. It is reasonable to assume that the lobby group is more informed about the impact of different policies than the voters (for example, oil companies are more knowledgeable than the average voter regarding the environmental risks of drilling in certain areas). The politician obviously aims to be elected by the voters. But if at the same time she relies on the lobby group's support (for example, as a source of campaign funding), then she faces the same problem as in our model.

- A factory manager is encouraged to report to the management any malfunction in the production line of a factory. The manager's subordinates, who are obviously better informed than the management regarding such malfunctions, may prefer to conceal such problems. The future compensation of the manager depends on the amount of trust that the management places in him, but also on the factory's level of production, which in turn depends on the cooperation of the workers. Thus, again, the manager faces the problem we introduced above.

We presented a very simple version the model. Further research should aim to relax some of the assumptions (especially of a perfectly informed intermediary), and add more periods and commitment types, in order to further explore the robustness of double reputation in different settings and provide a richer set of results.

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A Appendix

A.1 Proof of Proposition 4.4

Proposition. *In case the issuer sells two assets, if the following conditions are satisfied:*

1. $\pi > \frac{1}{2}$;
2. $\mu > \frac{2(1+\pi)[1+\pi(\ell-1)]}{1+2\pi[1+\ell+\pi(\ell-1)])} > \frac{4}{5}$;

then the equilibrium strategy of the strategic CRA is to inflate ratings with positive probability, and specifically $x^* = \frac{\mu(3\ell\pi+\ell+\pi)-2\ell(1+\pi)}{\mu\pi(1+2\ell)} > 0$.

Proof. Assume the CRA faces a bad asset ($a = B$). Assume a rating strategy. We first calculate, for a given strategy $x = \Pr(r = G|a = B)$, the expected payoff of the CRA from good and bad ratings. We then use those payoffs to find conditions under which rating inflation occurs and calculate the equilibrium strategy x^*.

Expected Fees. If a strategic CRA gives a *bad* rating its type is revealed and therefore $\hat{\mu}^s = \hat{\mu}^b = 1$. Substituting this to equation 3, its fee in the next period is $\hat{w}(x, r = B) = 0.5$ (a strategic CRA is known to give an honest rating in the second period so $p^G = 1$ and $\Pr(r = G) = \Pr(a = G) = 0.5$).

If the strategic CRA gives a *good* rating, there are two possible fees, depending on the return of the bad asset. with probability $1 - \pi$ the asset defaults, indicating a rating inflation had occurred, and the CRA's reputation is updated to $\hat{\mu}^b = \hat{\mu}^s = \frac{\mu x}{1-\mu(1-x)} < \mu$. With probability π the asset does not default, so $\hat{\mu}^s = \frac{\mu x}{1-\mu(1-x)}$ (the issuer identifies rating inflation) but $\hat{\mu}^b = \frac{\mu(1+\pi x)}{1+\pi[1-\mu(1-x)]}$ (the investor does not know if the good rating is due to rating inflation or simply because the asset is good). Notice that $\hat{\mu}^s < \hat{\mu}^b < \mu$. Substituting these beliefs into 3, the expected fee of the CRA in the next period is[28]

$$E\hat{w}(x, r = G) = \tag{4}$$
$$\begin{cases} \frac{\pi}{2}\left(2 - \frac{\mu x}{1-\mu(1-x)}\right) \cdot \left(\frac{1+\pi[1-\mu(1-x)]-\ell(1+\pi)(1-\mu)}{\pi[2-\mu(2-x)]+2-\mu}\right) + \frac{1-\pi}{2}\left(1 - \frac{\ell(1-\mu)}{1-\mu(1-x)}\right) & 0 < x \leq 1 \\ \pi \cdot \frac{\mu[\pi(\ell-1)+\ell]-(\ell-1)(1+\pi)}{1+(1-\mu)(2\pi+1)} & x = 0 \end{cases}$$

Conditions for Rating Inflation. A truthful strategy ($x = 0$) is not an equilibrium strategy if $E\hat{w}(0, r = G) > \hat{w}(r = B) = 0.5$. Substituting the lower branch of 4 to the inequality and some algebraic manipulation leads to $\mu \geq \frac{2(1+\pi)[1+\pi(\ell-1)]}{1+2\pi[1+\ell+\pi(\ell-1)])}$ (condition 2). Notice that in order to ensure that the RHS of this inequality is less than or equal to 1, we must demand $\pi \geq 0.5$ (condition 1).

Equilibrium Strategy When the conditions of the proposition are satisfied, then $x^* > 0$. We know from lemma 4.2 that $x^* < 1$. In a mixed strategy equilibrium the strategic CRA is indifferent between a good rating and a bad rating and therefore $E\hat{w}(x^*, r = G) = \hat{w}(x^*, r = B) = 0.5$. Substituting the upper branch of 4 and some algebraic manipulation leads to $x^* = \frac{\mu(3\ell\pi+\ell+\pi)-2\ell(1+\pi)}{\mu\pi(1+2\ell)}$.

□

A.2 Proof of Proposition 5.2

Proposition. *In a model where an incumbent CRA faces a threat of entry, in case issuers sell only one asset, and therefore the second issuer has the same information as the investor in the second period:*

1. *In equilibrium, the issuer hires the entrant if and only if its reputation is higher than the reputation of the incumbent ($\mu_e > \hat{\mu}$); and*

2. *a strategic incumbent never inflates ratings in equilibrium ($x^* = 0$).*

Proof. We prove both parts of the proposition:

1. In the beginning of period 2 both CRAs have a commonly known reputation: μ_e for the entrant and $\hat{\mu}$ for the incumbent. The expected payoff to the issuer from hiring

[28] The expected wage is non-continuous because if $x = 0$ and the asset default then $\hat{\mu}^b = 0$ and $\hat{w} = 0$. However, for every $x > 0$ we receive $\hat{\mu}^b > 0$ because we assume $\ell = 1 + \epsilon$ and therefore $\hat{w} > 0$.

a CRA in the monopolistic case is calculated in subsection 4.3. Substituting $\mu^b = \mu^s = \mu$ into equation 3, and multiplying it by the issuer's share from assumption 5.1 we get the expected payoff of the issuer from hiring the CRA with a commonly known reputation μ:

$$U(\mu) \equiv E(p|\mu) = \frac{(1-\alpha)\left[1-(1-\mu)\ell\right]}{2}.$$

The expected payoff increases in μ and therefore the payoff maximizing issuer hires the entrant if and only if $\mu_e > \hat{\mu}$ (we assume that if the issuer is indifferent he hires the incumbent).

2. The expected fee to a CRA with a commonly known reputation is calculated as above and equals to

$$\hat{w}(\mu) = \frac{\alpha\left[1-(1-\mu)\ell\right]}{2}.$$

Assume the incumbent faces a bad asset in the first period. If it gives a bad rating its reputation in the second period is $\hat{\mu} = 1$, and it is hired in the second period with probability one and receives a wage of $\hat{w} = 0.5\alpha$. If it gives a good rating, its fee conditional on being hired is $\hat{w} < 0.5\alpha$, and its probability of hiring is less than or equal to one. Therefore $Ew(r = G|x) < Ew(r = B|x)\,\forall x$ so there is no rating inflation in equilibrium – $x^* = 0$.

□

A.3 Proof of Proposition 5.3

Proposition. *In a model where an incumbent CRA faces a threat of entry, If the following conditions are satisfied:*

1. $\pi > \frac{1}{2}$;
2. $\mu > \frac{2(1+\pi)[1+\pi(\ell-1)]}{1+2\pi[1+\ell+\pi(\ell-1)])} > \frac{4}{5}$.
3. $\mu_e \leq \underline{\mu_e}$

then the equilibrium strategy of the strategic incumbent is to inflate ratings with positive probability. The threshold $0 < \underline{\mu_e} < \hat{\mu}^b(r = G, \textit{no-default})$ *represents the maximal entrant's* *reputation under which the issuer rehires the incumbent following a good rating to a good asset.*

For relatively low levels of μ_e the equilibrium strategy of the incumbent is similar to the monopolistic case, while for higher levels of $\mu_e \leq \underline{\mu_e}$ the incumbent inflates ratings less than a monopolistic CRA.

Proof. In what follows, we denote the optimal strategy of the incumbent under competition by x^c and denote the optimal strategy of a monopolistic CRA calculated in proposition 4.4 by x^m. We solve the game backwards: first we find the optimal hiring strategy of the issuer in the beginning of the second period, and then we find the optimal strategy of the incumbent in the first period.

Hiring Decision of the Issuer in the Second Period Following the analysis in section 4.3, the issuer's expected "gross" payoff in the second period (before paying to the CRA), equals to

$$E(p|\hat{\mu}^s, \hat{\mu}^b) = \Pr(r = G) \cdot p^G = \frac{2 - \hat{\mu}^s}{2 - \hat{\mu}^b} \cdot \frac{1 - (1 - \hat{\mu}^b)\ell}{2}. \tag{5}$$

The issuer wishes to maximize this payoff, as his net payoff is simply $(1 - \alpha) \cdot E(p|\hat{\mu}^s, \hat{\mu}^b)$. As before, the expected payoff increases in $\hat{\mu}^b$ and decreases in $\hat{\mu}^s$. If $\hat{\mu} = \hat{\mu}^s = \hat{\mu}^b$, then the expected payoff increases in $\hat{\mu}$.

There are four possible histories to the game in the beginning of the second period. Below are the four histories with the equivalent posteriors of the incumbent, as a function of the first period strategy x:

History		$\hat{\mu}^s$	$\hat{\mu}^b$	Remark
Asset	Rating and Return			
$a = B$	$r = B$	1	1	
$a = B$	$r = G$, no-default	$\frac{\mu x}{1-\mu(1-x)}$	$\frac{\mu(1+x\pi)}{1+\pi[1-\mu(1-x)]}$	$\hat{\mu}^s < \hat{\mu}^b$
$a = B$	$r = G$, default	$\frac{\mu x}{1-\mu(1-x)}$	$\frac{\mu x}{1-\mu(1-x)}$	
$a = G$	$r = G$	μ	$\frac{\mu(1+x\pi)}{1+\pi[1-\mu(1-x)]}$	$\hat{\mu}^s > \hat{\mu}^b$

Substituting the posteriors above to equation 5 we get all possible expected payoffs from rehiring the incumbent as a function of the history. We denote the "gross" expected payoff of the issuer (before paying to the CRA) from the incumbent by

$$U(a, r, \cdot; x) \equiv E\left[p|\hat{\mu}^s(x, a, r, \text{default}), \hat{\mu}^b(x, a, r, \text{default})\right].$$

The order of the expected payoff from every history is as follows:

$$U(B, G, \text{default}; x) < U(G, G, \text{no-default}; x) < U(B, G, \text{no-default}; x) < U(B, B, \cdot).$$

When deciding which CRA to hire, the issuer compare the expected payoff from the incumbent as calculated above to expected payoff from the entrant, which equals $U_e(\mu_e) \equiv E(p|\mu_e)$. Because the expected payoff is increasing in reputation if $\mu = \mu^s = \mu^b$, *the incumbent is always hired if it publishes a bad rating in the first period* (because $\mu_e \leq \hat{\mu} = 1$). In such case its fee is $\hat{w}(r = B) = 0.5\alpha$. If the incumbent publishes a good rating in period 1 it may not be rehired.

Optimal Strategy of the Incumbent in the First Period We have shown in the proof to proposition 4.4 that conditions 1 and 2 are necessary and sufficient for rating inflation if the CRA is always hired. In the competitive case, the incumbent is always hired following a bad rating, but is not necessarily hired following a good rating. Therefore, the conditions are still necessary for rating inflation but are not sufficient (if the conditions do not hold, it is always more profitable for the incumbent to be truthfull). In addition, if the incumbent is rehired in any case then its optimal strategy is x^m. However, if the incumbent may not be rehired following a good rating than rating inflation is less profitable under threat of entry compared to the monopolistic case. Therefore, $x^c \leq x^m$.

A truthful strategy ($x = 0$) is not an equilibrium strategy if $E\hat{w}(0, r = G) > \hat{w}(r = B) = 0.5\alpha$. In the proof to proposition 4.4 we show that if condition 1 and 2 holds, it is sufficient for the incumbent to inflate ratings if it is rehired following a rating inflation that is not publicly discovered (i.e. $a = B$, $r = G$, and no-default).[29] Therefore it is enough to examine under what condition the incumbent is rehired following a good rating and no default.

Define by $\underline{x}$ the optimal strategy of the incumbent if it expects to he rehired following a good rating and no default, but not to be rehireg following a good rating and default.

[29] If $x = 0$ then the incumbent is not rehired following a good report and default even in the monopolistic case.

Therefore $\underline{x}$ satisfies

$$\pi \cdot \alpha \cdot U(B, G, \text{no-default}; x) = \alpha \cdot U(B, B, \cdot).$$

Notice $\underline{x} < x^m$. define by $\underline{\mu_e}$ the initial reputation of the entrant that satisfies

$$U_e(\underline{\mu_e}) = U(G, G, \text{no-default}; \underline{x}).$$

If $\mu_e > \underline{\mu_e}$ then

$$U(G, G, \text{no-default}; \underline{x}) < U_e(\mu_e) < U(B, G, \text{no-default}; \underline{x})$$

and the issuer prefers to hire the entrant following a truthful good rating i.e. ($a = G$ and $r = G$). In such case the issuer never hires the incumbent following a good signal, even if the asset in the first period is bad. This is because such action reveals to the investor that $a = B$ in the first period, and therefore the expected payoff to the issuer is

$$U(B, G, \text{default}; x) < U(G, G, \text{no-default}; x) < U_e(\mu_e).$$

Therefore, the optimal strategy for the incumbent is $x = 0$, as $E\hat{w}(x, r = G) = 0$. In contrast, If $\mu_e \leq \underline{\mu_e}$ then

$$U_e(\mu_e) < U(G, G, \text{no-default}; \underline{x}) < U(B, G, \text{no-default}; \underline{x})$$

so the issuer always prefers to hire the incumbent following a good rating. In this case, hiring of the incumbent following a good rating does not signal the issuer's private information to the investor, and therefore following a rating inflation and no default the issuer expects $U(B, G, \text{no-default}; \underline{x})$ and hired the incumbent. If the incumbent expects to be hired following a good rating and no-default (and not to be hired following a good rating and default) its optimal strategy is $\underline{x}$ by construction. This holds for all $\mu_e \in \left(\hat{\mu}^b(B, G, \text{default}; \underline{x}), \underline{\mu_e}\right]$: if $\mu_e \leq \hat{\mu}^b(B, G, \text{default}; \underline{x})$ then the issuer prefers the incumbent also after a good rating and default, and therefore $\underline{x}$ is not an equilibrium strategy.

Finally, if $\mu_e \leq \hat{\mu}^b(r = G, \text{default}, x^m)$, then if the incumbent chooses x^m it is always rehired. Therefore, x^m is an equilibrium strategy. To see why notice that if conditions 1 and 2 hold and the incumbent chooses x^m, then $U(\cdot) \geq U_e(\mu_e)$ for all possible histories in the beginning of period 2, so the incumbent is always rehired. If the incumbent chooses $x > x^m$ then it is always rehired but $E\hat{w}(x, r = G) < \hat{w}(x, r = B) = 0.5\alpha$.[30]

Notice that $\hat{\mu}^b(B, G, \text{default}; \underline{x}) < \hat{\mu}^b(r = G, \text{default}, x^m)$ because $\underline{x} < x^m$ and $\hat{\mu}^b(B, G, \text{default}; x) = \frac{\mu x}{1-\mu(1-x)}$ is increasing in x. If $\mu_e \leq \hat{\mu}^b(B, G, \text{default}; \underline{x})$ then x^m is a unique equilibrium strategy. If $\mu_e \in \left(\hat{\mu}^b(B, G, \text{default}; \underline{x}), \hat{\mu}^b(r = G, \text{default}, x^m)\right]$ then there are two equilibria: in the first the incumbent's optimal strategy is as in the monopolistic case x^m and it is always rehired; in the second the optimal strategy of the incumbent is $\underline{x} < x^m$ and it is hired only if a rating inflation was no publicly exposed. In both of theses equilibria the expected fee of the incumbent is 0.5α. □

[30]For calculations of the incumbent's fee if it is always rehired see the proof for the monopolistic case, proposition 4.4. The only difference is that all fees should be multiplied by α.